

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય

નવસારી કૃષિ યુનિવર્સિટી

નવસારી-૩૯૬ ૪૫૦



માહિતી પરિચયગ્રંથ

ધી રાઈટ ટુ ઈન્ફર્મેશન એક્ટ, ૨૦૦૯
કલમ ૪(૧)(બી)

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય

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માહિતી અને પરિચય ગ્રંથ

૦૧/૦૫/૨૦૧૫ ની સ્થિતી

અનુક્રમણિકા		
પ્રકરણ	વિગત	પાન નંબર
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વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય
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નવસારી – ૩૯૬૪૫૦

રાઈટ ટુ ઈન્ફોર્મેશન એક્ટ, ૨૦૦૫ની કલમ ૪(૧) (બી) અન્વયેની માહિતીનું મેન્યુઅલ
પ્રકરણ – ૧

સંસ્થાનું સંસ્થાપન, ઉદ્દેશો, કાર્યો અને ફરજોની વિગતો.

સંસ્થાનું સંસ્થાપન :

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલયની સ્થાપના તા. ૧ જુલાઈ, ૨૦૦૮ ના રોજ માન. મુખ્યમંત્રીશ્રીની વનબંધુ કલ્યાણ યોજનાના ૧૦ મુદ્દા કાર્યક્રમ હેઠળ નવસારી કૃષિ યુનિવર્સિટી, નવસારી ખાતે કરવામાં આવી હતી.

ઉદ્દેશો :

આ સંસ્થાના ઉદ્દેશો નીચે મુજબ છે:

- સ્નાતક અને અનુસ્નાતક કક્ષાએ પશુચિકિત્સા અને પશુપાલન શિક્ષણ આપવું.
- દક્ષિણ ગુજરાતના વિસ્તારની પશુચિકિત્સા અને પશુપાલનની ચોકકસ જરૂરિયાતોને ધ્યાનમાં રાખીને તેના પર સંશોધન કરવું.
- પશુ સ્વાસ્થ્ય / પેદાશોને લગતી પદ્ધતિઓની અદ્યતન ભલામણો દક્ષિણ ગુજરાતના ખેડૂતો / આદિવાસી પશુપાલકો સુધી અસરકારત રીતે પહોંચાડવી.
- આ દિવાસી વિસ્તારના વિદ્યાર્થીઓમાં પશુચિકિત્સા અને પશુપાલનનું શિક્ષણ આપવું જેનાથી તેમના કુટુંબની આર્થિક સુધારી શકાય.

આ સંસ્થાના ધ્યેયો નીચે મુજબ છે :

- વિદ્યાર્થીઓને શ્રેષ્ઠ શિક્ષણ આપવું.
- મૂળભૂત તેમજ જરૂરિયાત લક્ષી સંશોધન કરવું.
- પશુચિકિત્સા અને પશુપાલનના વિષયમાં થયેલાં અદ્યતન સંશોધનોને ગામડાનાં લોકો સુધી પહોંચાડવા.
- ભારતની પશુચિકિત્સા અને પશુપાલન એ શ્રેષ્ઠ કોલેજ તરીકે નામના મેળવવી.
- નવસારી જીલ્લાનો વાંસદા તાલુકો દત્તક લેવો તેમજ તેનાથી લોકોની આવક પાંચ વર્ષમાં બમણી થાય તે માટેના પ્રયત્નો કરવા.

આ સંસ્થાના કાર્યો અને ફરજો નીચે મુજબ છે :

- (૧) પશુચિકિત્સા, પશુપાલન અને સંલગ્ન વિદ્યાશાખામાં શિક્ષણ અને પ્રશિક્ષણની જોગવાઈ કરવી.
- (૨) પશુચિકિત્સા, પશુપાલન અને સંલગ્ન વિદ્યાશાખામાં સંશોધન માટેની જોગવાઈ કરવી.
- (૩) વિસ્તરણ કાર્યક્રમો ધ્વારા સંશોધનના તારણો અને ટેકનીકલ માહિતીના પ્રસાર માટે જોગવાઈ કરવી.
- (૪) વિશેષ કાર્યક્રમો હાથ ધરવાની જોગવાઈ કરવી.
- (૫) પદવી/ડીપ્લોમા/યુ.જી.પી.જી અભ્યાસક્રમો શરૂ કરવા તેમજ વિવિધ પરિક્ષાઓ માટે અભ્યાસક્રમો નક્કી કરવા.
- (૬) શિક્ષણ સંશોધન અને વિસ્તરણ કાર્યો માટે પ્રયોગશાળા, ગ્રંથાલયો અને સંશોધન મથકો સ્થાપવા અને નિભાવવા.
- (૭) પુર્વ સ્નાતક તેમજ અનુસ્નાતક શિક્ષણ અને સંશોધનનું સંચાલન અને સંકલન કરવું.

મહાવિદ્યાલય વિશ્વવિદ્યાલયનાં સત્તામંડળ :

ગુજરાત કૃષિ યુનિવર્સિટીઓના વિધેયક-૨૦૦૫ના અધિનિયમની કલમ - ૧૭ ની જોગવાઈઓ અન્વયે જે સત્તા મંડળો કાર્યરત છે તેમના તમામ નિયમોને આધિન રહી વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય કાર્યરત છે. યુનિવર્સિટીના સત્તા મંડળોની માહિતી યુનિવર્સિટીની વેબ સાઈટ ઉપર ઉપલબ્ધ છે.

પશુચિકિત્સા અને પશુપાલન વિદ્યાશાખા પરિક્ષક સમિતિ :

અ નં	નામ	હોદ્દો	કચેરીનું નામ	સમિતિમાં સ્થાન
૧	ડો એન. એચ. કેલાવાલા	વિદ્યાશાખાઅધ્યક્ષશ્રી	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	ચેરમેન
૨	ડો. વી.બી. ખરાદી	સંશોધન વૈજ્ઞાનિક (એજીબી)	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	સભ્ય
૩	ડો. સંધ્યા ચૌધરી	પ્રાધ્યાપક (પ્રી. કલીનીકલ)	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	સભ્ય
૪	ડો. આર. એમ. પટેલ	પ્રાધ્યાપક (પ્રી. કલીનીકલ)	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	સભ્ય
૫	ડો. એ.બી. કુલસૌંદર	પ્રાધ્યાપક અને વડા (એલપીએમ)	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	સભ્ય
૬	ડો. સી.વી.સાવલીયા	પ્રાધ્યાપક અને વડા(VPH)	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	સભ્ય
૭	ડો. જે.એન. મિસ્ત્રી	પ્રાધ્યાપક અને વડા(સર્જરી)	પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય , નકૃયુ., નવસારી	સભ્ય
૮	શ્રી એ.એમ. પટેલ	મદદનીશ કુલસચિવ (એકેડેમીક)	કુલસચિવશ્રી ની કચેરી, નકૃયુ., નવસારી.	સેક્રેટરી

તદ ઉપરાંત પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલયનાં શિક્ષણ, સંશોધન, વિસ્તરણ અને વહીવટી કામગીરી સરળ રીતે ચાલી શકે તે માટે "ફેકલ્ટી બોર્ડ ઓફ સ્ટડીઝ" ની સ્થાપના કરવામાં આવેલ છે. જેમાં નીચે મુજબના સભ્યોનો સમાવેશ થાય છે.

Sr. No.	Name & Designation	Status in Board of Studies, Faculty of Agriculture	Tenure
1	Dr. N.H. Kelawala, Dean, Faculty of Veterinary Science & A.H., Veterinary College, NAU, Navsari	Chairman	By Virtue of Designation
2	Dr. A.N. Sabalpara, Director of Research & Dean P.G. Studies NAU, Navsari	Member	
3	Dr. G.R. Patel, Director of Extension Education, NAU, Navsari.	Member	
4	Dr. H.R. Pandya, Director of Students Welfer, Navsari Agricultural University, Navsari	Member	
5	Dr. A.B. Fousundar, Professor & Head, Deptt. of Livestock Production Management, Veterinary College, NAU, Navsari	Member	
6	Dr. V.B. Kharadi, Research Scientist, Livestock Research Station, Veterinary College, NAU, Navsari	Member	
7	Dr. V.S. Dabas, Professor & Head, Vet. Surgery & Radiology, Veterinary College, NAU, Navsari	Member	
8	Dr. B.P. Brahmkshtri, Professor & Head, Deptt. of ILFC, Veterinary College, NAU, Navsari	Member	
9	Dr. C.V. Savalia, Professor & Head, Deptt. of Veterinary Public Health, Veterinary College, NAU, Navsari	Member	
10	Dr. S.K. Bhavsar, Professor & Head, Deptt. of Pharmacology, Veterinary College, NAU, Navsari	Member	
11	Dr. Sandhya Chaudhary, Professor & Head, Physio.-Biochemistry, Veterinary College, NAU, Navsari	Member	
12	Dr. Sunil Chaudhary, ADR, Animal Science, Veterinary College, NAU, Navsari	Member	

13	Dr. J.N. Mistry, Professor & Head, Deptt. of TVCC, Veterinary College, NAU, Navsari	Member	By Virtue of Designation
14	Dr. R.M. Patel, Professor & Head, Medicine, Veterinary College, NAU, Navsari	Member	
15	Dr. I.H. Kalyani, Assoc. Professor & Head, Microbiology Veterinary College, NAU, Navsari	Member	
16	Dr. J.B. Solanki, Assoc. Professor & Head, Parasitology Veterinary College, NAU, Navsari	Member	
17	Dr. O.P. Sharma, Assoc. Professor & Head, Extension Veterinary College, NAU, Navsari	Member	
18	Dr. C.T. Khasatiya, Assoc. Professor & Head, Gynaecology Veterinary College, NAU, Navsari	Member	
19	Dr. K.S. Prajapati, Retd. Professor & Head, Veterinary College, AAU, Anand	Co-opted member	Nominated by Hon. Vice Chancellor
20	Dr. M.C. Desai, Visiting Faculty & Retd. Dean, Veterinary College, AAU, Anand	Co-opted member	
21	Dr. K.N. Vyas, Visiting Faculty & Retd. Dean, Veterinary College, AAU, Anand	Co-opted member	
22	Dr. P.M. Desai, Retd. Professor, Veterinary College, Navsari	Co-opted member	
23	Ms. Bhupamani Das, ICAR, PG Student, Parasitology	Co-opted member	
24	Prof. A.M. Patel, Asstt. Registrar (Academic), NAU, Navsari	Secretary	

પ્રકરણ - ૨

સંસ્થાના અધિકારીઓ અને કર્મચારીઓની સત્તાઓ અને ફરજો

૧. વિદ્યાશાખાના ડીન :

- (૧) વિદ્યાશાખા અધ્યક્ષ તરીકેની જવાબદારી વહન કરે છે.
- (૨) વિદ્યાશાખામાં હાથ ધરવામાં આવતી શિક્ષણ, સંશોધન અને વિસ્તરણ શિક્ષણની પ્રવૃત્તિઓનું સંચાલન અને નિયંત્રણ કરવું.
- (૩) વિદ્યાશાખાને લગતા સ્ટેચ્યુટ અને વિનિયમોનું યોગ્ય પાલન થાય તેની તકેદારી રાખશે.
- (૪) વિદ્યાર્થીઓની પ્રગતિ અને નોંધણી ઉપર દેખરેખ રાખશે.
- (૫) વિદ્યાશાખાની જરૂરિયાતો, નિતિઓ અને ધોરણો બાબતે એકેડેમિક કાઉન્સિલને ભલામણ કરશે.
- (૬) સ્નાતક, અનુસ્નાતક અભ્યાસક્રમ, શિક્ષણ અને વિદ્યાર્થીઓને લગતા રેકર્ડ જાળવણી ઉપર દેખરેખ રાખે છે.
- (૭) જુદા જુદા સંશોધનોનું આયોજન, સંકલન અને અમલવારીની કામગીરી વિવિધ વિદ્યાશાખાધ્યક્ષના સહયોગથી કરવાની રહે છે.
- (૮) સંશોધન, અનુસ્નાતક શિક્ષણના કાર્યક્રમો, મિલ્કત, ફંડ, વહીવટી નાણાંકીય નિયંત્રણ અધિકારી તરીકેની ફરજો.
- (૯) નાણાંકીય સહાય માટે વિવિધ પુરસ્કૃત સંસ્થાઓ યહબચલ DST, State & International Agencies સાથે લાઈઝન અધિકારી તરીકેની ફરજો બજાવે છે.
- (૧૦) વિવિધ ફેકલ્ટીની એકેડેમિક બાબતો તથા રીસર્ચને લગતી નિતિઓ કાર્યક્રમો ઘડવા વિગેરેની ફરજો.
- (૧૧) ખેડૂત ઉપયોગ સંશોધન પરિણામો પ્રસિધ્ધિ માટે બુલેટિન તથા સાયન્ટીફિક જનરલમાં ખેડૂતો સમજી શકે તેવા તારણો પ્રકાશિત કરવા.
- (૧૨) સંશોધન યોજનાઓ અંગે અન્ય સંસ્થાઓના કરાર કરવા.

કર્મચારીઓની ફરજો :

આ મહાવિદ્યાલયમાં મુખ્યત્વે શૈક્ષણિક અને તાંત્રિક કર્મચારીઓ તથા વહીવટી કર્મચારીઓ સામેલ છે. શૈક્ષણિક કર્મચારીઓ મુખ્યત્વે શિક્ષણ, સંશોધન, વિસ્તરણ તથા પોતાના વિભાગમાં જરૂરી ખરીદી તથા વહીવટની કામગીરી સંભાળે છે. તાંત્રિકી કર્મચારીઓ જે તે વિભાગના વડાના માર્ગદર્શન હેઠળ સંશોધન અને વહીવટની કામગીરીમાં મદદનીશ તરીકે ફરજો બજાવે છે. મહાવિદ્યાલયનાં વહીવટી કર્મચારીઓ મહાવિદ્યાલયની તમામ વહીવટી કામગીરી સંભાળે છે.

કચેરીનો સમય નીચે મુજબ છે:

- (૧) વહીવટી કર્મચારીઓ માટે : સવારે ૧૦-૩૦ થી સાંજના ૬-૧૦ સુધી
રિસેષ નો સમય : ૧૪-૦૦ થી ૧૪-૩૦
- (૨) શિક્ષક અને તાંત્રિક કર્મચારીઓ માટે : સવારે ૮-૦૦ થી ૧૨-૦૦ અને
બપોરે ૧૪-૦૦ થી ૧૭-૧૦ સુધી

રિસેષ નો સમય: ૧૨-૦૦ થી ૧૪-૦૦

પ્રકરણ – ૩

સંસ્થામાં કામકાજ અને નિર્ણય પ્રક્રિયામાં અનુસરવાની કાર્યપદ્ધતિ (તેમાં દેખરેખ ને જવાબદારીઓ માટેની ચેનલોની બાબતનો સમાવેશ થવો જરૂરી છે)

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલયની સ્થાપના નવસારી કૃષિ યુનિવર્સિટી, નવસારી હેઠળ કરવામાં આવી છે. જેથી આ કોલેજની પ્રગતિ અને વિકાસને લગતી બાબતોને વિચારણા યુનિવર્સિટીના ધારા-ધોરણો મુજબ કરવામાં આવે છે. જેની વિગતો www.nau.in પર ઉપલબ્ધ છે.

શિક્ષણની કામગીરી :

આ મહાવિદ્યાલયમાં શિક્ષણની સંકલ્પના દ્વિસ્તરીય પદ્ધતિ ઉપર આધારિત છે. પ્રથમ સંકલ્પનામાં ઉચ્ચકક્ષાનું શિક્ષણ કે જેમાં પશુચિકિત્સા અને પશુપાલનને લગતુ સ્નાતક અને અનુસ્નાતક કક્ષાનું નિવાસી ઉચ્ચ શિક્ષણ "વેટરનરી કાઉન્સિલ ઓફ ઈન્ડિયા" ના ધારાધોરણો મુજબ હાથ ધરવામાં આવે છે. જ્યારે બીજી સંકલ્પનામાં પશુપાલનનો ડિપ્લોમાં અભ્યાસક્રમ ચલાવવામાં આવે છે.

શૈક્ષણિક પ્રવેશ પાત્રતા અને ધોરણો :

સ્નાતક કક્ષાના અભ્યાસક્રમો:

સને ૨૦૧૫ – ૧૬ પ્રવેશ ક્ષમતાની વિગત નીચે મુજબ છે.

વિગત	વેટરનરી
પ્રવેશ ક્ષમતા	૬૬

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય, નવસારી કૃષિ યુનિવર્સિટી હેઠળ કાર્યરત છે. જેમાં સ્નાતક કક્ષાના અભ્યાસક્રમમાં ઉચ્ચતર માધ્યમિક શાળાંત પરીક્ષામાં વિજ્ઞાન પ્રવાહમાં અંગ્રેજી, ગણિત, ભૌતિકશાસ્ત્ર, રસાયણશાસ્ત્ર અને જીવવિજ્ઞાન વિષય સાથે (ઓછામાં ઓછા ૫૦% જનરલ કેટેગરી, ૪૦ % બક્ષી પંચ, અનુસુચિત જાતિ અને ૩૫ % અનુસુચિત જનજાતિ ના વિદ્યાર્થીઓ) પાસ હોય તથા ગુજકેટની ટકાવારીને ધ્યાનમાં રાખીને પ્રવેશ આપવામાં આવે છે. વિદ્યાર્થીઓને ગુજરાત સરકારના નિયમોનુસાર જુદા જુદા વર્ગોને ફાળવેલ ટકાવારી મુજબ પ્રવેશ આપવામાં આવે છે. તેમજ ઉચ્ચતમ ન્યાયાલયના આદેશો અન્વયે સ્નાતક તથા અનુસ્નાતક કક્ષાએ પ્રત્યેક અભ્યાસક્રમમાં શૈક્ષણિક વર્ષ ૨૦૦૨-૦૩ થી ૩% જગ્યાઓ શારીરિક ખોડખાંપણ ધરાવતા વિદ્યાર્થીઓ માટે અનામત રાખવામાં આવે છે.

અનુસ્નાતક કક્ષાના અભ્યાસક્રમો:

નવસારી કૃષિ યુનિવર્સિટી, નવસારી ખાતે આવેલ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલયના શિક્ષકો તેમજ સંશોધન યોજનાઓના અંગભૂત એકમ તરીકે અનુસ્નાતક શિક્ષણને ગણવામાં આવતું હોય તેને માટે કોઈ અલગ અનુસ્નાતક મહાવિદ્યાલય કે વિભાગની વ્યવસ્થા કરવામાં આવેલ નથી.

(૧) અનુસ્નાતક કક્ષાના અભ્યાસક્રમો:-

૧. એમ.વી.એસ.સી.
૨. પી.એચ.ડી.

પ્રવેશ પદ્ધતિ:

(અ) અનુસ્નાતક કક્ષાના પદવી અભ્યાસક્રમમાં પ્રવેશ મેળવવા ઈચ્છતા ઉમેદવારે સ્નાતક કક્ષાની પદવીમાં ૧૦ પોઈન્ટ પદ્ધતિમાં કુલ ગુણમાંથી તેમજ સંબંધિત વિષયમાં ઓછામાં ઓછા ૬.૦૦ O.G.P.A. અથવા સમકક્ષ ગુણ મેળવેલ હોવા આવશ્યક છે.

- (બ) ઉમેદવારે અનુસ્નાતક કક્ષાના પીએચ.ડી. પદવી અભ્યાસક્રમમાં પ્રવેશ મેળવવા ૧૦ પોઈન્ટ પદ્ધતિમાં ૬.૫૦ O.G.P.A. અથવા તેની સમકક્ષ ગુણ સાથે અનુસ્નાતક પદવી મેળવેલ હોવી જોઈએ.
- (ક) અનુસૂચિત જાતિ, અનુસૂચિત જનજાતિ અને સામાજીક અને શૈક્ષણિક રીતે પછાત વર્ગોના ઉમેદવારોને માસ્ટર ડીગ્રી / પીએચ.ડી. માં પ્રવેશ માટે ૫ ટકાની છૂટછાટ આપવામાં આવે છે.
- (ખ) અનુસ્નાતક કક્ષાના અભ્યાસક્રમોમાં પ્રવેશ ક્ષમતા મેજર ગાઈડની ઉપલબ્ધતા પ્રમાણે રાખવામાં આવે છે.

અન્ય રાજ્યોના વિદ્યાર્થીઓ, આઈ.સી.એ.આર., ભારત સરકારના નિયુક્ત કરેલ વિદ્યાર્થીઓ, અનુસૂચિત જાતિ, અનુસૂચિત જનજાતિ અને સામાજીક અને શૈક્ષણિક રીતે પછાત વર્ગોના વિદ્યાર્થીઓ માટે અનામત રાખવામાં આવે છે.

નોંધ: અનુસૂચિત જાતિ, અનુસૂચિત જન જાતિ તેમજ સામાજીક અને શૈક્ષણિક રીતે પછાત વર્ગના ઉમેદવારે અનુસ્નાતક પદવીમાં પ્રવેશ મેળવવા સ્નાતક કક્ષાની પદવીમાં ૫.૦૦ (ઓજીપીએ) ગુણાંક (૧૦ ગુણાંક પદ્ધતિ મુજબ) અથવા તેની સમકક્ષ ગુણ જ્યારે પીએચ.ડી. ની પદવીમાં પ્રવેશ મેળવવા અનુસ્નાતક કક્ષાની પદવીમાં ૬.૦૦ (ઓજીપીએ) ગુણાંક (૧૦ ગુણાંક પદ્ધતિ મુજબ) મેળવેલ હોવા જરૂરી છે.

આ શૈક્ષણિક પ્રવૃત્તિઓ માટે ઉપર જણાવેલ અધિકાર મંડળો / પરિષદો / સમિતિઓમાં ચર્ચા કરી નિર્ણય લેવામાં આવે છે.

સંશોધનની કામગીરી :

સંશોધન અંગે તૈયાર કરેલ યોજનાઓ / કાર્યક્રમ તથા અનુદાન માટે મળેલ દરખાસ્તોને લાગતી વળગતી સંશોધન બેઠકોમાં રજૂ કરીને અને ત્યારબાદ સંશોધન પરિષદમાં નીતીઓ / કાર્યક્રમો ઘડવા માટે રજૂ કરવામાં આવે છે. આ સંશોધન પરિષદે લીધેલ નિર્ણય ભલામણો અંતિમ માન્યતા માટે કુલપતિશ્રી મારફતે યુનિવર્સિટી નિયામક મંડળમાં રજૂ કરવામાં આવે છે. સંશોધન પેટા કેન્દ્રો હસ્તક કામગીરીની દેખરેખ અને જવાબદારી કેન્દ્રના વડા કરે છે. અને સંશોધન કેન્દ્ર હસ્તકની કામગીરીની દેખરેખ અને જવાબદારી સંશોધન નિયામક કરે છે.

વિસ્તરણ શિક્ષણની કામગીરી :

વિસ્તરણ શિક્ષણની કામગીરી માટે વિસ્તરણ શિક્ષણ નિયામક જવાબદાર છે. તેઓ કુલપતિશ્રીને વિસ્તરણ શિક્ષણ પ્રવૃત્તિઓ માટે નિર્ણય લેવામાં સહાય કરે છે. નિતિ વિષયક બાબતો માટે વિસ્તરણ શિક્ષણ પરિષદ અસ્તિત્વમાં છે. વિસ્તરણ શિક્ષણ કેન્દ્રો હસ્તકની કામગીરી વિસ્તરણ શિક્ષણ નિયામક કરે છે.

વહીવટ અને શૈક્ષણિક કામગીરી :

શૈક્ષણિક કામગીરી ઉપરાંત શૈક્ષણિક વહીવટની કામગીરી કુલસચિવશ્રી ધ્વારા કરવામાં આવે છે. તેઓ કુલપતિશ્રીને વહીવટી બાબતોના નિર્ણયો લેવામાં સહાય કરે છે. ફેકલ્ટી વાઈઝ યુ.જી પી.જી. ના અભ્યાસક્રમો સેમેસ્ટર મુજબના અભ્યાસક્રમ, પરીક્ષા, પરિણામો, માર્કશીટની કામગીરી કરે છે.

નાણાં અને હિસાબી કામગીરી :

નાણાં અને હિસાબી કામગીરી હિસાબી અધિકારી-વ-હિસાબ નિયામકશ્રી ધ્વારા કરવામાં આવે છે. આ કામગીરી રાજ્ય સરકારશ્રીએ નિયત કરેલ બજેટ નાણાં અને ટ્રેઝરીના નિયમો અનુસાર કરવામાં આવે છે. આ વિભાગ ધ્વારા ઓડિટ, પી.એફ., ખર્ચ પર નિયંત્રણની જવાબદારી પણ છે. જે અંગેના કાર્ય પદ્ધતિ સરકારશ્રીએ નિયત કરેલ કાર્ય પદ્ધતિ મુજબ અમલ કરે છે. નાણાં વિભાગ ધ્વારા કેન્દ્રો અને પેટા કેન્દ્રો ધ્વારા બનાવેલ બજેટ નાણાંકીય સંચાલન ગ્રાન્ટની ફાળવણી અને પગારભથ્થાનું સંચાલન કરે છે.

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય સંપૂર્ણપણે નવસારી કૃષિ યુનિવર્સિટીના નિયમો હેઠળ કાર્યરત છે તથા યુનિવર્સિટીના તમામ નિયમોને બંધનકર્તા છે.

પ્રકરણ – ૪

સંસ્થાનાં કાર્યો કરવા માટેના નિયત કરેલાં ધોરણો

નવસારી કૃષિ યુનિવર્સિટી દ્વારા નક્કી કરાયેલા ધોરણો વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય દ્વારા અનુસરવામાં આવે છે જેની વિગતો www.nau.in પર ઉપલબ્ધ છે.

પ્રકરણ – ૫

સંસ્થાના કાર્યો કરવા માટે સંસ્થા ધ્વારા ઘડાયેલા નિયમો, વિનિયમો, સુચનાઓ, નિયમ સંગ્રહો અને રેકર્ડ

સંસ્થાના કાર્યો કરવામાં માટે તેમજ કર્મચારીઓની નોકરી તેમજ સેવાકીય બાબતોના નિયમન માટે નવસારી કૃષિ યુનિવર્સિટી દ્વારા લાગુ પડાયેલા ગુજરાત સિવિલ સર્વિસ રૂલ્સ, ૨૦૦૨ મુજબ કરવામાં આવે છે. જેની વિગતો www.nau.in પર ઉપલબ્ધ છે.

સ્નાતક કક્ષાના વિનિયમો

(અ) પશુપાલન અને પશુચિકિત્સા વિદ્યાશાખાના વિનિયમો ([પરિશિષ્ટ-૧](#))

અનુસ્નાતક કક્ષાના વિનિયમો

(અ) પશુપાલન અને પશુચિકિત્સા વિદ્યાશાખાના વિનિયમો ([પરિશિષ્ટ A to F મુજબ](#))

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય સ્નાતક કક્ષાએ વેટરનરી કાઉન્સિલ ઓફ ઈન્ડિયાના તથા નવસારી કૃષિ યુનિવર્સિટીના નિયમો હેઠળ તેમજ અનુસ્નાતક કક્ષાએ આઈ. સી. એ. આર. (ICAR) (૨૦૦૮) તથા નવસારી કૃષિ યુનિવર્સિટીના નિયમો હેઠળ કાર્યરત છે.

પ્રકરણ – ૬

સંસ્થા પાસેના દસ્તાવેજોના પ્રકારનું પત્રક

વનબંધુ પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલય, નવસારી કૃષિ યુનિવર્સિટી, નવસારી નીચે જણાવેલ દસ્તાવેજોની સાચવણી કરે છે.

- (૧) વિદ્યાર્થીઓના વિદ્યાકીય રેકર્ડ.
- (૨) કર્મચારીઓના સેવાકીય રેકર્ડ.
- (૩) મહાવિદ્યાલય ધ્વારા કરવામાં આવેલ કરારો / મેમોરેન્ડમ ઓફ અન્ડરસ્ટેન્ડીંગ અંગેના રેકર્ડ.
- (૪) રાજ્ય સરકારના યુનિવર્સિટીને સંબંધિત ઠરાવો, યુનિવર્સિટીના જાહેરનામા અને પરિપત્રોનો રેકર્ડ.
- (૫) સંશોધન અંગેનો રેકર્ડ.
- (૬) જુદા જુદા અધિકાર મંડળોની કાર્યવાહીની નોંધ.
- (૭) સંસ્થાના કાર્યો માટેના અન્ય જરૂરી રેકર્ડ.

પ્રકરણ – ૭

સંસ્થાની નીતિ ઘડવા અંગેના અથવા તેમના વહીવટ અંગેના જાહેર જનતા સાથેના પરામર્શ અથવા પ્રતિનિધિત્વ માટેની કોઈ વ્યવસ્થા હોય તો તેની વિગતો.

સંસ્થાની નીતિ ઘડવા અંગેના તમામ નિયમો યુનિવર્સિટી દ્વારા નક્કી કરાયેલા નિયમો પ્રમાણે અનુસરવામાં આવે છે. જેની વિગતો www.nau.in ઉપર ઉપલબ્ધ છે.

પ્રકરણ – ૮

સંસ્થાની વિવિધ સમિતિઓ અને તેમના ભાગ તરીકે અથવા તેની સલાહના ઉદ્દેશથી બે થી વધુ સભ્યોનાં બનેલાં એકમોની બેઠકો જાહેર જનતા માટે ખુલ્લી છે કે કેમ અને આવી બેઠકોની કાર્યવાહી નોંધ જાહેર જનતા માટે ઉપલબ્ધ છે કે કેમ, તે અંગેનું પત્રક.

યુનિવર્સિટીના નિયામક મંડળ, એકેડેમિક કાઉન્સિલ વગેરે અધિકાર મંડળોની બેઠકોની કાર્યવાહીની નોંધ જાહેર જનતા માટે યુનિવર્સિટીની વેબ સાઈટ પર ઉપલબ્ધ હોય છે.

પ્રકરણ – ૯

સંસ્થાના અધિકારીઓ અને કર્મચારીઓની નિર્દેશિકા.

સંસ્થાના અધિકારીઓ તથા કર્મચારીઓની માહિતી યુનિવર્સિટીની વેબ સાઈટ પર ઉપલબ્ધ છે.

પ્રકરણ – ૧૦

દરેક અધિકારી અને કર્મચારીને મળતુ માસિક મહેનતાણું અને નિયમો મુજબના વળતરની પદ્ધતિની માહિતી.

અધિકારી/કર્મચારીઓને મળતાં માસિક મહેનતાણાં (પગાર ધોરણ) અને વળતર યુનિવર્સિટીના ધારા ધોરણ મુજબ આપવામાં આવે છે. જેની તમામ માહિતી સામેલ ([પરિશિષ્ટ –૨](#)) માં દર્શાવેલ છે.

પ્રકરણ – ૧૧

સંસ્થાની એજન્સીની તમામ યોજનાઓની વિગતો, સુચિત ખર્ચ અને કરેલી ચૂકવણીઓના અહેવાલ દર્શાવતું ફાળવેલું બજેટ.

માહિતી આ ([પરિશિષ્ટ – ૩](#)) માં સામેલ છે.

પ્રકરણ – ૧૨

ફાળવેલી સહાયકી અને સહાયકી કાર્યક્રમોના લાભાર્થીઓની વિગત સહિત આવા કાર્યક્રમોના અમલની પદ્ધતિ.

લાગુ પડતું નથી.

પ્રકરણ – ૧૩

સંસ્થા પાસેથી કોઈપણ પરવાનગીઓ અથવા અધિકારી પત્ર અથવા છુટછાટ / રાહત મેળવનાર અમલની પદ્ધતિ.

લાગુ પડતું નથી.

પ્રકરણ – ૧૪

સંસ્થા પાસે ઉપલબ્ધ અથવા તેમની પાસે રહેતી વીજાણ માધ્યમમાં રૂપાંતરિત (ઈલેક્ટ્રોનિક્સ ફોર્મ) માહિતીની વિગતો.

- (૧) નવસારી કૃષિ યુનિવર્સિટીની વેબ સાઈટ www.nau.in ઈન્ટરનેટ પર ઉપલબ્ધ છે.
- (૨) યુનિવર્સિટીના સ્નાતક અને અનુસ્નાતક વિદ્યાર્થીઓના થીસીસના એબસ્ટ્રેક્ટ સીડીમાં ઉપલબ્ધ છે.
- (૩) સ્નાતક અને અનુસ્નાતક અભ્યાસક્રમો માટેના અંગ્રેજીમાં સૂચિ પત્રક (Prospectus).
- (૪) Gujarat Agricultural Universities Act, 2004.
- (૫) વિવિધ અભ્યાસક્રમોના વિનિયમો (Regulations).

પ્રકરણ – ૧૫

સંસ્થામાં જાહેર ઉપયોગમાં રાખેલી પુસ્તકાલય અથવા વાંચન ખંડની સવલતો માટેના સમય સહિત નાગરિકોને માહિતી મેળવવા માટેની પ્રાપ્ત સગવડોની વિગતો.

નવસારી કૃષિ યુનિવર્સિટી હસ્તક સને ૧૯૭૫ માં શરૂ કરાયેલ સેન્ટ્રલ લાયબ્રેરી હાલમાં અદ્યતન સુવિધા ધરાવે છે. જેમાં કાર્ડ ધ્વારા પુસ્તકો ઈશ્યુ કરવાથી માંડીને ઓન લાઈન ઈન્ટરનેટ સુવિધા ધરાવે છે. પશુચિકિત્સા અને પશુપાલન મહાવિદ્યાલયનાં વિદ્યાર્થીઓ તેમજ સ્ટાફ મેમ્બર્સ પણ યુનિવર્સિટી હસ્તકની સેન્ટ્રલ લાયબ્રેરીનો ઉપયોગ કરે છે. સદર સેન્ટ્રલ લાયબ્રેરીમાં રહેલા પુસ્તકો, સંદર્ભગ્રંથો અને અન્ય વાંચન સામગ્રીની વિગતો યુનિવર્સિટીની વેબ સાઈટ ઉપર ઉપલબ્ધ છે.

પ્રકરણ - ૧૬

માહિતી (મેળવવાના) અધિકાર અધિનિયમ- ૨૦૦૫
અન્વયે જાહેર માહિતી અધિકારી, જાહેર માહિતી
અધિકારી, ને એપેલેટ ઓથોરીટીની નિમણુંક બાબત.....

વંચાણે લીધા: આ કચેરીના કા.આ.નં.જા.નં.નકૃયુ/૨જી/અ.૩.૩/આરટીઆઈ/કા.આ./૮૫૦૧-૮૭૩૩/૨૦૧૨

કાર્યાલય આદેશ

ઉપરોક્ત વંચાણે લીધેલ કાર્યાલય આદેશ થી The Right to Information Act-2005 હેઠળ યુનિવર્સિટીનાં અધિકારીશ્રીઓને એપેલેટ ઓથોરીટી, જાહેર માહિતી અધિકારી (PIO) અને મદદનીશ જાહેર માહિતી અધિકારી (APIO) તરીકેની નિમણુંક કરવામાં આવેલ હતી. સદર કાર્યાલય આદેશમાં જરૂરી અંશત: સુધારો કરી નીચે મુજબ રીવાઈઝ્ડ નિમણુંક કરવામાં આવે છે.

ક્રમ	કચેરીનું નામ	જાહેર માહિતી અધિકારી (P.I.O)	જાહેર માહિતી અધિકારી (A.P.I.O)	એપેલેટ ઓથોરીટી	RTI-2005 હેઠળ માહિતી અંગેની કામગીરી
૧	૨	૩	૪	૫	૬
૨૪	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	મદદ. વહી. અધિકારી*	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક*	કુલસચિવશ્રી, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	વેટરનરી કોલેજ હસ્તકની સંપૂર્ણ કામગીરી
૨૬	પ્રાધ્યાપક અને વડાશ્રી, સર્જરી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, સર્જરી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સર્જરી વિભાગને લગતી તમામ કામગીરી
૨૭	પ્રાધ્યાપક અને વડાશ્રી, સર્જરી વિભાગ, (વેટ. ક્લીનીક) વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, સર્જરી વિભાગ, (વેટ. ક્લીનીક) વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	વેટ. ક્લીનીકને લગતી તમામ કામગીરી
૨૮	પ્રાધ્યાપક અને વડાશ્રી, પેથોલોજી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, પેથોલોજી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પશુરોગોને લગતી તમામ કામગીરી

ક્રમ	કચેરીનું નામ	જાહેર માહિતી અધિકારી (P.I.O)	જાહેર માહિતી અધિકારી (A.P.I.O)	એપેલેટ ઓથોરીટી	RTI-2005 હેઠળ માહિતી અંગેની કામગીરી
૧	૨	૩	૪	૫	૬
૨૯	પ્રાધ્યાપક અને વડાશ્રી, મેડીસીન વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, મેડીસીન વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	વેટરનરી મેડીસીનને લગતી તમામ કામગીરી
૩૦	પ્રાધ્યાપક અને વડાશ્રી, વીપીએચ વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, વીપીએચ વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	વેટરનરી પબ્લીક હેલ્થને લગતી તમામ કામગીરી
૩૧	પ્રાધ્યાપક અને વડાશ્રી, ગાયનેકોલોજી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, ગાયનેકોલોજી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પશુમાં ગાયનેક તથા કૃત્રિમ બીજદાનને લગતી તમામ કામગીરી
૩૨	પ્રાધ્યાપક અને વડાશ્રી, એજીબી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, એજીબી વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પશુ જનીન અને પશુ સંવર્ધનની તમામ કામગીરી
૩૩	પ્રાધ્યાપક અને વડાશ્રી, એલપીએમ વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	પ્રાધ્યાપક અને વડાશ્રી, એલપીએમ વિભાગ, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	સીનીયર મોસ્ટ સહ પ્રાધ્યાપક	આચાર્યશ્રી, વેટરનરી સાયન્સ કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી	લાઈવ સ્ટોક પ્રોડક્શન મેનેજમેન્ટને લગતી તમામ કામગીરી

પ્રસ્તુત કાર્યાલય આદેશ આ કચેરીની ફાઈલ ઉપર માન.કુલપતિશ્રીની મંજૂરી મેળવી બહાર પાડવામાં આવે છે

જા.નં.નકૃયુ/૨જી/અ.૩.૩/આરટીઆઈ/કા.આ./૭૪૮-૯૬૯/૨૦૧૪

* મદદનીશ વહીવટી અધિકારીની જગ્યા ખાલી હોવાથી આચાર્યશ્રી, ડૉ.એન.એચ.કેલાવાલા, જાહેર માહિતી અધિકારી તરીકે ફરજ બજાવે છે. મદદનીશ જાહેર માહિતી અધિકારી તરીકે વહીવટી બાબતો માટે હેડ ક્લાર્ક શ્રી નટુભાઈ આર. પટેલ તથા તાંત્રિકીય બાબતો માટે આચાર્યશ્રીના ટેકનીકલ ઓફિસર ડૉ. ગૌરવ પંડ્યા ફરજ બજાવે છે.

કુલસચિવ

નવસારી કૃષિ યુનિવર્સિટી

નવસારી.

તા.૧૮/૦૧/૨૦૧૪

નકલ સવિનય રવાના જાણ તેમજ ઘટતું થવા સાડુ:-

૧. આ યુનિવર્સિટીના તમામ યુનિટ/સબ યુનિટના વડાશ્રીઓ તરફ.
૨. આ યુનિવર્સિટીના તમામ એપેલેટ ઓથોરીટી/પી.આઈ.ઓ./એ.પી.આઈ.ઓ. તરફ.
૩. કુલસચિવશ્રી, કૃષિ યુનિવર્સિટી, આણંદ/જુનાગઢ/સરદાર કૃષિનગર તરફ.

નકલ રવાના:-

૧. માન. કુલપતિશ્રીના રહસ્ય સચિવશ્રી, નવસારી કૃષિ યુનિવર્સિટી, નવસારી.
૨. કુલસચિવશ્રીના રહસ્ય સચિવશ્રી, નવસારી કૃષિ યુનિવર્સિટી, નવસારી.
૩. આ વિભાગની તમામ શાખાઓ તરફ.

પ્રકરણ-૧૭

વખતો વખત નિયત કરવામાં આવે તે પ્રમાણેની આવી અન્ય માહિતી.

સરકારશ્રી તથા નવસારી કૃષિ યુનિવર્સિટી ધ્વારા વખતો વખત આ બાબતે નિયત કરવામાં આવનાર માહિતી તેમજ સુચનો યથા સમયે જણાવવામાં આવશે.

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APPENDIX - A
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI-396 450

(VETERINARY COUNCIL OF INDIA)
NOTIFICATION
New Delhi, the 6th August. 2008

The Veterinary Council of India, with the previous approval of the Central Government hereby makes the following regulations in suppression of the notification vide GSR 69(E) dated the 7th February, 1994, namely:-

PART I
PRELIMINARY

1. Short title and commencement:(1) These regulations may be called the Veterinary Council of India -Minimum Standards of Veterinary Education- Degree Course (B.V.Sc. & AH.) Regulations, 2008.
(2) They shall come in force on date of their publication in the official Gazette.
2. Definitions- In these regulations, unless the context otherwise requires-
 - (a) "Act" means the Indian Veterinary Council Act, 1984 (2 of 1964);
 - (b) 'course" means a teaching unit of a subject to be covered within a semester as prescribed in the syllabus;
 - (c) "credit hours" means the weekly unit of work recognized for any particular course as per the course catalogue issued by the University. A lecture class of one hour per week shall be counted as one credit whereas a practical class of two hours duration or a working period of three hours in the Teaching Veterinary Clinical Complex or Institution or Farm per week shall count as one credit;
 - (d) "degree course" means the course of study in Veterinary Science, namely Bachelor of Veterinary Sciences and Animal Husbandry (B.V.Sc. & A.H.); .
 - (e) "First Schedule" and "Second Schedule" mean the First Schedule and Second Schedule respectively appended to the Act;
 - (f) "guidelines" means*the guidelines/instructions issued by the Veterinary Council of India from time to time for uniform implementation of these Regulations;
 - (g) "Inspector" means the Veterinary Inspector appointed under sub-section (1) of section 19 of the & Act;
 - (h) "President" means the President of the Veterinary Council of India;
 - (i) "qualifying examination" means Higher Secondary (10+2) examination or equivalent conducted by a State Board of Education or Central Board of Education.
 - (j) "Semester" means a period consisting of minimum one hundred instructional days, excluding Annual examination days ;
 - (k) "Secretary" means the Secretary of the Veterinary Council of India appointed under section 11 of the Act,
 - (l) "syllabus" and 'curriculum" mean the syllabus and curriculum for courses of study as specified by the Veterinary Council of India;

- (m) 'teaching experience*' means experience of teaching in the subject concerned in a Veterinary College, or Animal Science or Allied subjects Institution, or Veterinary Hospital, or Institution recognized by the Veterinary Council of India;
- (n) "Veterinary College" means an institution imparting veterinary education for the award of B.V.Sc. & A.H. degree having the required number of departments/units, infrastructure, manpower and other facilities as laid down in these Regulations under the overall administrative control of the Dean/Principal; *
- (o) "Veterinary Hospital or Institution" means teaching and non-teaching Veterinary Hospital or Institution relevant to livestock health, production or technology by whatever name called;
- (p) "Visitor" means a Visitor appointed under sub-section (i) of section 20 of the Act.

PART II COURSE OF STUDY

3. **Description:** A degree course of B.V.Sc. & A.H. shall comprise of a course of study consisting of curriculum and syllabus provided in regulations Part V (9) of these regulation spread over five complete academic years including a compulsory internship of six months duration undertaken after successful completion of all credit hours provided in the syllabus.
During the course of study there shall be training in a teaching Veterinary hospital, livestock and poultry farms and field training in Veterinary Institution as part of the course.
4. **Duration of Semester or academic year**
 - (a) First semester in the respective academic year of B.V.Sc. & A.H. classes should commence preferably in July or August every year but not later than 31st October.
 - (b) The annual examination should be conducted prior to annual vacation for the year.
 - (c) It is essential that each academic year shall consist of at least 200 days of instruction excluding time spent for examinations.
5. Procedure to be adopted for imparting training in the veterinary hospitals or institutions or farms and internship with suitable adjustments at-
 - (1) **Teaching Veterinary Clinical Complex (TVCC)**
 - (a) The Teaching Veterinary Clinical Complex shall be a separate unit in every veterinary college under the independent charge of a Faculty Member of the rank of a Professor with specialization in any of the clinical subjects.
 - (b) Teaching Veterinary Clinical Complex shall be recognized only if it has an average minimum of 500 outdoor cases and 10 indoor cases in a month.
 - (c) In case-the Teaching Veterinary Clinical Complex does not have requisite number of out patient .and in-patient cases as prescribed in (b), the city veterinary hospitals of State Government/ nearest veterinary hospitals should be used and developed providing all the infrastructure prescribed for a teaching veterinary clinical complex. The attached teaching veterinary hospitals should have properly built indoor wards, client accommodation, emergency service and the necessary facilities to conduct and demonstrate/ train all medical, surgical and gynaecological cases and separate "in Health" care facilities like artificial insemination, pregnancy diagnosis, health verification tests, prophylaxis etc.
 - (d) Being a round the clock service there shall be residential accommodation or clinical and hospital staff and suitable accommodation for students on emergency/night duties and cafeteria/canteen for staff, students and clients

- (e) All the concerned staff on duty in the teaching veterinary hospital shall be responsible for the treatments and allied public services and would invariably attend the clinics including emergencies/ night duties and on Sundays/ holidays. The staff as well as students should be properly attired and equipped for the performance of clinical duties.
- (f) The teaching institutions shall maximally utilize the animal/patient information observing all the time the principles of animal welfare and ethics, and arrange:
 - i) The teaching material in the form of clinical cases in sufficient number, variety and species.
 - ii) Subsidized treatment to encourage larger attendance in teaching veterinary, hospitals.
 - iii) Procure or provide free maintenance to, cases of academic interest or typical cases of teaching value so that students can benefit from them.
 - iv) In the case of death/ euthanasia detailed necropsy be demonstrated and specimens preserved.

(2) Instructional Livestock Farm Complex (I.L.F.C)

The Instructional Livestock Farm Complex shall be a separate unit in every veterinary college under the independent charge of a Faculty Member of the rank of a Professor with specialization in any of the production subjects. The farm complex shall be for teaching in rearing of livestock species including poultry with the following facilities:

- i) housing, feeding, breeding and management of large and small ruminant units, piggery, poultry and animals of regional interest
- ii) record keeping
- iii) storage facilities for feed and fodder
- iv) production facilities for fodder crops
- v) suitable- housing for managerial and technical staff

Being a round the clock service there shall be residential accommodation and suitable accommodation for staff and students on duties.

All the concerned staff on duty in the Instructional Livestock Farm Complex shall be responsible for management including emergencies of the animals in the livestock Farm. They shall arrange and supervise the routine managerial practices from time to time and shall maintain record for the same. They shall also be responsible for production activity in each of the units

PART III

ADMISSION TO THE B. V. Sc. & A.H. DEGREE COURSE

- 6. A candidate shall not be admitted to B.V.Sc. & A.H. degree course unless:-
 - (a) He/she has completed the age of 17 years on or before the 31st December of the year of his/her admission to the 1st year of B.V.Sc. & A.H. course; and
 - (b) He/ she has passed the qualifying examination as defined under these Regulations with the subjects of Physics, Chemistry, Biology and English as core course and obtained marks as specified under Regulations Part III (7) or an examination equivalent to intermediate Science examination of an Indian University/Board recognized by the Association of Indian Universities taking Physics, Chemistry and Biology including a practical test in each of these subjects and English.

SELECTION OF STUDENTS

7. (1) The selection of students for admission to B.V.Sc. & AH. Degree Course shall only be on the basis of merit through a competitive entrance examination to achieve a uniform evaluation, as there may be variation among students at qualifying examinations conducted by different agencies.

NOTE: To be eligible for competitive entrance examination, candidate must have passed any of the qualifying examinations as enumerated under the head, "Admission to B.V.Sc. & A.H. Degree Course*" at Part III (6) above

- (2) A candidate under General Category for admission to the B.V.Sc. & A.H. degree course must have passed in each of subjects of English, Physics, Chemistry and Biology, and obtained 50% marks In aggregate of these subjects, at the qualifying examination. Admission of students to B.V.Sc.& A.H. degree course shall be made only on the basis of his/her merit in the competitive entrance examination. No other merit/weightage shall be for admission to B.V.Sc. & A.H. degree course.
- (3) In respect of candidates belonging to the Scheduled Castes/ the Scheduled Tribes or other special category of students as specified by the Government from time to time, marks required for admission shall be 10% less than that prescribed for general category. Where the seats reserved for the Scheduled Caste and the Scheduled Tribes students in any State cannot be filled for want of requisite number of candidates fulfilling the minimum require prescribed from that State, then such vacancies shall be filled up on all India basis with students belonging to the Scheduled Castes and Scheduled Tribes getting not less than the minimum prescribed pass percentage.
- (4) The students educated abroad seeking admission into veterinary colleges in India, must have passed the subjects of Physics, Chemistry, Biology and English up to the 12th Standard level with 50% marks in the individual subjects.
- (5) Sponsored candidates shall have to qualify the admission procedures as laid down for the students under General category.
- (6) Admission of candidates to B.V.Sc. & A.H. degree course under bilateral exchange programme shall be regulated by Veterinary Council of India.
- (7) 15% of the total number of seats of each veterinary college shall be reserved to be filled on an All India basis through Common Entrance Examination (All India Pre-veterinary Test) to be conducted by the Veterinary Council of India.
- (8) The candidates selected through this examination shall be admitted in various veterinary colleges as per the eligibility criteria prescribed in these regulations only and the last date for reportingst of these candidates to the allotted University/ Veterinary Institution shall be 31st August of that year irrespective of the closing date of admission of that University/Veterinary Institution for that year, if earlier.
- (9) A candidate shall not be allowed admission to B.V.Sc. & A.H. degree course including those admitted under 15% reserved quota of Veterinary Council of India if he/she suffers disabilities in physical fitness as listed below:
- disability of total body including disability of chest/spine more than 50%,
 - disability of lower limb of more than 50%,
 - disability of upper limb, visually handicapped candidates and those with hearing disability,
 - candidates with progressive diseases like myopathies etc.
 - disabilities which otherwise would interfere in the performance of the duties of a veterinarian.

- (10)The disability should be certified by a duly constituted and authorised Medical Board comprising of at least three specialists out of which two should be of the specialty concerned and the candidate has to present him/her- self before the Medical Board. The last valid disability certificate of the candidate from a Medical Board should not be more than three months old from the date of submitting his/her certificate for disabled candidates.

PART IV
VETERINARY CURRICULUM - STRUCTURING AND ORGANIZATION OF
COURSE CURRICULUM

8(1) VETERINARY CURRICULUM –

- (a) The veterinary curriculum is comprised of six components of study:
- (i) Core Courses,
 - (ii) Tracking Programmes,
 - (iii) Study Circles,
 - (iv) Entrepreneurial Training,
 - (v) Internship, and
 - (vi) Competence in skills.
- (b) The curriculum is meant to provide adequate emphasis on cultivating logical and scientific habits of thought clarity of expression, independence of judgment, ability to collect information and to correlate them, and develop habits of self education.
- (c) A judicious balance has been ensured in distribution of course credits in theory and practical and sequence among basic, production, pre-clinical and clinical subjects including public health and livestock products technology.
- (d) The educational process may be placed in a historic background as an evolving process and not merely as an acquisition of large number of disjointed facts without a proper perspective.
- (e) Medium of instruction to B.V Sc.&A.H. degree course shall be English.
- (f) Clinical practice shall be organized in small groups of 5-10 students so that each teacher can give personal attention to each student with a view to improve his/her skill and competence in handling of the patients.
- (g)Efforts be made to encourage students to participate in group discussions and seminars to enable them to develop personality, character expression and other faculties which are necessary for a veterinary graduate to function either in solo practice or as a team member when he/she begins his/her independent professional career. An appropriate time slot for this activity be provided in the student study time table.
- (h)Practical training be imparted to produce a well balanced and all-rounder graduate. Continuing self-education among students for further development in different aspects of veterinary and animal science/technology be encouraged. Tutorials be organized for this activity.

(2) SUBJECTS TO COVERED IN THE B.V.Sc. & A.H. DEGREE COURSE

1. Veterinary Anatomy
2. Veterinary Physiology and Biochemistry
3. Veterinary Pharmacology and Toxicology
4. Veterinary Parasitology
5. Veterinary Microbiology

6. Veterinary Pathology
7. Veterinary Public Health and Epidemiology
8. Animal Nutrition
9. Animal Genetics and Breeding
10. Livestock Production Management
11. Livestock Products Technology
12. Veterinary Gynaecology and Obstetrics
13. Veterinary Surgery and Radiology
14. Veterinary Medicine
15. Veterinary and Animal Husbandry Extension Education

3. MIGRATION OR TRANSFER OF STUDENT FROM ONE RECOGNIZED VETERINARY COLLEGE OR INSTITUTION TO ANOTHER

- (1) A student studying in a recognized veterinary college may be allowed to migrate/be transferred to another recognized veterinary college under another/same university.
- (2) The migration/transfer may be allowed by the university concerned after passing 1st year of B.V.Sc. & A.H. degree course within one month of the start of academic session of 2nd year of the receiving college/university.
- (3) Migration/ transfer of a student shall not be allowed during the middle of an academic year.
- (4) The number of students migrating/ transferring from one veterinary college to another veterinary college during the period of one academic year will be kept to the maximum limit of 5% of the intake capacity of each of the veterinary colleges in one year.
- (5) Cases not covered under such regulations, (1) to (4) may be referred to the Veterinary Council of India for consideration on merits.
- (6) An intimation about the admission of migrated/ transferred students into any veterinary college should be sent to the Veterinary Council of India by the respective college/university.

PART V SYLLABUS

9.(1).(a) The semester-wise distribution of theory and practical courses comprising of 177 credits (core courses) for B.V.Sc. & A.H. degree course are summarized below :-

Professional Year	Semester	Theory	Practical	Total
First	I	11	07	18
	II	12	08	20
Second	III	12	09	21*
	IV	12	09	21*
Third	V	12	07	19
	VI	13	08	21
Fourth	VII	10	10	20
	VIII	10	08	18**

Fifth	IX	09	10	19
		101	76	177

* 1 credit (0+1) each for two courses on Livestock Farm Practice (non credit) included.

** 1 credit (1+0) for Veterinarian in Society (non credit) included.

(b) In addition to the Core Courses above, a student has to successfully complete the Tracking Programmes, Study Circles, Entrepreneurial Training, Internship and Core Competence in Veterinary skills as has been detailed under Part IV (8)(1) of these regulations for the award of B.V.Sc. & AH. degree.

(c) Remount Veterinary Corps (RVC) Squadron/ National Cadet Corps (NCC)/ Equestrian/National Service Scheme (NSS)/ Sports and games shall be non-credit training programmes one of which for a duration of minimum of two Professional Years shall be compulsory for the award of B.V.Sc. & A.H. degree. The performance of the students in these training programmes shall be assessed and graded as 'Satisfactory' or 'Unsatisfactory'. A student has to obtain 'Satisfactory' grading for successful completion of course requirements.

NOTE: The Syllabus prescribed in sub-regulation is the minimum instructional syllabus and is illustrative of the course content for teaching different courses at the veterinary colleges in the country for B.V.Sc. & A.H. degree programme. However, there is scope for flexibility of addition of topics/courses in the programme as per need or regional/ institutional demand from time to time. Such changes should be non-violative and commensurate to the basic structure, curriculum and infrastructure prescribed in these regulations

(2) Tracking Programmes

These programmes have been developed to allow students to exercise more control over the specific direction of their profession and motivate them for self-teaming through virtual classroom, distant learning, internet etc. A student has to compulsorily take any two programmes of two credits each (2x2=4 credits) any time (one semester duration each) during second year to fifth year of B.V.Sc. & A.H. Degree Course under the supervision of one faculty member as designated by the Dean/Principal of the College for that programme. Evaluation of the students for this programme shall be done internally on Grade basis (A-Excellent, B-Good, C-Average). In case of unsuccessful candidates, the programme can be carried over to the next semester/year.

List of the Tracking Programmes is given below:

- i) Feline Medicine
- ii) Cryobiology of Gametes
- iii) Neurosciences
- iv) Clinical/ Interventional Nutrition
- v) Dermatology/integument Science
- vi) Alternate Veterinary Medicine
- vii) Ophthalmology
- viii) Anesthesiology
- ix) Small Animal Critical Care
- x) Non-Mammalian Medicine
- xi) Sports Animal Medicine
- xii) Drug designing
- Xiii- xv)- To be decided by the college/university.

These will be Non-Credit courses but shall be mentioned in the Degree Transcript along with the grades obtained.

(3) Study Circles

Each student of B.V.Sc. & A.H. degree course shall have to enroll himself/herself for at least two Study Circle activities during the B.V.Sc. & A.H. degree course out of the proposed Study Circles-as listed below:

- i) Livestock and Livelihood Study Circle
- ii) Production Systems Study Circle
- iii) Ecosystems and Livestock Study Circle
- iv) Equine Study Circle
- v) Canine Study Circle
- vi) Diagnostic Study Circle
- vii) Alternate Animal Use Study Circle
- viii) Fun/Sport Animal Study Circle
- ix) Law and Veterinary Science Study Circle

The College shall designate an Advisor for each of the above Study Circle activities who shall supervise, guide, monitor and evaluate the activities of the Study Circles. Each enrolled student shall have to present a Seminar on the topics of his/her Study Circle any time during the Semester. The date and time of the Seminar shall be notified inviting participation of all students. The Study Circle shall also put up news, wall papers, drawings, exhibits of their subject in the college. The Dean of the college shall coordinate the activities with the Advisors for each of the above Study Circles. The evaluation of the student for each of the registered Study Circles shall be done by the Advisor who will grade them as A-Excellent, B-Good, C-Average as per their performance. The same shall be recorded in the Degree Transcript along with the grades obtained. No student shall be allowed to change the Circles during the professional year.

(4) Entrepreneurial Training,-

Each student of B.V.Sc. & A.H. degree course shall be required to compulsorily undertake one of the activities of Entrepreneurial Training as listed below. This training is aimed at developing entrepreneurial skill for self employment. The university/college shall provide interest free loans out of a revolving fund (not less than Rs. 3.00 lakhs in a college) to students groups (team of up to five students), technical support and infrastructure for these activities. Inputs, day-to-day work and financial accounting shall be undertaken by the students. The profits/loss, if any, shall be kept/borne by the students. However, in case of loss, the Dean of the college through the Entrepreneurship Committee consisting of four faculty members (at least one subject matter specialist) may evaluate the reasons of such loss and provide compensation in case it is found that the loss has been inadvertent. Proposed List of 16 Entrepreneurial activities is as follows:

- (i) Goat Production
- (ii) Sheep Production
- (iii) Pig Production
- (iv) Broiler and Egg Production
- (v) Pet Production
- (vi) Dairy Production
- (vii) Meat Production and Processing
- (viii) Fish Production
- (ix) Feed Production-Mineral Mixture
- (x) Milk Products

- (xi) Food safety-residue Analysis
 - (xii) Clinical Investigatory laboratory (xiii) Quality Control-Evaluation (Microbial) (xiv) Shoeing and Shoe Manufacture
 - (xv) Production of Diagnostic
 - (xvi) Pharmaceutical Formulations ,
- Besides, the Colleges/Institutions may also offer the facilities for Entrepreneurial Training involving the activities of regional interest

(5) Internship.-

- (a) As per regulation 3 of Part II of these regulations, every student of B.V.Sc. & A.H. degree course shall be required after passing the fifth annual examination to undergo compulsory rotating internship to the satisfaction of the University for a minimum period of six calendar months so-as to be eligible for the award of the degree of B.V.Sc & AH. and full registration with the Council.
- (b) Compulsory rotating internship shall include a full time training in veterinary and animal husbandry services {including emergencies and night duties, Sundays and holidays). The intern will devote whole time to the training and will not be allowed to accept a whole time or part time appointment paid or otherwise,
- (c) Internship shall be undertaken only after completion of all credit requirements of veterinary curriculum including Tracking Programmes, Study Circles, Entrepreneurial Training -and R.VC. Squadron/N.C.C./ Equestrian/N.S.S/Sports and games as prescribed under these regulations.
- (d) The university shall issue a provisional course completion certificate of having passed all the professional examinations and having successfully completed course work.
- (e) The State or Union Territory Veterinary Council or Veterinary Council of India will grant provisional registration to the candidate on production of provisional B.V.Sc. & A.H. course completion certificate. The provisional registration will be for a minimum period of six months and maximum of eight months.
- (f) After provisional registration with the State or Union Territory Veterinary Council or Veterinary Council of India, the candidate shall register for internship of six calendar months.
- (g) Interns will be actively involved in rendering veterinary service under the supervision of an experienced teacher.
- (h) They shall assist the teacher in all activities of the units they are posted in.
- (i) During the period of internship they shall be" provided accommodation/lodging and paid consolidated remuneration in the form of internship allowance as may be decided by the University/Institution from time to time.
- (j) Attendance will be compulsory. The candidate will be entitled for 10 days casual leave. The leave cannot be claimed as a matter of right until and unless the sanctioning authority sanctions it. If an intern willfully absents from the training programme even if for part of a day or during off hours duty (including Sundays/holidays) he/ she may be treated absent for that day. The candidate will be required to undergo training for the additional days in lieu of the absence period and internship allowance will not be paid for these additional days.
- (k) The internship programme shall be monitored by a Committee constituted by the Dean under his/her chairmanship including among others the Head of TVCC and Head of ILFC as members. This Committee shall monitor effective implementation of the internship training programme from time to time.
- (l) In case of unsatisfactory work/ performance and/or shortage of attendance, the period of compulsory rotating internship shall be extended by not more than two months by the appropriate authority If this period is more than two months, the intern has to re-

- register afresh for internship programme for entire six calendar months including registration with the State or Union Territory Veterinary Council.
- (m) Internship allowance will be paid only for six calendar months. No internship allowance will be paid for the period of absence/unsatisfactory performance/extended period.
 - (n) The compulsory rotating internship for six calendar months shall be done in teaching and approved Veterinary Polyclinics/Veterinary Hospitals, Veterinary Biological Centres, Technology Centers, Farms and Veterinary Disease Investigation Centers. The internship programme can be undertaken at approved veterinary institutions in India,
 - (o) The compulsory rotating internship shall be in the following areas:
 - (i) Clinical training covering veterinary medicine, surgery and radiology, animal reproduction, gynaecology and obstetrics, clinical emergencies, indoor ward care, hospital management record keeping etc. for three months.
 - (ii) Livestock production and management training, covering farm routines of cattle and buffalo farms, piggery/rabbitary, sheep and goat farms, and equine/ camel unit etc. for one month.
 - (iii) Poultry production and management covering layer and broiler production, hatchery and chick management quail, turkey, duck units etc. as well as fishery or any other recycling unit where feasible, for one month.
 - (iv) Livestock technology and service' covering familiarization in biological product units, disease control campaigns (disease investigation and sample collection and dispatch, vaccination, mass testing etc.) in plant training in meat plants, milk plants, etc. training in zoo/ wild life center/ national parks, for one month.
 - (p) Details of day to day work, posting and duration needs to be worked out by the Veterinary Institution as per its needs and infrastructure facilities,
 - (q) Where an Intern is posted to a recognized Veterinary hospital for training, a representative of the college and the In-charge of the Veterinary hospital shall regulate the training of such interns,
 - (r) Every Intern shall render professional veterinary service, skill and knowledge under supervision and guidance of a registered veterinary practitioner working in the approved Veterinary Institution.
 - (s) Function, responsibilities and duties of Interns:
 - (i) Participation with clinical faculty in the hospital practice.
 - (ii) Shares the emergency and night duties on rotation in the larger and small ' animal hospitals including Sundays & holidays.
 - (iii) Participation with staff of the place of posting in Veterinary Practice (production or technology).
 - (iv) The intern responsibilities include hands-on diagnostic and treatment procedures for hospitalized cases under the supervision of the attending veterinarian.
 - (v) Participation in the tutorial instructional program of the Veterinary College.
 - (vi) The intern will administer primary care to emergency cases and participate in service such as anaesthesia, radiology, ultrasonography, endoscopy, laboratory and diagnostic procedures. Medicine and Surgery rounds are held periodically allowing the interns to present cases and participate in topic discussion.
 - (t) The training shall be supplemented by weekly sessions of clinical conference, farm operation and data analysis, preparation of feasibility reports, project report, campaigns/ discussions in, clinical training, farm training and technology and services respectively.
 - (u) For the purpose of internship all necessary inputs .like accommodation, transport, adequate clinical facilities etc. shall be provided.

- (v) The intern shall maintain a log book of day to day work which may be verified & certified by the supervisor under whom he/she works. In addition the interns will prepare a brief project report on the basis of his/ her case study/ case analysis, survey reports etc. This shall be based on his/ her own study during the internship. Such reports can be supervised by more than one teacher, if required. The interns shall present such report in seminar organized for the purpose.
- (w) The grading shall be based upon the evaluation of log book, their performance reports from all the minimum prescribed training postings, project report and comprehensive examination in core competence in veterinary skills conducted at the end of the programme by an Evaluation Committee comprising of the faculty representing the concerned departments appointed by the Dean for this purpose.
- (x) Every Intern shall have to submit an Entrepreneurial Project during the Internship Programme.

(6) Comprehensive Examination on Core Competence in Veterinary skills:

The competence in veterinary skills examination shall be based on an evaluation of core competence in professional skills as detailed below;

- (i) Restraint of cow, sheep, horse, dog and pig. Haltering, snaring, muzzling, tad switch, bandaging of horse for exercise and stable bandaging
- (ii) Animal identification, Dentition and ageing of animals
- (iii) Housing layout/requirements of livestock and poultry
- (iv) Computation of ration of livestock of different breeds and age groups in health and disease
- (v) Fodder management and interpretation of feed quality evaluation
- (vi) Physical. evaluation of livestock health parameters (auscultation, percussion, recording of temperature, pulse, heart rate, respiration rate etc.)
- (vii) Recording and interpretation of cardiovascular response
- (viii) Testing of milk and milk products for quality, clean milk production
- (ix) Carcass quality evaluation (ante-mortem & post-mortem examination)
- (x) Specific diagnostic tests for zoonotic diseases
- (xi) Sample collection, handling-and dispatch of biological materials for laboratory examination
- (xii) Staining techniques for routine clinico- pathological examinations
- (xiii) Relating post-mortem lesions to major livestock diseases
- (xiv) Haematological evaluation (total leukocyte count, differential leukocyte count, haemoglobin, packed cell volume, erythrocyte sedimentation rate etc.) and interpretation
- (xv) Tests and their interpretation for haemoprotozoan diseases
- (xvi) Body fluids collection, examination and interpretation as an aid to diagnosis
- (xvii) Urine evaluation procedures and interpretation as indicators for diagnosis of diseases
- (xviii) Fecal examination- procedures and interpretation
- (xix) Examination of skin scrapings and interpretation
- (xx) Interpretation of blood chemistry profile in diseases
- (xxi) Deworming procedures and doses for different species of animals/birds
- (xxii) Managing an outbreak of infectious/contagious disease
- (xxiii) Approach to diagnosis of a given disease condition
- (xxiv) Pre-anesthetic administration and induction, maintenance of general anesthesia and dealing with anesthetic emergencies

- (xxv) Local anesthetic administration
- (xxvi) Nerve blocks-sites, functional application
- (xxvii) Suture material, suture pattern and tying knots
- (xxviii) Common surgical procedures including dehorning, docking, caesarian section, ovariectomy, castration, rumenotomy
- (xxix) Application of plaster cast/splint for fracture immobilization and other bandaging procedure in large and small animals.
- (xxx) Soundness in horses
- (xxxi) Rectal examination - palpation of pelvic/abdominal organs in cattle/ horses/ buffaloes,
- (xxxii) Detection of oestrus, artificial insemination, pregnancy diagnosis,
- (xxxiii) Management of vaginal/uterine prolapse and dystocia
- (xxxiv) Andrological examination of bull, handling, preservation and evaluation of semen
- (xxxv) Vaccination procedures, vaccination schedules and vaccine types for different diseases
- (xxxvi) Handling of radiograph, interpretation of a given radiograph of large and small animals
- (xxxvii) Client management
- (xxxviii) Managing a clinical practice, ambulatory van, transporting a sick animal requirements, etc.
- (xxxix) Dosage regimens of important drugs
- (xl) Drug administration techniques in different species of animals- oral, parenteral, rectal, intra-peritoneal and intra-uterine
- (xli) Identification of major livestock/poultry breeds
- (xlii) Measuring climatic parameters and their interpretation
- (xliii) Communication technology tools

There shall be no marks for this examination. Every intern shall be graded as 'Satisfactory' or as 'Unsatisfactory' based on the evaluation of this examination and submission of Entrepreneurship Project. The Dean shall then issue the certificate of satisfactory completion of internship training as prescribed by the Veterinary Council of India. In case of unsatisfactory performance in the comprehensive examination for core competence in professional skills, the candidate has to repeat the entire internship programme.

- (7) The candidate will become eligible for registration with State/UT Veterinary Council only on the award of the B.V.Sc: & A.H. degree or production of a provisional degree certificate by the University.

EXAMINATION AND EVALUATION

- 10. (1) It shall be the responsibility of the teacher(s)/instructor(s) to ensure that the topics to be covered in the theory and practical in each course is recorded through a lecture/practical schedule and distributed to the students at the beginning of each course. The Head of the Department/ Dean shall ensure that the schedule is adhered to and alternate arrangements are made to cover up the loss in case of any eventualities of unavoidable reasons that lead to non-adherence of the above schedule.
- (2) Work distribution chart of each teacher should be available with Dean's office for inspection of the Council. In each subject Professors and senior teachers must be actively involved in teaching, especially in conducting practical for degree course. The principle behind each practical, the objective of each practical level of

competence expected from the students etc. should be clearly explained to them by senior teachers.

- (3) The examination shall be to assess whether the student has been able to achieve a level of competence. For academic assessment, evaluation of practical aspects of the curriculum should receive much greater emphasis leading to separate examinations and requiring the student to secure a minimum of 50% marks, in theory as well as in practical, in each such examination.
- (4) The weightage of Theory and Practical shall be in the ratio of 60:40 respectively in both internal and annual examinations.
- (5) The distribution of marks for objective and subjective questions in each course/paper shall be in the ratio of 60: 40 respectively both in internal and annual examinations.
- (6) The schedule of examination during B.V.Sc. & A.H. course shall consist of internal (semester) and external (annual) examinations: internal examination (theory and practical separately) for each course at the end of each semester; and external examinations (theory and practical separately) at the end of each academic year comprising of all the courses of a particular subject taught during that year.
- (7) The internal assessment (Semester) shall be conducted in 50% of total marks in theory and practical separately and shall invariably be conducted on completion of the course as per lecture/practical schedule explained under sub-regulation (1) and shall be held without any preparatory leave. It shall be the responsibility of the-University/College authorities to conduct these examinations without: loss of instructional days of a Semester. Internal Practical examination shall be conducted by a board of examiners consisting of Instructors) of the course and a representative of the head of the department. Evaluation of answer books shall be done by the concerned instructors). Marks obtained in theory and practical in the internal examinations would be recorded separately and submitted to the Dean/ Principal at the end of the particular semester.
- (8) A composite Annual examination for a group of courses/ a course (if only a single course is involved in the paper) shall be conducted for the rest 50% marks in theory and practical separately as per schedule of examination. The annual theory examination(s) shall be conducted by inviting the question paper from appointed paper setters). A paper setter shall be provided the courses and syllabus prescribed by the VCI including detailed course outline. A paper setter shall be requested to prepare two sets of question papers, each for main examination and compartment examination (if any). Where necessary, more than one paper setter/ examiner can be appointed. The practical examinations shall be conducted by the Board of Examiners appointed by the university and shall consist of two or more internal (representing the subjects being examined) and one external examiner. Evaluation of answer books of annual examinations shall be done by the external examiner (s).
- (9) Annual examinations shall be held on such dates, time and places as the university may determine and must be completed so that the results are announced before the onset of the ensuing semester.
- (10) The schedule of examinations (internal/external) shall be adhered to strictly. No re-examination shall be allowed in events of students.-strike, boycott, walkouts, medical grounds or what-so-ever may be the reason.
- (11) There shall be no supplementary (make up) examinations during the academic session. However, a candidate may be allowed to provisionally sit in the next class provided he/she has failed only in two papers. He/she cannot be promoted to next B.V.Sc. & A.H. class unless he/she has cleared the failed papers),
- (12) The records of examination shall be made available to the Council, as and when required and the records of assessment may be retained till six months after the conduct of the Annual examination.

EXPLANATION 1: For the first B.V.Sc. & A.H. examination, the subject of Veterinary Anatomy, has one course in the first semester (VAN-111, 1+2=3) and one course in the second semester (VAN-121, 2+2=4). Internal evaluations for VAN-111 shall be conducted at the end of the 1st semester and for VAN-121 the internal evaluation shall be conducted at the end of the 2nd semester. The marks obtained in <the examinations shall be recorded separately for theory and practical and sent to the concerned Registrar/ Controller of Examinations/ Dean. After the completion of courses in the second semester, a composite annual examination (for Veterinary Anatomy Paper-I) shall be conducted for the theory and practical of VAN-111 and VAN-121 giving due weightage to each course. The marks obtained in the theory and practical of internal and annual examination shall be added and the grade point calculated and recorded against Anatomy Paper-I. Similar pattern shall be followed for all other subjects of B.V.Sc. & A.H. Degree course. (Annexure I)

EXPLANATION 2: The teachers while evaluating practical, shall take into account the followings:-

- (1) A record or log book maintained by each student as practical records.
- (2) Observation and recording of the skill with which each student executes the practical.
- (3) Assessment of the comprehensive skill and knowledge of each student through an oral examination (viva-voce).
- (4) At least ten percent marks may be awarded to day to day records including record of case sheets etc.

NB: Practical manuals be prepared by the respective departments of each of the courses.

TEACHERS, EXAMINERS, PAPER SETTERS

11. (1) The persons with basic veterinary qualification (B.V.Sc/B.V.Sc. & A.H.) shall be recruited as teaching faculty in the Veterinary Colleges.
- (2) Teachers in the disciplines of Biochemistry, Biotechnology, Biostatistics and Computer Application, Entrepreneurship, Extension and Economics may be recruited from the persons having qualifications other than the basic veterinary qualification only in case of non-availability of candidates with basic veterinary qualifications. Where candidates with basic veterinary qualification are available, they should be given priority in selector appointment over the candidates without basic veterinary qualification. Appointment of persons without the basic veterinary qualification as teachers in the aforesaid disciplines shall require prior approval of the Veterinary Council of India.
- (3) The post of Head of Department in a Veterinary College shall be filled up only with a teacher with basic veterinary qualification.
- (4) A person possessing qualification included in the First or Second Schedule to the Act shall be generally appointed as examiner or paper setter for the conduct of a professional examination for the B.V.Sc. & A.H. course. However, a person without the qualifications mentioned above may also be appointed examiner in his/her concerned subject provided he/she possesses the doctorate degree in that subject and a minimum three years teaching experience.

Provided that-

- (a) no such person shall be appointed as an external examiner unless he/she has at least three year's teaching experience;
- (b) no person below the rank of Lecturer/Assistant Professor or equivalent shall be appointed as internal examiner

- (c) no person shall be appointed as an external examiner in any Para-clinical / clinical subject unless he/she possesses a recognized veterinary qualification and hold a postgraduate degree and teaching experience In the subject concerned.
- (d) persons working in Government/Semi Government or similar organizations may also be considered for appointment as external examiners provided they possess qualification and experience as laid down above.
- (e) paper setter(s) cannot be appointed as practical examiner(s) in the same paper.
- (f) local person(s) shall normally not be appointed as paper setter(s)/ external examiner(s) However, under exceptional circumstances or unavoidable exigencies arising at the time of examination (like hot arrival of appointed examiner/ non-receipt of question paper from paper setter etc.), the University may appoint any qualified person for the purpose to avoid postponement/ cancellation of annual board examination
- (5) Oral and practical examinations shall be conducted by the respective internal, and external examiners with mutual co-operation. They shall allot marks to the candidate appearing at the examination according to their performance and the marks sheet so prepared shall be signed by both the examiners.
- (6) Every veterinary college shall provide all facilities to the internal and external examiners which are necessary for the conduct of examinations and the internal examiner shall make all preparations for holding the examinations.
- (7) The external examiner shall have the right to communicate to the examining body his/ her views and observations about any short comings or deficiencies in the facilities provided by the Veterinary College with a copy to VCI, if he/she so desire.
- (8) Verification of percentage of passing/failing and deviation from the normal curve of distribution will be subject to scrutiny/ enquiry by the examining body.

ATTENDANCE

- 12. (1) The required condition of attendance shall not be deemed to have been satisfied in respect of the course, unless the student has ordinarily attended all the scheduled theory and practical classes; however, the minimum requirement of attendance shall not be less than 75% (including attendance benefit, if any) of scheduled theory & practical classes separately on the basis of cumulative attendance of ail the courses grouped for a paper for annual examination.
- (2) A candidate having attendance below- 75% in a paper will not be eligible to appear in the annual examination of that paper.
- (3) The percentage of attendance of a student in a course/ paper shall be computed on the basis of the total number of theory and practical classes scheduled between the date of commencement of instructions and date of closing of instructions irrespective of the date of registration. However, for the students who are reverted- back owing to failure in the compartment examination, the attendance shall be counted from the date of declaration of result of compartment examination and the date of closing of instructions.

PROMOTIONS AND FAILURE

- 13. (1) Promotion or failure of a student in a professional year shall be decided only on the basis of aggregate marks of internal and annual board examinations.
- (2) A student shall be promoted to next higher professional class only if he/she has passed in all the papers of his/her class by obtaining at least 50% marks in theory and practical separately (internal and external combined).

- (3) A student should secure over all grade point average (OGPA) of 5.00 out of 10.00 at the end of degree programme to be eligible to get B.V.Sc. & AH. degree.
- (4) A student may also be allowed provisional promotion to next higher class till the declaration of the result of the compartment examination (s). However, this promotion shall be subject to clearance in the compartment examination(s) of that/those paper (s) and shall be provisional. If the student fails in the compartment examination (s), he/she shall stand automatically reverted to the class from where he/she was allowed provisional promotion.
- (5) Failed students shall register again for the entire professional class, they failed. Such students shall have to fulfill all requirements of the class afresh.
- (6) A student failing in the annual examination for three consecutive years in a professional year of B.V.Sc. & AH. degree programme, shall be finally dropped automatically from the University on account of poor academic performance
- (7) In no case, a student shall be allowed to continue his/her B.V.Sc. & AH, studies beyond 8 academic years (16 semesters) in a Veterinary College.

COMPARTMENT EXAMINATION

14. (1) A student failing in a maximum of two papers only may be allowed once to appear in compartment examinations for those paper(s). Compartment examination shall comprise of the external component of both the theory and practical of the failed paper(s), which shall constitute the 100% weightage for that paper(s) and the marks of Internal examination shall not be considered for the evaluation of Compartment Examination.
- (2) The compartment examinations shall be conducted within 20 calendar days after the date the results of the concerned professional year examination declared. The results of such compartment examination shall be declared within 5 days after the examination is conducted.
- (3) In case of failure in any of the compartment paper(s), the student will be reverted back to the previous professional year and will be required to repeat all the requirements of that failed professional year.

SCRUTINY OF ANSWER BOOKS AND RECTIFICATION OF ERRORS

15. (1) There shall be no provisions of re-evaluation of answer book(s).
- (2) A student, however, may be allowed to get his/her answer book(s) scrutinized, for which, the student shall have to apply to Controller of Examination/Coordinator of Examination within three days after the declaration of result and after paying prescribed fee.
- (3) The Controller/Coordinator (Examination) shall arrange the scrutiny of answer book(s) by the Moderation Committee.
- (4) Scrutiny means re-totaling of the marks, and examination of unmarked question(s), if any.
- (5) The answer book(s) of annual examination shall not be shown to the student under any circumstances.
- (6) In case, the total marks are found to be incorrect on scrutiny, the same will be corrected and the result shall be revised accordingly (even if it is towards lower side). If, however, any question is found to be unchecked by the Examiner, the answer book(s) shall be sent to the Examiner for doing the needful and the results) shall be revised accordingly if there occurs any change in the marks
- (7) No representation by the students) shall be entertained regarding the outcome of the result after scrutiny.

- (8) In case a student on the basis of the result of scrutiny becomes eligible for the compartment examination, he/she may apply to the concerned authority to appear in the compartment examination on the announced scheduled date. The scheduled date of the compartment examination shall under no circumstances be changed on this account.

MODERATION

16 (1) Question Paper:

The examining body may appoint a single moderator or a board of moderators not exceeding three in number. The moderators shall review the question papers on the day of examination after they have been distributed. Any corrections needed will be conveyed to the examinees and any discrepancy in the question paper in respect of syllabus noticed will be conveyed to the Controller/Coordinator of Examination in a written report.

(2) The Results:

The Controller/Coordinator of Examination in consultation with the Dean of the College shall form Committee of three members consisting of Dean of the College as Chairman and two other teaching faculty members to moderate the results-obtained at the annual board examination. This Committee shall review the results for the normal distribution of marks, the percentage of pass or failure. Any moderation suggested shall be uniformly applied to all students for that papers) without altering the merit of the passed candidates. Any moderation effected should not involve of enhancing of- more than total of 5 marks in a professional year for a particular candidate, and in no case more than 3 marks in one paper. The provisions for Moderation of results shall not apply to Compartment Examinations There shall be no provision for grace marks in any case.

GRADING AND GRADE POINT AVERAGE

17. (1) Grade Point (GP) in a course will be the total marks obtained by a student out of (100divided by 10
(2) Credit Pont (CP) in a course will be GP multiplied by the credit hours.
(3) Total Credit Points = Sum of the credit points secured.
(4) The Credit Points earned will be zero if the GP In a paper is less than 5.00
(5) Grade Point Average (GPA) = Sum of the Total credit Points earned divided by the sum of Credit Hours.
(6) The corresponding ranking of OGPA with respect to traditional scoring system of Division Ranking shall be as follows:
8.000 and above - First Division with Distinction
7.000 -7.999 - First Division
6.000 - 6.999 - Second Division
5.000 - 5.999 -Pass

Formats of Detailed Marks Certificate (DMC) and Degree Transcript are at Annexure II and III,

REGULATIONS FOR POST-GRADUATE STUDIES



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NAVSARI AGRICULTURAL UNIVERSITY
Post-Graduate Studies

Regulations for Post-Graduate Studies

"IN SUPERSESSION OF ALL THE REGULATIONS FOR POST-GRADUATE TEACHING, THE ACADEMIC COUNCIL WITH THE APPROVAL OF THE BOARD OF MANAGEMENT HEREBY MAKES THE FOLLOWING REGULATIONS FOR POST-GRADUATE STUDIES".

REGULATION NO. 1:

SHORT TITLE AND COMMENCEMENT:

- 1.1** These regulations shall be called "**The Regulations for Post-graduate Studies, 2010**".
- 1.2** They shall come into force from the date on which they are approved by the Board of Management.
- 1.3 Definitions:** In these Regulations, unless the context otherwise requires:
 - 1.3.1 "Academic Year"** consists of two semesters. It starts with the beginning of first semester and ends with the **completion** of second semester.
 - 1.3.2 "Centre"** means a place for imparting training for Post-Graduate Studies in a particular field of study. Department is a unit in the University which combines teaching/research/extension education in a discipline and is strong enough to undertake Post-Graduate Studies. These programmes may be offered from more than one places in the University. Such places will be termed as Centres.
 - 1.3.3 "Course"** is an integral part of the curriculum. It means an organized subject matter in which instructions are offered through a series of lectures and skill orientation (work experience) during a semester.
 - 1.3.4 "Course Credit"** is the quantitative measure of the content of a course of instruction, especially with reference to the value of the course in relation to the total requirements for a degree. A course credit means one hour theory lecture or about two hours of laboratory or field practical per week. In taking a course, a student shall attend a series of lectures, do laboratory/field work and submit assignments and report as required.

- 1.3.5 "Curriculum"** means the aggregate of courses of study given in the University for a particular Field.
- 1.3.6 "Field of Study"** means the specialized subject of knowledge in which Post-Graduate degree is offered by the University.
- 1.3.7 "Grade Point"** means a numerical designation (on 10 point scale) of the relative standard of performance, a student has achieved during the study of a course.
- 1.3.8 "Grade Point Average"** is the weighted average of the grade point earned for the courses offered during the semester.
- 1.3.9 "Programme of Study"** means a series of coherent courses and a research work assigned to a student to provide training to meet the requirements of a degree.
- 1.3.10 "Semester"** means an academic period of 20 to 22 weeks (including semesters end examination) during which a course is completed. There are two semesters in an academic year referred 1.3.1. The semester will be announced in academic calendar every year by the Dean, P. G. Studies. Suitable adjustment in a semester will be made to accommodate *Diwali* and other holidays as notified by the University.

REGULATION NO. 2:

ADMISSION:

2.1 General:

The Navsari Agricultural University offers the following Post-Graduate degrees:

- (i) M.Sc. (Agri.)
- (ii) M.Sc. (Horticulture)
- (iii) M.Sc. (Forestry)
- (iv) M.Sc.
- (iv) M.V.Sc.
- (v) MBA (Agribusiness Management)
- (vi) Ph.D.
- (vii) Such other degrees / P.G. Diploma, the Board may approve from time to time.

2.2 The number of students to be admitted shall be decided, depending upon infrastructural facilities and faculty competence (intake capacity), by the Admission Committee consisting of Head of the Department, Registrar, Dean / Associate Deans

and Dean of Faculty of Post-Graduate Studies, as Chairman, hereinafter referred to as the Dean of P.G. Studies.

2.3 Medium of instruction and examination shall be English.

2.4 The following shall be the field of studies:

(A) Agriculture:

- (1) Agronomy
- (2) Agricultural Chemistry & Soil Science
- (3) Agricultural Economics
- (4) Agricultural Statistics
- (5) Plant Pathology
- (6) Agricultural Entomology
- (7) Genetics and Plant Breeding
- (8) Agricultural Extension
- (9) Plant Physiology & Ecology
- (10) Horticulture
- (11) Biochemistry
- (12) Molecular Biology and Biotechnology
- (13) Seed Science and Technology

(B) Horticulture & Forestry

B1 Horticulture

- (1) Fruit Science
- (2) Vegetable Science
- (3) Floriculture & Landscape Architecture
- (4) Plantation, Spices, Medicinal & Aromatic Crops
- (5) Post Harvest Technology

B2 Forestry

- (1) Wood Science Technology
- (2) Medicinal & Aromatic Plants
- (3) Eco Tourism
- (4) Agro Forestry
- (5) Forest Genetic Resources
- (6) Forest Bio-technology
- (7) Silviculture
- (8) Natural Resource Management

(C) Veterinary Science and Animal Husbandry:

- (1) Anatomy
- (2) Animal Genetics and Breeding
- (3) Animal Nutrition

- (4) Animal Physiology and Bio-chemistry
- (5) Livestock Production
- (6) Parasitology
- (7) Poultry Science
- (8) Reproductive Biology
- (9) Veterinary Extension
- (10) Veterinary Medicine
- (11) Veterinary Microbiology
- (12) Animal Reproduction, Gynecology and Obstetrics
- (13) Veterinary Pathology
- (14) Veterinary Pharmacology & Toxicology
- (15) Veterinary Public Health
- (16) Veterinary Surgery

(D) Master of Business Administration

- (1) Agribusiness Management

(E) Such other fields as the Board may approve from time to time.

2.5 REQUIREMENTS:

2.5.1 (A) A candidate for admission to the Master's degree programme should have the minimum requirement of marks at the Bachelor degree level as under:

Sixty per cent **as per** traditional system, or under O.G.P.A. system 6.0 out of 10.0 (relaxable to **55% or 5.50 out of 10.00** for SC/ST and Government/ University sponsored candidates or candidates with five years experience).

(B) A candidate for admission to the Ph.D. degree programme should **possess Master's degree in respective/related subject with 65% as per traditional system or under O.G.P.A. 6.50 out of 10.00 or its equivalent (relaxable to 60% or 6.0 out of 10.00** for SC/ST and Government sponsored candidates or candidates with five years experience).

(C) In addition to the requirement of marks for admission as mentioned above in 2.5.1 (a & b) the eligibility qualification shall be as under:

Sr. No.	Name of Degree	Eligibility Qualification from recognized University
1.	M.Sc. (Agriculture)	Bachelor's degree in Agriculture/Horticulture /Forestry or equivalent (4 years programme).
2.	M.Sc. (Horticulture)	Bachelor's degree in Horticulture / Agriculture/ Forestry or equivalent (4 years programme).

3.	M.Sc. (Forestry)	Bachelor's degree in Horticulture / Agriculture/ Forestry or equivalent (4 years programme).
4.	M.Sc.	Bachelor's degree in Basic Sciences in related subjects*
5.	M.V.Sc.	Bachelor's degree in Veterinary Science and Animal Husbandry or equivalent (5 years programme)
6.	M.B.A. (Agri-Business Management)	Bachelor's degree in Agriculture/Horticulture/Forestry/Veterinary Sciences &A.H. and Allied disciplines
7.	Ph.D.	Master's degree in the concerned discipline of Agriculture (Agriculture Faculty), Horticulture, Forestry, Veterinary Sciences & Animal Husbandry (Veterinary Faculty) and related discipline / basic sciences**

*** Related subject for M.Sc. Programme means following:**

Sr. No.	Name of Degree	Eligibility Qualification
1.	Agricultural Chemistry & Soil Science	Bachelor's degree in Chemistry
2	Agricultural Economics	Bachelor's degree in Economics/Statistics
3	Agricultural Statistics	Bachelor's degree in Science (Statistics/ Mathematics)
4	Plant Pathology	Bachelor's degree in Microbiology
5	Agricultural Entomology	Bachelor's degree in Zoology
6	Genetics and Plant Breeding	Bachelor's degree in Botany/Seed Science
7	Plant Physiology & Ecology	Bachelor's degree (Botany/Physiology)
8	Molecular Biology & Biotechnology	Bachelors degree in Biotechnology
9.	Seed Science & Technology	Bachelor's degree in Botany/ seed science & Technology
10.	Biochemistry	Bachelor's degree in Chemistry/ Biochemistry

**** Related subject for Doctorate degree Programme means followings:**

Sr. No.	Subject of Doctorate Degree	Eligibility Qualifications
Faculty of Agriculture		
1	Agricultural Chemistry & Soil Science	Master's degree in Chemistry
2	Agricultural Entomology	Master's degree in Zoology
3	Plant Pathology	Master's degree in Microbiology
4	Agricultural Economics	Master's degree in Economics
5	Agricultural Statistics	Master's degree in Science (Statistics /Mathematics)
6	Genetics and Plant Breeding	Master's degree in Pl. Breeding/Botany
7	Plant Physiology	Master's degree Physiology /Botany
8.	Molecular Biology & Biotechnology	Master's degree in Biotechnology
9.	Seed Science & Technology	Master's degree in Botany/ seed science & Technology
10.	Biochemistry	Master's degree in Chemistry/ Biochemistry

(D) **Students having Bachelor degree in basic science (3 years)** will have to make up the professional deficiencies by taking pre-requisites /remedial and supporting courses in first year as prescribed in course curriculum and suggested by the Advisory Committee of the student before registering regular courses. The minimum requirement will be 6 semesters in such cases.

2.5.2 A students getting admission in Ph.D., in the stream other than his/her field of master's level shall have to undertake required pre-requisite courses as decided by the Advisory committee considering the background of the student. The minimum requirement will be 8 semesters in such cases.

If the candidate with Basic Science degree possess PG Diploma in respective field of study need not have to take prerequisite courses.

2.5.3 The admission requirements shall be relaxed by maximum five per cent (5 % from traditional stream and 0.5 OGPA in 10 point system) **on** account of service experience for employee of the University nominated for M. Sc. and Ph. D. study under the scheme of Faculty Competence Improvement sanctioned vide notification No. GAU/ Aca/ 42233-92, dt. 02.08.74; for Navsari Agricultural University in-service candidates as well as employees nominated by State or Central Government or I.C.A.R. or other Universities or Institutes.

2.5.4 Weightage to sport persons.

I.	Participation at the International Level	7%
II.	Participation at National Level/ All India Inter University Level	1%
	(a) Secured 1 st position :	5%
	(b) Secured 2 nd position :	3%
	(c) Secured 3 rd Position :	2%
III.	Participation at the state level :	0.5%
	(a) Secured 1 st position :	1%

2.6 ADMISSION PROCEDURE:

2.6.1 Application received by the Registrar shall be scrutinized by the Committee consisting of Professor in-charge (P.G. Centers in the subject) and Head of the Department concerned (as Convener). The same shall be forwarded to the University in order of preference. The basis of selection of candidate for the admission shall be merit of entrance test examination. Interviews will be taken, if necessary. Based on the merit of entrance test, separate merit list for each subject will be prepared. **Separate merit list for student of Gujarat state and other states students will be prepared.** The admission of the candidates from those recommended by the above Committee will be decided by the admission committee (specified in 2.2) looking to the seats available in each subject. The decision of Dean,P.G. Studies shall be final.

Admissions shall be given at the beginning of **odd semester only** subject to intake capacity and other facilities available. Regular advertisement will be published once a year for the P.G. admission.

- 2.6.1 (A)** The admission for Master's and Doctoral degrees shall be on the basis of merit of entrance test.
- (B)** For admission to Master's degree entrance test paper shall be drawn from syllabus of group of all the subjects of the faculty.
- (C)** For admission to M.Sc. a common paper shall be drawn from related subjects.
- (D)** For admission to Ph.D. degree paper shall be drawn subject-wise.
- (E)** Navsari Agricultural University in-service trainees as well as employees nominated by State or Central Government or ICAR or Other Agricultural Universities or Institutes shall not be required to appear in the entrance test.

2.6.2 (A) Reservation of seats:

Sr. No.	Category	Percentage of total seats
1.	Non resident of Gujarat/ ICAR / nominees of Govt. of India / other State / other Agril. Universities/ Basic Science and Technology.	30
2.	Schedule Caste	7
3.	Schedule Tribe / Nomadic Tribe and Notified Tribe	15
4.	SEBC (Defined by Baxi commission and Mandal Punch as determined from time to time and specified by Government of Gujarat)	27
5.	Disabled (physically handicapped)	3

However, if sufficient number of candidates of above categories is not available, the vacant seats will be filled up by candidates who are residents of Gujarat in order of their merit. Similarly, vacant seats of candidates meant for residents of Gujarat will be filled up by candidates who are non residents of Gujarat, nominees of Government of India, other State Governments, Agricultural Universities and ICAR and Basic Science candidates on merit basis. Vacant seats of Scheduled Castes and Scheduled Tribes will filled up by other candidates on merit basis.

- (B)** (i) If an employee of any State Government, Government of India, ICAR, any University other than Navsari Agricultural University and Public/Co-operative Organization is permitted by his/her department to continue her/his service and submits NOC for specific time to avail admission for higher studies leading to Master's degree or Ph.D. shall be admitted (i) on merit basis on seats reserved for the nominees of employees of Government etc. as per Regulation No. 2.6.2 (a) and (ii) subject to fulfillment of the residential and other requirements of admission in P.G. programme. (ii) SC/ST and SEBC candidates who are able to secure admission on merit in general quota shall not however, be counted

against the seat reserved for them. Reservation of SC/ST seats shall be interchangeable among SC/ST candidates.

A candidate availing benefit of the reserved seats as specified above shall be required to produce the certificate of his /her belonging to a particular group from the competent authority of the concerned state. In case of any doubts or discrepancy about the castes/classes/group, the decision of the competent authority of the concerned state shall be treated as final. As SEBC candidate (belonging to Baxi Commission) shall have to produce current year "not belonging to creamy layer" certificate from competent authority.

2.6.3 From amongst the recognized Post-Graduate guides at College, the Dean of Post-Graduate Studies will appoint a Professor as P.G. Center I/C for the purpose of Post-Graduate studies at college level. However, the Head of the Department will be responsible for efficient functioning of Post-Graduate studies of his/her subject in the University.

2.6.4 On registration of the student at college and payment of fees, he/she will be allotted to the recognized Guide by Dean PG studies in consultation with Dean of the faculty. The major Guide/Advisor will propose the advisory committee for student which will be recommended by Dean of the faculty and will be approved by Dean PG studies.

REGULATION NO.3: REGISTRATION:

3.1 Nothing in this regulation shall effect the enrolment of a candidate for any Post-Graduate study already made under the Regulation hereby superseded.

3.2 A candidate selected for admission shall report to the Principal of the concerned College on the date specified by the University for the purpose of First Registration.

3.3 (A) The admission of the candidate who failed to report to the concerned College on the specified date shall be treated as cancelled and the vacant seats will be allotted to the next candidate on the waiting list.

(B) A candidate who is not in a position to report for first registration on the specified date due to unavoidable circumstances may register by paying fees through post or by messenger on or before the date specified for registration.

(C) A candidate registered in the first semester by payment of fees must complete the registration of course within a period of ten days from the date of his registration failing which his / her admission shall be treated as cancelled.

3.4 The First Registration shall consist of the following:

- (1) Payment of Fees.
- (2) Orientation.
- (3) Registration for courses.

However, this should not be considered for residential requirement if permitted by Dean, Post-Graduate Studies.

- 3.5** (A) Registration requirements for the subsequent semesters shall also be the same except for the orientation. However, the fees shall have to be paid within a month from the commencement of the semester, failing which his/her registration for that semester shall stand cancelled.

The registration in person for subsequent semester should be completed within the first three days of beginning of the semester failing which a fine of Rs.25/- (Rupees twenty five only) per day will have to be paid by the students missing registration up to the period of 30 days.

(B) A Post-Graduate student in any degree programme be re-registered within a period of three years at his / her own risk in the same semester from which he/she gave up his/her studies, provided that no disciplinary action should have been taken against such a student during his/her career at the College. This period of absence will be calculated from the date on which he/she left the College. Only one such chance will be given for revival of registration to the student who gives up the studies.

(C) If an enrolled P.G. student joins a regular service before submitting thesis; his / her registration shall automatically be cancelled. The major guide will report this immediately to the University.

- 3.6** A student enrolled in the University shall be given a registration number, which shall be used along with his name in all the documents and correspondence pertaining to him/her.

For the student who has revived his/her study and re-registered his/her old registration No. will be continued and the year of re-registration will be shown with old registration number.

- 3.7** An Identity Card shall be issued to each registered student on completion of first registration. The student shall carry it with him / her at all times and should show the same when it is asked for. In case the Identity Card is lost, a new card may be issued to him/her on payment of Rs.50/- It shall be obligatory on part of student to surrender the Identity Card on Completion of his / her studies.

REGULATION NO.4:

FEES, DEPOSITS, etc.:

- 4.1** The fees, deposits *etc.* payable by the candidates for Post-Graduate Studies shall be as prescribed by the Navsari Agricultural University, time to time.
- 4.2** The Girls students are exempted from Tuition fee and Hostel fee.

REGULATION NO.5:

CURRICULA AND COURSES:

- 5.1** Additions, Deletions, Dropping, Substitution and Completion of Courses:

(A) Addition, substitution and deletion of course(s) shall be permitted by the Dean, P.G. Studies on the recommendation by the advisory committee, Head of

Department and Dean of respective faculty with due justification **under the intimation of the Exam branch of Registrar office.**

- (B) Dropping of a course in a semester shall be permitted by the Dean, P.G. Studies on the recommendation by the advisory committee, Head of Department and Dean of respective faculty with due justification within six weeks from the commencement of a semester on recommendation of Major Guide **under the intimation of the Exam branch of Registrar office. However student has to earn 'D' grade for that course in that semester evaluation report (mark sheet).**
- (C) A student shall be deemed to have cleared and completed a course if he/she attended the lectures and laboratory / field work and has completed all such other necessary requirements for the course and has obtained a requisite grade point.
- (D) A student securing less than **6.00 and 6.50 grade point (60 percent marks/65 per cent marks) for Master & Doctorate degree, respectively** in a course shall be considered to have failed to pass that course and shall have to repeat the course.

The repetition of particular course shall be allowed only twice **(1 regular + 2 trials)** to obtain the minimum required grade point. **Failing on this, registration of the student will stand cancelled automatically.**

5.2 System of Evaluation:

- (A) The different types of examination and weightage for each shall be as follows from August, 2010.

Sr. No.	Examination	Weightage
1.	Self Study (Assignments)	20%
2.	Tests	30%
3.	Semester End Examination	50%

N.B.: Wherever applicable equal weightage of practical will be given in test and semester end examination.

- (B) Each of the courses shall be of 100 marks (Theory and practical combined). The mode of evaluation and weightage for each course shall be as shown in 5.2(A). The score secured by candidate out of total of 100 marks in a course shall be converted to equivalent grade under 10.00 point system to represent the grade point for that course.

The following method/mode of marking also shall be shown by the teachers / examiners in the Students Performance Report.

For Master's Degree

Grade	Significance	Remarks
6.00 and above	Pass	--
Below 6.00	Fail	--
D	Drop	--
I	Incomplete	--
W	Withdrawn	--
S	Satisfactory	For six comprehensive courses and thesis credits
US	Unsatisfactory	

For Doctorate degree

Grade	Significance	Remarks
6.50 and above	Pass	--
Below 6.50	Fail	--
D	Drop	--
I	Incomplete	--
W	Withdrawn	--
S	Satisfactory	For six comprehensive courses and thesis credits
US	Unsatisfactory	

- (C) Grade Point Average (GPA) is the sum of the products of credits of course and the grade point obtained in that course is divided by the total number of credits of the different courses offered in the semester *i.e.*

$$\text{GPA} = \frac{G1C1 + G2C2 + G3C3}{C1 + C2 + C3} = \frac{\text{Total Grade Point}}{\text{Total Credits}}$$

The Cumulative Grade Point Average (CGPA) obtained by the student upto the end of a particular semester shall be calculated by dividing the sum of the products of the grade point average and the credits in each semester by the total credits completed upto the end of that semester.

A grade point below **6.00** in a course shall be counted in working GPA for that semester. However, on revision of the grade point after repeating that course the earlier grade point shall be replaced by the revised grade point average and CGPA/OGPA shall be recalculated.

The revised grade point shall substitute the original grade point and the same will be counted in working out the OGPA/CGPA for the purpose other than the award of the scholarship / freeship / fellowship or for competing for a Certificate of honor or of a position.

The course cleared by more than one trial shall be shown as repeat course in the transcript **as well as in the evaluation report of that semester (mark sheet).**

- (D) A student shall have to appear at the examination to be announced by the teachers concerned in the course(s) in which he / she has registered. Absence from the test examination account of valid reason and prior permission of **major guide, course teacher and Dean** shall be sufficient cause to award **W**

grade and the student shall have to clear that course in the subsequent semesters.

However, absence from the test examination without valid reason and prior permission of Dean shall be sufficient to award **I** grade and the student shall have to clear that course in the subsequent semesters as a repeated course.

For Seminar, if student is unable to clear seminar with due justification within six weeks from the commencement of a semester on recommendation of Major/Minor Guide, shall be sufficient cause to award 'W' grade and the student shall have to clear that course in the subsequent semesters. However, absence from the seminar without valid reason and prior permission of Dean shall be sufficient cause to award **I** grade and the student shall have to clear that course in the subsequent semesters as a repeated course.

(E) A teacher shall be responsible for evaluating the student's performance and maintaining the history of the material covered in the courses by system of tests, term papers, skill orientated practicals, assignments and semester end examination.

(F) **Academic probation:**

(1) A student shall be required to maintain the CGPA of not less than **6.50** in order to be eligible for continuance as regular enrolled student of the University.

(2) If the CGPA of a student is less than **6.50** at the end of a semester, he/she shall be placed on the Academic Probation.

(3) If the CGPA of student at the end of a semester in which he/she was on academic probation is **6.50** or higher he/she shall be removed from the academic probation and shall be allowed to continue as a regular enrolled student. Otherwise he/she will continue to be on academic probation till he/she obtains the OGPA of **6.50** and above by taking additional courses even after the fulfillment of the prescribed courses.

5.3 Award of Class:

The award of a class to a student shall be based on OGPA (Overall Grade Point Average) obtained by him/her and shall be indicated in the Master's degree certificate. The basis of the award of class shall be as under.

Overall Grade Point Average	Class
8.00 and above	First Class with Distinction
7.00 to 7.99	First Class
6.50 to 6.99	Second Class

REGULATION NO.6.: REQUIREMENTS:

6.1 Master's Degree:

A student enrolled for Master's degree programme has:

- (A) To earn a minimum of 35 credit hours (Major subject 20 credits(Minimum), Minor subject, 9 credits (minimum), Supporting subject 5 credit (minimum), a seminar, 1 credit (minimum) plus credits of allied and /or special problems other than pre-requisite and /or supporting courses adjudged necessary by the Advisory Committee). In addition to 35 minimum course credits student has to earn 20 credits of thesis which will be granted as Satisfactory/Unsatisfactory.
- (B) To pass six comprehensive courses of one credit each as given below is compulsory which is to be granted as Satisfactory/ Un-satisfactory.

Sr.No.	Course	Credits
1	Library and Information Services	(0+1)
2	Technical Writing and Communication Skills	(0+1)
3	Intellectual Property and its Management in Agriculture (e-course)	(1+0)
4	Agril. Research, Research Ethics and Rural Development Programme (e-course)	(0+1)
5	Basic Concepts in Laboratory Techniques	(0+1)
6	Disaster Management (e-course)	(1+0)

- (C) To clear the qualifying examination.
- (D) To submit an acceptable thesis based on an approved research project conducted satisfactorily as adjudged by the examiner for the award of degree. However, once the thesis (*Kachcha* bound) is submitted by the student no fees should be charged even though the thesis viva is not completed as all the requirements are over on submission of thesis. **However, minimum residential requirement of the student with registration and payment of fees must be completed.**
- (E) Having to complete minimum residential requirements of 4 semesters for general students and students having degree in basic science along with Diploma, while 6 semesters for the students coming from Basic Science stream and for in-service students.
- (F) Maximum duration for Master's degree is 8 semester for fresh candidates.

6.2 Doctorate Degree:

Award of degree of Doctor of Philosophy shall be on the evidence of:

- (A) Having earned a minimum of 30 course credit hours (Major subject 15 credits (minimum), Minor subject, 8 credits (minimum), supporting subject, 5 credit (minimum), Seminar, 2 credits (minimum), (one in major and one in minor field) plus credits of allied and / or special problems. Thus, the student has to earn a total of 30 credits other than already earned in Master's degree and Pre-requisite and / or supporting courses adjudged necessary by the advisory committee. **In addition to this 30 minimum course credits, student has to earn 45 credits of thesis.**
- (B) **Having passed six comprehensive courses of one credit each** is compulsory, if not cleared at Master's level.
- (C) Having cleared the qualifying examination.

- (D) Having submitted an acceptable thesis based on original research work conducted satisfactorily as adjudged by the examiners, once the thesis (*Kachcha* bound) is submitted by the student, no fees should be charged even though the thesis viva is not completed as all the requirements are over on submission of thesis, **However, minimum residential requirement of the student with registration and payment of fees must be completed.**
- (E) Having completed minimum residential requirements of 6 semesters after Master's degree for students of concerned faculties and 8 semesters for the students coming from Basic science stream and for the In-service students.
- (F) Maximum duration for Doctorate degree is 12 semester for fresh candidates.

6.3 (A) Cases of in-service post-graduate M.Sc. and Ph.D. students requiring extension up to two semesters in addition to normal period shall be granted by the Principal of concerned colleges on recommendation of the Advisory Committee. For further extension, cases shall be forwarded to the Registrar with recommendation of the Advisory Committee and the Principal of respective college. Registrar will scrutinize and put up all such cases with the remarks to the Dean P.G. Studies for consideration and approval. Such extension up to maximum period of two semesters in either case shall be granted. **For further extension, cases with document of work done shall be forwarded to the Vice-Chancellor with recommendation of Registrar and Dean P.G. for consideration and approval of 2 semester extension.**

If student does not complete the study within the extended period, he/she shall have to complete the remaining requirements of study by proceeding on leave due to him/her (limitation of 3 months only). Amount of Bond will be recovered from the candidate for incompleteness of study.

- (B) The cases shall be reviewed after 4 semesters by the major guide who will report to the Dean of the concerned faculty about taking courses during each semester. If a student has not taken any course during any one semester before completing a course work his/her registration will stand cancelled. Principal will report the same to Dean, Post-Graduate Studies and Registrar.

REGULATION NO.7:

PROGRAMME OF STUDY:

- 7.1** Every student shall have a Major guide from his Major Field of study. He shall be the Chairman of Advisory Committee of minimum four members from his Major, Minor and Allied field of study. **The major guide will propose committee in consultation with Head of Department and Senior PG Teachers of the centre, Dean of faculty will recommend and Dean PG will approve the committee.** The committee shall draw out the programme of study keeping in view the student's academic background, within the ten days of the starting of the first semester and the report to this effect will be sent to the Dean of Post-graduates Studies, through the Principal.

- 7.2 The research problem of the student may be complementary to the Department/ University research programme and shall be decided by the Major guide in consultation with the Head of Department and senior most P.G. teacher in the subject of the Centre. The outline of the thesis work (synopsis) shall be discussed in the presence of teachers of major field of study in addition to **the committee members** and be communicated to the Dean of Post-Graduate studies **for approval** before the end of **first/Second** semester.
- 7.3 A student shall not normally be allowed to take more than **18 credits** courses in a semester. **A recipient of an assistance ship/fellowship of project and In-service candidates shall not be allowed to take more than 9 credits (for Masters) / 6 credits (for Doctorate) courses in a semester.**

REGULATION NO.8:

QUALIFYING EXAMINATION:

8.1 On completion of **75% course work separately in major and minor subjects** the candidate will be eligible to appear in qualifying examination. The qualifying examination for Master's and Ph.D. degree will consist of a written examination in addition to viva-voce. For Master degree, there shall be one paper in major field including allied courses of the study and another paper in minor field of the study. The paper in major and minor field of study shall be drawn by major and minor guide, respectively. **For Ph.D degree, there shall be two papers in major field including allied courses of the study and another paper in minor field of the study. The paper in major and minor field of study shall be drawn by major and minor guide, respectively. (Qualifying marks for this examination will be 60%). In both the degrees paper setting will be internal but evaluation will be by external examiner from other than advisory committee members from SAUs, The grading will be Satisfactory / Unsatisfactory.** The viva-voce exam (prelim) will be conducted by the Advisory Committee after obtained permission from the Dean of Post-Graduate Studies through Principal.

For Ph.D. however, one more member will be nominated in addition to the Advisory Committee by the Dean of Post-Graduate Studies, for the purpose of qualifying examination. The Chairman of the Advisory Committee will communicate the result of examination to the Dean Post-Graduate Studies.

The candidate shall be declared successful only if the decision of the Advisory Committee (with additional member in case of Ph.D.) is unanimous.

- 8.2 A candidate failing to pass the qualifying examination will be eligible to reappear in the said examination for a maximum of two additional trials only spaced at intervals of not less than 3 months.
- 8.3 **For Master degree, student has to present a seminar on his / her thesis work before submitting the thesis.**
- 8.4 **For doctorate degree, (a) student has to present a seminar on his / her thesis work and (b) one research paper should have been accepted and second submitted or one patent filed out of thesis work.**

8.5 After completion of above requirement, candidate shall be eligible to submit the thesis.

If the thesis work and all requirements of the PG study are completed by end of 3rd semester (Master degree) and end of 5th semester (doctorate degree), thesis can be submitted, however, degree will be awarded only after completion of minimum residential requirements.

REGULATION NO.9:

THESIS AND FINAL EXAMINATION:

9.1 Master's Degree:

The thesis submitted in partial fulfillment of the Master's degree shall be evaluated by the external referees from outside the University who shall be appointed by the Dean of Post-Graduate Studies from a panel of three persons suggested by the Principal of respective colleges. The external referees shall examine the thesis and send his/her report to the Dean of Post-Graduate studies **and Registrar** under intimation to the Major guide normally within 4 weeks from the date of receipt of the thesis. On receipt of the report from the external referees by the Dean Post-Graduate Studies, the candidate will be examined orally on the thesis giving due weightage to the report of external referee, **by the Advisory committee and one teacher from the Major field** nominated by the Dean of Post-Graduate Studies who will present their final report on thesis examination to the Dean of Post-Graduate Studies through the Principal of the College. However, the Dean of Post-Graduate Studies if convinced of the need for inviting the external referee to hold viva-voce examination he may invite external referee for viva-voce examination instead of one teacher to be nominated by him. In case the examiners do not agree with the report of the external referee, the Dean of Post-Graduate Studies may obtain opinion of any second referee whose opinion will be considered as final.

9.2 Doctorate Degree:

- (1)** The thesis submitted in partial fulfillment of Ph.D. degree shall be examined by the two external referees appointed by the Dean of Post-Graduate Studies, from a panel of five experts suggested by the Principal of respective colleges. The referees shall evaluate the thesis and shall submit their report to the Dean of Post-Graduate Studies **and Registrar** under intimation to the Principal of respective colleges normally within 6 weeks from the date of receipt of the thesis. If one of the external referees does not recommend the acceptance of the thesis, a third external referee from the same panel shall be appointed. **If third referee also does not recommend the thesis for acceptance the candidate shall be declared to have failed and no oral examination shall be conducted. If both the external referees recommend acceptance of the thesis, the final oral examination shall be conducted by a committee consisting of major, minor advisors, one of the appointed external referees as decided by the Dean of Post-Graduate Studies and one referee from major subject nominated by the Dean of Post-Graduate Studies from SAUs of Gujarat state.**
- (2)** The candidate is expected to defend the thesis work at the examination. The degree shall be awarded on unanimous recommendation of the examiners in respect of the

thesis itself and the performance of the student in the oral examination. The recommendation of the examiners shall be forwarded by the Major guide to the Dean Post-Graduate Studies through the Principal of the College.

9.3 Technical queries raised by external referee should be thoroughly discussed in the viva voce exam of thesis and its detailed report signed by all the examiners shall be submitted along with the result.

All evaluation reports, mark sheets, transcript and other certificates (except Degree Certificate) shall be issued under the signature of the Registrar.

સ્ટાફની પરિસ્થિતિ દર્શાવતું ત્રિમાસિક ચાર્જપત્રક તારીખ : ૦૧/૦૧/૨૦૧૫ થી ૩૧/૦૩/૨૦૧૫ અંતિત

યુનિટનું નામ:- વેટરનરી કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોનપ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ઘોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧	૧૨	૧૩	૧૪	૧૫	૧૬	૧૭	૧૮	૧૯	૨૦
૧	એસ્ટાબ્લીશ મેન્ટ ઓફ વેટરનરી સાયન્સ એન્ડ એનીમલ હસબન્ડરી કોલેજ, ફેઝ-૩, નવસારી બ.સ. ૧૨૪૦૪	પ્લાન	આચાર્ય	૧	-	વેટરનરી સર્જરી અને રેડીયોલોજી	૩૭૪૦૦- ૬૭૦૦૦/ ગ્રે.પે. ૧૦૦૦૦	૧. ડૉ. નરેશકુમાર હસમુખલાલ કેલાવાલા	વેટરનરી સર્જરી અને રેડીયોલોજી	૦૮/૦૨/૧૯૬૪	૨૬/૦૮/૧૯૮૬	૨૨/૦૧/૨૦૦૮	૦૮/૧૦/૨૦૦૭	-	૨૮/૦૨/૨૦૨૬	નવસારી	બ.પંચ	સુરત	
૨			પ્રાધ્યાપક	૧૫	૦૬	એલપીએમ	૩૭૪૦૦- ૬૭૦૦૦/ ગ્રે.પે. ૧૦૦૦૦	૧. ડૉ. અન્નાસાહેબ ભાઉરાવ ફુલસોદર	એલપીએમ	૦૧/૦૬/૧૯૫૩	૦૨/૦૬/૧૯૭૮	૧૪/૧૦/૨૦૧૪	૦૫/૦૩/૨૦૧૧	-	૩૦/૦૬/૨૦૧૫	નવસારી	જનરલ	અહમદનગર	
			"			વે. પબ્લીક હેલ્થ	"	૨. ડૉ. ચંદુભાઈ વીરજીભાઈ સાવલીયા	વે. પબ્લીક હેલ્થ	૦૧/૦૬/૧૯૬૨	૧૭/૮/૧૯૮૭	૦૬/૦૭/૨૦૧૦	૦૫/૧૧/૨૦૦૮	-	૩૦/૬/૨૦૨૪	નવસારી	જનરલ	અમરેલી	
			"			એજીબી	"	૩. ડૉ. બાલકૃષ્ણા પ્રતાપચંદ્રજી બ્રહ્મક્ષત્રિ	એજીબી	૨૦/૦૮/૧૯૬૨	૦૬/૮/૧૯૮૫	૧૩/૦૭/૨૦૧૦	૨૮/૧૦/૨૦૦૮	-	૩૦/૮/૨૦૨૪	નવસારી	જનરલ	ભરૂચ	
			"			ફાર્માકોલોજી	"	૪. ડૉ. શૈલેષ કાન્તિભાઈ ભાવસાર	ફાર્માકોલોજી	૧૦/૦૮/૧૯૬૫	૦૫/૦૬/૧૯૮૮	૦૭/૦૪/૨૦૧૧	૦૮/૧૦/૨૦૦૭	-	૩૦/૮/૨૦૨૭	નવસારી	જનરલ	મહેસાણા	
			"			ફીઝીયોલોજી / બાયો કેમેસ્ટ્રી	"	૫. ડૉ. સંધ્યા સુનિલ ચૌધરી	ફીઝીયોલોજી / બાયો કેમેસ્ટ્રી	૧૦/૧૧/૧૯૬૩	૧૧/૦૮/૧૯૮૬	૧૧/૦૪/૨૦૧૧	૧૦/૦૮/૨૦૦૭	-	૩૦/૧૧/૨૦૨૫	નવસારી	જનરલ	ઈન્દોર (મ.પ્રદેશ)	
			"			વેટ. સર્જરી (ટીવીસીસી)	"	૬. ડૉ. વિજેન્દ્રસિંહ હુકમચંદ ડબાસ	વેટ. સર્જરી ટીવીસીસી	૧૪/૧૦/૧૯૬૫	૦૪/૦૮/૧૯૮૮	૩૧/૦૩/૨૦૧૧	૨૮/૦૮/૨૦૦૭	-	૩૧/૧૦/૨૦૨૭	નવસારી	જનરલ	દિલ્હી	
			"			વેટરનરી સર્જરી અને રેડીયોલોજી	"	૭. ડૉ. જયંતિલાલ નાથાલાલ મિસ્ત્રી	વેટરનરી સર્જરી અને રેડીયોલોજી	૦૧/૦૬/૧૯૫૫	૦૧/૦૮/૧૯૮૨	૧૧/૪/૨૦૧૧	૧૩/૦૬/૨૦૦૭	-	૩૦/૬/૨૦૧૭	નવસારી	ઓબીસી	મહેસાણા	
			"			એક્ષટેન્શન	"	૮. ડૉ. સુનિલ રામભાઈ ચૌધરી	એક્ષટેન્શન	૦૮/૦૧/૧૯૬૩	૧૧/૦૮/૧૯૮૬	૧૧/૦૪/૨૦૧૧	૦૩/૦૧/૨૦૦૮	-	૩૧/૦૧/૨૦૨૫	નવસારી	જનરલ	અકોલા (મહારાષ્ટ્ર)	ડી.આર.ઓફિસમાં એ.ડી.આર. તરીકેની કામગીરી
			"			મેડીસીન	"	૯. ડૉ. રમેશચંદ્ર માધવલાલ પટેલ	મેડીસીન	૧૨/૧૧/૧૯૬૩	૧૬/૦૮/૧૯૮૭	૧૬/૧૦/૨૦૧૨	૧૩/૦૬/૨૦૦૭	-	૩૦/૧૧/૨૦૨૫	નવસારી	જનરલ		

નોંધ:- પ્રાધ્યાપક :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે પ્રાધ્યાપકની કુલ જગ્યા-૧૭ મંજૂર થયેલ છે જેમાંથી ૦૨ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ ૨જી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૮૧- ૨૮૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી પ્રાધ્યાપકની મંજૂર થયેલ કુલ જગ્યા-૧૫ દર્શાવવામાં આવેલ છે તેમજ ૦૧ જગ્યા રદ કરવામાં આવેલ છે. તો કુલ મંજૂર થયેલ જગ્યા ૧૫ + ૨૬ થયેલ જગ્યા ૦૧=૧૬ થાય છે. તો એબેયન્સમાં મુકવામાં આવેલ બીજી ૦૧ જગ્યાને કોઈપણ જગ્યાએ દર્શાવેલ નથી.તેમજ ૨૬ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ	
૩.			સહ પ્રાધ્યાપક	૧૧	૦૫	માઈક્રોબાયોલોજી	૩૭૪૦૦-૬૭૦૦૦ ગ્રેડ પે.૯૦૦૦	૧. ડૉ. ઈરસાદઉલ્લાખાન હબીબઉલ્લાખાન કલ્યાણી	માઈક્રોબાયોલોજી	૨૪/૧૨/૧૯૬૫	૧૯/૦૩/૧૯૯૦	૨૫/૦૬/૨૦૧૦	૦૮/૧૦/૨૦૦૭	ઓક્ટો-૨૦૦૧	૩૧/૧૨/૨૦૨૭	નવસારી	જનરલ	સાબરકાંઠા		
			"			એક્ષટેન્સન		૨. ડૉ. મનોજ રમેશચંદ્ર ભટ્ટ	એક્ષટેન્સન	૦૪/૦૭/૧૯૬૪	૨૨/૦૩/૧૯૯૫	૩૧/૦૩/૨૦૧૧	૦૮/૧૦/૨૦૦૭	૨૯/૦૮/૨૦૦૨	૩૧/૭/૨૦૨૬	નવસારી	જનરલ	ખેડા	પુલના ધોરણે NMCA	
			"			-	ગાયનેકોલોજી		૩. ડૉ. ચંદુભાઈ તલશીભાઈ ખસતિયા	ગાયનેકોલોજી	૦૧/૦૧/૧૯૭૦	૧૧/૦૪/૨૦૦૭	૦૨/૦૪/૨૦૧૧	૦૮/૧૦/૨૦૦૭	૨૭/૦૭/૨૦૦૨	૩૧/૦૧/૨૦૩૨	નવસારી	ઓબીસી	ભાવનગર	
			"			ફીઝીયોલોજી/ બાયોકેમેસ્ટ્રી		૧૫૬૦૦-૩૯૧૦૦ ગ્રેડ પે.૮૦૦૦	૪. ડૉ. ગોપાલ પુરી રઘુવંશી	ફીઝીયોલોજી/ બાયોકેમેસ્ટ્રી	૧૦/૦૬/૧૯૭૧	૨૭/૦૨/૨૦૧૨	૨૭/૦૨/૨૦૧૨	૨૮/૦૬/૨૦૧૨	ઓક્ટો-૨૦૦૧	૩૦/૦૬/૨૦૩૩	નવસારી	જનરલ	દોસા	
			"			પેરાસાયટોલોજી		૩૭૪૦૦-૬૭૦૦૦ ગ્રેડ પે.૯૦૦૦	૫. ડૉ. જયેશ બાબુલાલ સોલંકી	પેરાસાયટોલોજી	૨૩/૦૧/૧૯૭૪	૨૪/૦૧/૨૦૧૨	૨૪/૦૧/૨૦૧૨	૨૧/૦૬/૨૦૧૧	-	૩૧/૦૧/૨૦૩૬	નવસારી	એસ.સી.	ગાંધીનગર	આચાર્ય, પોલીટેકનીક કોલેજ, નવસારી તરીકે ફરજ ઉપરાંત વધારાનો ચાર્જ સંભાળે
			"			એક્ષટેન્સન એજ્યુકેશન	૩૭૪૦૦-૬૭૦૦૦ ગ્રેડ પે.૯૦૦૦	૬. ડૉ. ઓમ પ્રકાશ શર્મા	એક્ષટેન્સન એજ્યુકેશન	૧૧/૦૩/૧૯૭૨	૧૬/૦૨/૨૦૦૯	૦૧/૦૨/૨૦૧૩	૧૩/૧૧/૨૦૦૯	ડીસે-૧૯૯૬	૩૧/૦૩/૨૦૩૪	નવસારી	જનરલ	જયપુર		

નોંધ:- સહ પ્રાધ્યાપક :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે સહ પ્રાધ્યાપકની કુલ જગ્યા- ૨૬ મંજૂર થયેલ છે જેમાંથી ૧૫ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નક્યુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી સહ પ્રાધ્યાપકની મંજૂર થયેલ કુલ જગ્યા-૧૧ દર્શાવવામાં આવેલ છે તેમજ ૧૫ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ રદ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

૪			મદદનીશ પ્રાધ્યાપક	૫૦	૦૬	વેટરનરી ફીઝીયોલોજી	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૧. ડૉ. અરૂણકુમાર શર્મા	વેટરનરી ફીઝીયોલોજી	૦૪/૧૦/૧૯૭૫	૨૭/૦૧/૨૦૦૯	૨૭/૦૧/૨૦૦૯	૨૭/૦૭/૨૦૦૯	જુન-૨૦૦૪	૩૧/૧૦/૨૦૩૭	નવસારી	જનરલ	બીકાનેર	
			"			એનાટોમી		૨. ડૉ. આર. મેનકા	એનાટોમી	૦૯/૦૫/૧૯૭૬	૨૨/૦૧/૨૦૦૯	૨૨/૦૧/૨૦૦૯	૨૦/૧૧/૨૦૦૯	જુન-૨૦૦૪	૩૧/૦૫/૨૦૩૮	નવસારી	જનરલ	નમકલ્લ	
			"			એલ.પી.એમ.		૩. ડૉ. રાણા રણજિતસિંહ	એલ.પી.એમ.	૨૬/૦૩/૧૯૭૭	૨૪/૦૨/૨૦૦૯	૨૪/૦૨/૨૦૦૯	૨૦/૧૧/૨૦૧૩	એપ્રિલ-૨૦૦૭	૩૧/૦૩/૨૦૩૯	નવસારી	જનરલ	સીતામઢી	
			"			વેટરનરી પેથોલોજી		૪. ડૉ. પ્રીતી દિલીપસિંહ વિહોલ	વેટરનરી પેથોલોજી	૦૧/૦૨/૧૯૮૩	૧૭/૦૧/૨૦૦૯	૧૭/૦૧/૨૦૦૯	૨૭/૦૭/૨૦૦૯	એપ્રિલ-૨૦૦૯	૨૮/૦૨/૨૦૪૫	નવસારી	જનરલ	બનાસકાંઠા	
			"			એઆરજીઓ		૫. ડૉ. ચંદ્રકાન્ત કુલજીભાઈ ચૌધરી	એઆરજીઓ	૧૮/૦૯/૧૯૭૮	૨૨/૦૧/૨૦૦૯	૨૨/૦૧/૨૦૦૯	૨૭/૦૭/૨૦૦૯	એપ્રિલ-૨૦૦૭	૩૦/૦૯/૨૦૪૦	નવસારી	ઓબીસી	મહેસાણા	
			મદદનીશ પ્રાધ્યાપક			વેટરનરી પેરાસાયટોલોજી		૬. ડૉ. નિરંજન કુમાર	વેટરનરી પેરાસાયટોલોજી	૨૬/૦૧/૧૯૭૯	૨૩/૦૩/૨૦૦૯	૨૩/૦૩/૨૦૦૯	૩૦/૧૧/૨૦૦૯	એપ્રિલ-૨૦૦૭	૩૧/૦૧/૨૦૪૧	નવસારી	જનરલ	મુજફરપુર	
			"			વેટરનરી માઈક્રોબાયોલોજી		૭. ડૉ. ધર્મેશકુમાર રમેશભાઈ પટેલ	વેટરનરી માઈક્રોબાયોલોજી	૦૩/૦૭/૧૯૭૪	૧૬/૦૨/૨૦૦૯	૧૬/૦૨/૨૦૦૯	૨૦/૧૧/૨૦૦૯	ઓક્ટોબર-૨૦૦૧	૩૧/૦૭/૨૦૩૬	નવસારી	જનરલ	અમદાવાદ	
			"			એ.એચ.ઈ.		૮. ડૉ. દુર્ગા રાની વિશ્વામિત્રન	એ.એચ.ઈ.	૨૩/૦૫/૧૯૭૮	૨૭/૨/૨૦૦૯	૨૭/૨/૨૦૦૯	૦૯/૦૨/૨૦૧૦	એપ્રિલ-૨૦૦૯	૩૧/૫/૨૦૪૦	નવસારી	ઓબીસી	કોલ્લમ	
			"			વેટરનરી માઈક્રોબાયોલોજી		૯. ડૉ. કિશનકુમાર શર્મા	વેટરનરી માઈક્રોબાયોલોજી	૦૧/૦૮/૧૯૭૬	૨૨/૦૧/૨૦૦૯	૨૨/૦૧/૨૦૦૯	૩૦/૧૧/૨૦૦૯	જુન-૨૦૦૪	૩૧/૦૮/૨૦૩૮	નવસારી	જનરલ	બીકાનેર	
			"			એ.જી.બી.		૧૦. ડૉ. મમતા જનમેદા	એ.જી.બી.	૦૪/૦૩/૧૯૮૧	૨૩/૦૭/૨૦૦૯	૨૩/૭/૨૦૦૯	૩૦/૧૧/૨૦૦૯	સપ્ટેમ્બર-૨૦૧૦	૩૧/૩/૨૦૪૩	નવસારી	જનરલ	રાજકોટ	
			"			મેડીસીન		૧૧. ડૉ. સુરેશ વાઘજીભાઈ માવડીયા	મેડીસીન	૦૫/૦૫/૧૯૮૪	૧૭/૦૬/૨૦૧૦	૧૭/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૩	૩૧/૫/૨૦૪૬	નવસારી	એસ.સી.	પોરબંદર	
			"			ગાયનેકોલોજી		૧૨. ડૉ. લલીતકુમાર ચંદ્રકાન્ત મોદી	ગાયનેકોલોજી	૨૬/૦૮/૧૯૮૧	૧૯/૦૬/૨૦૧૦	૧૯/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	મે-૨૦૦૮	૩૧/૦૮/૨૦૪૩	નવસારી	ઓબીસી	મહેસાણા	પુલના ધોરણે વી.સી. ઓફિસ
			"			ગાયનેકોલોજી		૧૩. ડૉ. નરેશકુમાર કુલજીભાઈ	ગાયનેકોલોજી	૦૧/૦૬/૧૯૮૧	૧૯/૦૬/૨૦૧૦	૧૯/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	સપ્ટેમ્બર-૨૦૧૦	૩૦/૦૬/૨૦૪૩	નવસારી	ઓબીસી	મહેસાણા	
			"			સર્જરી		૧૪. ડૉ. દિપકકુમાર નારણભાઈ	સર્જરી	૨૦/૦૨/૧૯૮૦	૧૯/૦૬/૨૦૧૦	૧૯/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૩	૨૮/૦૨/૨૦૪૨	નવસારી	ઓબીસી	પાટણ	

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
			મદદનીશ પ્રાધ્યાપક		-	મેડીસીન	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૧૫. ડૉ. અર્ધિ અરજણભાઈ વાઘ	મેડીસીન	૦૩/૦૭/૧૯૮૩	૧૯/૦૬/૨૦૧૦	૧૯/૦૬/૨૦૧૦	૩૦/૦૬/૨૦૧૦	સપ્ટે-૨૦૧૦	૩૧/૦૭/૨૦૪૫	નવસારી	ઓબીસી	જુનાગઢ	
					-	મેડીસીન		૧૬. ડૉ. સુધીર અમિતલાલ મહેતા	મેડીસીન	૧૭/૦૭/૧૯૮૪	૧૯/૦૬/૨૦૧૦	૧૯/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૩	૩૧/૦૭/૨૦૪૬	નવસારી	જનરલ	રાજકોટ	
			"		-	એનાટોમી	"	૧૭. ડૉ. શૈલેન્દ્ર ચોરસીયા	એનાટોમી	૦૧/૦૭/૧૯૭૭	૨૧/૦૬/૨૦૧૦	૨૧/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	મે-૨૦૦૮	૩૧/૦૭/૨૦૩૯	નવસારી	જનરલ	છત્તરપુર	
			"		-	લાઈવ સ્ટોક પ્રોડેક્શન મેનેજમેન્ટ	"	૧૮. ડૉ. ઠાકુર કિષ્ના શંકરરાવ	લાઈવ સ્ટોક પ્રોડેક્શન મેનેજમેન્ટ	૦૧/૦૩/૧૯૭૭	૨૧/૦૬/૨૦૧૦	૨૧/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	એપ્રિલ-૨૦૦૭	૩૧/૦૩/૨૦૩૯	નવસારી	જનરલ	ભાગલપુર	
			"		-	ફાર્માકોલોજી	"	૧૯. ડૉ. રસેશકુમાર દેવાભાઈ વરીયા	ફાર્માકોલોજી	૧૩/૧૧/૧૯૮૨	૨૪/૦૬/૨૦૧૦	૨૪/૦૬/૨૦૧૦	૦૩/૦૨/૨૦૧૧	નેટ પરીક્ષા આપી છે.	૩૦/૧૧/૨૦૪૪	નવસારી	ઓબીસી	વડોદરા	
			"		-	લાઈવ સ્ટોક પ્રોડેક્શન ટેકનોલોજી	"	૨૦. ડૉ. સ્વાતિ ગુપ્તા	લાઈવ સ્ટોક પ્રોડેક્શન ટેકનોલોજી	૨૪/૦૯/૧૯૮૧	૦૯/૦૭/૨૦૧૦	૦૯/૦૭/૨૦૧૦	૦૩/૦૨/૨૦૧૧	એપ્રિલ-૨૦૦૯	૩૦/૦૯/૨૦૪૩	નવસારી	જનરલ	દુર્ગ	
			મદદનીશ પ્રાધ્યાપક		-	એજીબી	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૨૧. ડૉ. ગૌરવ મૂળવંતભાઈ પંડ્યા	એજીબી	૧૬/૦૯/૧૯૭૮	૧૨/૦૭/૨૦૧૦	૧૨/૦૭/૨૦૧૦	૦૩/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૩	૩૦/૦૯/૨૦૪૦	નવસારી	જનરલ	જામનગર	
			"		-	વે. ફીઝયોલોજી બાયોકેમેસ્ટ્રી	"	૨૨. ડૉ. વિરેન્દ્રમાર સિંઘ	વે. ફીઝયોલોજી બાયોકેમેસ્ટ્રી	૧૧/૦૯/૧૯૮૧	૧૯/૦૭/૨૦૧૦	૧૯/૦૭/૨૦૧૦	૨૧/૦૪/૨૦૦૯	એપ્રિલ-૨૦૦૯	૩૦/૦૯/૨૦૪૩	નવસારી	જનરલ	લખનૌ (ઉત્તર પ્રદેશ)	
			"		-	વે. ફાર્માકોલોજી	"	૨૩. ડૉ. જતિન હરગોવિંદદાસ પટેલ	વેટરનરી ફાર્માકોલોજી	૨૧/૦૩/૧૯૮૨	૨૦/૦૭/૨૦૧૦	૨૦/૦૭/૨૦૧૦	૦૮/૧૦/૨૦૦૭	એપ્રિલ-૨૦૦૯	૩૧/૦૩/૨૦૪૪	નવસારી	જનરલ	મહેસાણા	
			"		-	સર્જરી	"	૨૪. ડૉ. શિવરાજસિંહ કિશોરસિંહ ઝાલા	સર્જરી	૨૫/૦૨/૧૯૮૩	૨૨/૦૭/૨૦૧૦	૨૨/૦૭/૨૦૧૦	૦૩/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૩	૨૮/૦૨/૨૦૪૫	નવસારી	જનરલ	અમદાવાદ	
			"		-	વે. પેથોલોજી	"	૨૫. ડૉ. ભાવેશકુમાર જયંતિલાલ ત્રાંગડીયા	વે. પેથોલોજી	૧૩/૦૩/૧૯૭૭	૨૭/૦૭/૨૦૧૦	૨૭/૦૭/૨૦૧૦	૦૩/૦૨/૨૦૧૧	સપ્ટેમ્બર-૨૦૧૦	૩૧/૦૩/૨૦૩૯	નવસારી	જનરલ	જુનાગઢ	
			મદદનીશ પ્રાધ્યાપક		-	સર્જરી	"	૨૬. ડૉ. રઘુવીર હિમાંશુભાઈ ભટ્ટ	સર્જરી	૨૭/૪/૧૯૮૩	૦૫/૦૮/૨૦૧૦	૦૫/૦૮/૨૦૧૦	૦૩/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૨	૩૦/૪/૨૦૪૫	નવસારી	જનરલ	ગાંધીનગર	
			"		-	એનીમલ ન્યુટ્રીશન	"	૨૭. ડૉ. વિપુલકુમાર રમણભાઈ	એનીમલ	૧૭/૮/૧૯૭૮	૩૦/૦૮/૨૦૧૦	૩૦/૦૮/૨૦૧૦	૦૫/૦૩/૨૦૧૧	સપ્ટેમ્બર-૨૦૧૦	૩૧/૮/૨૦૪૦	નવસારી	જનરલ	ખેડા	
			"		-	એગ્રોનોમી	"	૨૮. ડૉ. રતિલાલ નગીનભાઈ પટેલ (વિષય નિષ્ણાંત)	એગ્રોનોમી	૦૧/૦૩/૧૯૫૪	૧૧/૧૨/૧૯૮૧	૦૧/૧૧/૨૦૧૦	૨૪/૦૬/૨૦૧૧	-	૩૧/૦૩/૨૦૧૬	નવસારી	એસ.ટી.	વલસાડ	પુલના ધોરણે એલઆરએસ
			મદદનીશ પ્રાધ્યાપક		-	વેટ. પેરાસાઈટોલોજી	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૨૯. ડૉ. અંજુ વર્ગીસ	વેટ. પેરાસાઈટોલોજી	૦૫/૦૪/૧૯૮૪	૦૩/૧૧/૨૦૧૦	૦૩/૧૧/૨૦૧૦	૦૫/૦૮/૨૦૧૧	ડિસેમ્બર-૨૦૦૯	૩૦/૦૪/૨૦૪૬	નવસારી	જનરલ	કન્નુર	
			"		-	એલ.પી.એમ.		૩૦. ડૉ. નવિન બાબુલાલ પટેલ (વિષય નિષ્ણાંત)	એલ.પી.એમ.	૦૬/૧૦/૧૯૭૮	૨૦/૦૧/૨૦૦૯	૨૩/૦૩/૨૦૧૧	૦૯/૦૬/૨૦૦૮	મે-૨૦૦૮	૩૧/૧૦/૨૦૪૦	નવસારી	જનરલ	પાટણ	
			"		-	મેડીસીન	"	૩૧. ડૉ. જીગ્નેસકુમાર આલાભાઈ વાળા	મેડીસીન	૧/૧૧/૧૯૮૪	૧૫/૪/૨૦૧૧	૧૫/૪/૨૦૧૧	૦૪/૧૧/૨૦૧૧	સપ્ટેમ્બર-૨૦૧૦	૩૦/૧૧/૨૦૪૬	નવસારી	એસ.સી.	જુનાગઢ	
			"		-	પેથોલોજી	"	૩૨. ડૉ. જીગ્નેશ મણિલાલ પટેલ (વિષય નિષ્ણાંત)	પેથોલોજી	૧૦/૦૭/૧૯૮૩	૨૧/૦૧/૨૦૦૯	૦૧/૦૪/૨૦૧૧	૦૬/૦૩/૨૦૦૯	એપ્રિલ-૨૦૧૦	૩૧/૦૭/૨૦૪૫	નવસારી	જનરલ	બનાસકાંઠા	પુલના ધોરણે સંશોધન નિયામકશ્રીની કચેરી
			"		-	સર્જરી	"	૩૩. ડૉ. સુરભિ કુલદીપ ત્યાગી	સર્જરી	૦૯/૧૨/૧૯૮૧	૨૭/૫/૨૦૧૧	૨૭/૫/૨૦૧૧	૦૪/૧૧/૨૦૧૧	એપ્રિલ-૨૦૦૯	૩૧/૧૨/૨૦૪૩	નવસારી	જનરલ	ગાંધીયાબાદ	
			"		-	એનીમલ બાયો ટેકનોલોજી	"	૩૪. ડૉ. ઉમેદ વિઠ્ઠલભાઈ રામાણી	એનીમલ બાયો ટેકનોલોજી	૨૧/૧૧/૧૯૮૧	૦૧/૦૮/૨૦૧૧	૦૧/૦૮/૨૦૧૧	૨૧/૧૦/૨૦૧૧	સપ્ટેમ્બર-૨૦૧૦	૩૦/૧૧/૨૦૪૩	નવસારી	જનરલ	જુનાગઢ	
			"		-	માઈક્રો (ટીવીસીસી)	"	૩૫. ડૉ. પુષ્પાબેન હરીભાઈ રાઠોડ	માઈક્રો (ટીવીસીસી)	૨૦/૦૭/૧૯૮૦	૨૭/૦૨/૨૦૧૨	૨૭/૦૨/૨૦૧૨	૨૭/૦૪/૨૦૧૦	સપ્ટેમ્બર-૨૦૧૦	૩૧/૦૭/૨૦૪૨	નવસારી	એસ.સી.	અમદાવાદ	

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
						ટીવીસીસી	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૩૬. સૌરભ મેઘલાલ પરમાર	ટીવીસીસી	૨૧/૦૫/૧૯૮૬	૦૪/૦૩/૨૦૧૩	૦૪/૦૩/૨૦૧૩	૩૦/૦૪/૨૦૧૩	૧૯/૦૨/૨૦૧૨	૩૧/૦૫/૨૦૪૮	નવસારી	એસ.સી.	પંચમહાલ	
								૩૭. ડૉ. મહિપાલ ચૌધે	ન્યુટ્રીશન	૨૧/૧૨/૧૯૮૧	૦૭/૦૨/૨૦૧૩	૦૭/૦૨/૨૦૧૩	૨૩/૦૪/૨૦૧૪	એપ્રિલ-૨૦૦૯	૩૧/૧૨/૨૦૪૩	નવસારી	જનરલ	વરાણસી	
						ટીવીસીસી	"	૩૮. ડૉ. હિતેન્દ્રભાઈ ચંદુભાઈ શર્મા	ટીવીસીસી	૧૦/૦૫/૧૯૮૧	૧૮/૦૧/૨૦૧૩	૧૮/૦૧/૨૦૧૩	૩૦/૦૪/૨૦૧૩	સપ્ટેમ્બર-૨૦૧૦	૩૧/૦૫/૨૦૪૩	નવસારી	ઓબીસી	ખેડા	
						વી.પી.એચ.	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે.	૩૯. ડૉ. રાજીવ કુમાર	વી.પી.એચ.	૦૧/૦૩/૧૯૭૯	૦૩/૦૬/૨૦૧૩	૦૩/૦૬/૨૦૧૩			૩૧/૦૩/૨૦૪૧	નવસારી	જનરલ	નાલંદા	
						આઈ.એલ. એફ.સી.	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૪૦. ડૉ. નિખિલ શાંતિલાલ ડાંગર	આઈ.એલ. એફ.સી.	૨૪/૦૧/૧૯૮૭	૨૯/૦૮/૨૦૧૩	૨૯/૦૮/૨૦૧૩	૧૭/૦૭/૨૦૧૪		૩૧/૦૧/૨૦૪૯	નવસારી	ઓબીસી	જુનાગઢ	
			મદદનીશ પ્રાધ્યાપક			એક્ષ્ટેનશન	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૪૧. ડૉ. રીઝવાનખાન શબીરખાન ઘાસુરા	એક્ષ્ટેનશન	૨૧/૦૪/૧૯૮૬	૨૯/૦૮/૨૦૧૩	૨૯/૦૮/૨૦૧૩	૨૬/૦૬/૨૦૧૪	૧૮/૦૯/૨૦૧૨	૩૦/૦૪/૨૦૪૮	નવસારી	ઓબીસી		
			મદદનીશ પ્રાધ્યાપક			આઈ.એલ. એફ.સી.	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૪૨. ડૉ. યોગેશકુમાર ધરમશીભાઈ પટેરીયા	આઈ.એલ. એફ.સી.	૦૯/૦૯/૧૯૮૬	૨૯/૦૮/૨૦૧૩	૨૯/૦૮/૨૦૧૩	૨૬/૦૬/૨૦૧૪		૩૦/૦૯/૨૦૪૮	નવસારી	ઓબીસી	સુરેન્દ્રનગર	
			"			એનીમલ ન્યુટ્રીશન	"	૪૩. ડૉ. અજય પ્રહલાદભાઈ રાવલ	એનીમલ ન્યુટ્રીશન	૧૧/૦૬/૧૯૮૮	૩૦/૦૮/૨૦૧૩	૩૦/૦૮/૨૦૧૩	૨૮/૦૭/૨૦૧૪	૨૫/૦૬/૨૦૧૪	૩૦/૦૬/૨૦૫૦	નવસારી	ઓબીસી	પાટણ	પુલના ધોરણે એલઆરએસ
			"			વેટ. બાયોકેમેસ્ટ્રી	"	૪૪. ડૉ. સંજયકુમાર ભગુભાઈ પટેલ (વિષય નિષ્ણાંત)	વેટ. બાયોકેમેસ્ટ્રી	૩૦/૦૩/૧૯૮૪	૨૭/૦૮/૨૦૧૩	૦૩/૦૧/૨૦૧૪	૦૨/૦૭/૨૦૧૪	-	૩૧/૦૩/૨૦૪૬	નવસારી	ઓબીસી	ભરૂચ	
૫.			ફીઝીકલ ઈન્સ્ટ્રક્ટર	૧	-	-	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૧. મિલન પુરુષોત્તમ પટેલ	-	૧૨/૦૭/૧૯૮૩	૧૭/૦૬/૨૦૧૦	૧૭/૦૬/૨૦૧૦	૨૮/૦૧/૨૦૧૦	GSLET- જુલાઈ-૨૦૦૬	૩૧/૦૭/૨૦૪૫	નવસારી	જનરલ	વડોદરા	પુલના ધોરણે ડીએસ. ડબલ્યુ ઓફિસ
૬.			આસીસ્ટન્ટ લાયબ્રેરીયન	૧	-	-	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૧. કેલાશ દલુભાઈ ટંડેલ	-	૨૫/૦૫/૧૯૭૫	૧૯/૦૬/૨૦૧૦	૧૯/૦૬/૨૦૧૦	૦૨/૦૨/૨૦૧૧	GSLET- ડીસે-૨૦૦૮	૩૧/૦૫/૨૦૩૭	નવસારી	ઓબીસી	નવસારી	પુલના ધોરણે સેન્ટ્રલ લાયબ્રેરી, નવસારી
૭.			ઓફીસ સુપ્રિટેન્ડન્ટ	૨	૧	-	૯૩૦૦-૩૪૮૦૦/ ગ્રે.પે. ૪૨૦૦	૧. શ્રી નટુભાઈ રમણભાઈ પટેલ (કચેરી અધિકારીની જગ્યા સામે)	-	૦૧/૦૬/૧૯૬૦	૦૧/૧૧/૧૯૮૦	૧૪/૦૬/૨૦૧૩	૨૭/૦૧/૨૦૦૮	લાગુ પડતું નથી	૩૦/૦૬/૨૦૧૮	નવસારી	એસ.ટી.	વલસાડ	કુલસચિવશ્રીના કાર્યાલય આદેશથી તા. ૦૧/૦૩/૨૦૧૫ થી શ્રી એન.આર.પટેલને કચેરી અધિકારીની
<p>નોંધ:- ઓફિસ સુપ્રિટેન્ડન્ટ:- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે ઓફિસ સુપ્રિટેન્ડન્ટની કુલ જગ્યા- ૦૩ મંજૂર થયેલ છે. જેમાંથી ૦૧ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી ઓફિસ સુપ્રિટેન્ડન્ટની મંજૂર થયેલ કુલ જગ્યા-૦૨ દર્શાવવામાં આવેલ છે. પરંતુ ૨૬ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.</p>																			
૮.			સ્ટેનોગ્રેડ-૨	૩	-	-	૯૩૦૦-૩૪૮૦૦/ ગ્રે.પે. ૪૨૦૦	૧. શ્રી શોભાનભાઈ ભાયલુભાઈ બિરારી	-	૦૧/૦૬/૧૯૬૭	૨૯/૦૯/૧૯૯૮	૨૨/૦૮/૨૦૦૮	૨૭/૦૨/૨૦૦૮	"	૩૦/૦૬/૨૦૨૫	નવસારી	એસ.ટી.	વલસાડ	પુલના ધોરણે ડી.આર. ઓફિસ
			"	-	-	-		૨. શ્રીમતી મીનીબેન ચંદનભાઈ	-	૨૪/૦૫/૧૯૫૯	૦૪/૦૭/૧૯૮૫	૨૯/૧૦/૨૦૦૯	૧૩/૦૩/૨૦૦૯	"	૩૧/૦૫/૨૦૧૭	નવસારી	જનરલ	ત્રિચુર	
			"	-	-	-		૩. શ્રીમતી નયનાબેન સુમનભાઈ	-	૦૭/૧૨/૧૯૭૧	૨૨/૯/૧૯૯૮	૦૩/૧૧/૨૦૦૯	૧૯/૦૩/૨૦૦૮	"	૩૧/૧૨/૨૦૨૯	નવસારી	એસ.ટી.	નવસારી	
<p>નોંધ:- સ્ટેનો ગ્રેડ-૨ :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે સ્ટેનોગ્રેડ-૨ ની કુલ જગ્યા- ૦૮ મંજૂર થયેલ છે. જેમાંથી ૦૫ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી સ્ટેનોગ્રેડ-૨ ની મંજૂર થયેલ કુલ જગ્યા- ૦૩ દર્શાવવામાં આવેલ છે તેમજ ૦૧ જગ્યા ૨૬ કરવામાં આવેલ છે. પરંતુ ૨૬ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.</p>																			

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૯.			હેડ ક્લાર્ક	૧	-	-	૯૩૦૦-૩૪૮૦૦/ ગ્રે. પે. ૪૨૦૦	૧. શ્રી સતીશચંદ્ર પ્રાણજીવનદાસ રાજપુત	-	૧૩/૦૧/૧૯૫૯	૧૦/૦૪/૧૯૮૦	૦૧/૦૧/૨૦૧૩	૨૧/૦૩/૨૦૦૭	લાગુ પડતું નથી	૩૧/૦૧/૨૦૧૭	નવસારી	ઓબીસી	નવસારી	

નોંધ:- હેડ ક્લાર્ક :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે હેડ ક્લાર્કની કુલ જગ્યા- ૦૩ મંજૂર થયેલ છે. જેમાંથી ૦૧ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. અને ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ કુલ સચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧-૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી હેડ ક્લાર્કની મંજૂર થયેલ કુલ જગ્યા- ૦૧ દર્શાવવામાં આવેલ છે તેમજ ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ રદ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

૧૦.			સી.કલાર્ક	૪	-	-	૫૨૦૦-૨૦૨૦૦/ ગ્રે. પે. ૨૪૦૦	૧. કપિલાબેન ઉત્તમભાઈ પટેલ	-	૦૩/૦૬/૧૯૫૭	૦૫/૦૭/૧૯૯૯	૦૧/૦૨/૨૦૧૨	૨૭/૦૨/૨૦૦૮	"	૩૦/૦૬/૨૦૧૫	નવસારી	એસ.ટી.	સુરત	
			સી.કલાર્ક	-	-	-	૫૨૦૦-૨૦૨૦૦/ ગ્રે. પે. ૨૪૦૦	૨. શ્રી રમણભાઈ બબાભાઈ નાઈ	-	૦૫/૦૨/૧૯૬૨	૧૯/૩/૧૯૯૦	૦૫/૧૧/૨૦૦૯	૦૯/૦૪/૨૦૦૮	લાગુ પડતું નથી	૨૯/૨/૨૦૨૦	નવસારી	જનરલ	સાબરકાંઠા	પુલના ધોરણે કાઉન્સિલ ગાંધીનગર
				-	-	-	૫૨૦૦-૨૦૨૦૦/	૩. શ્રી મોહનભાઈ રવજીભાઈ આહિર	-	૦૫/૦૯/૧૯૭૪	૦૧/૦૫/૨૦૦૩	૩૧/૦૧/૨૦૧૨	૩૦/૦૧/૨૦૦૮	"	૩૦/૦૯/૨૦૩૨	નવસારી	ઓબીસી	નવસારી	
			"	-	-	-	"	૪. શ્રી જસવંતલાલ વીરચંદભાઈ ચૌહાણ	-	૦૯/૧૨/૧૯૬૩	૩૦/૦૧/૧૯૮૬	૦૩/૦૨/૨૦૧૨	-	-	૩૧/૧૨/૨૦૨૧	નવસારી	ઓબીસી	બનાસકાંઠા	

નોંધ:- સીનીયર કલાર્ક :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે સીનીયર કલાર્કની કુલ જગ્યા- ૦૭ મંજૂર થયેલ છે. જેમાંથી ૦૨ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. અને ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ કુલ સચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧-૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી સીનીયર કલાર્કની મંજૂર થયેલ કુલ જગ્યા- ૦૪ દર્શાવવામાં આવેલ છે તેમજ ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ રદ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

૧૧.			જુ.કલાર્ક	૧૧	-	-	૭૮૦૦ ફીકસ	૧. શ્રીમતી માયાબેન સંજયકુમાર રબારી	-	૫/૧૨/૧૯૮૩	૧૯/૦૩/૨૦૧૦	૧૯/૦૩/૨૦૧૦	જુન-૨૦૧૨	લાગુ પડતું નથી	૩૧/૧૨/૨૦૪૧	નવસારી	ઓબીસી	સુરેન્દ્રનગર	
			જુ.કલાર્ક	-	-	-	"	૨. સરકરાજ હકીઝમીયાં નેદરીયા	-	૨૯/૧૦/૧૯૭૯	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	નવેમ્બર-૨૦૦૯	"	૩૧/૧૦/૨૦૩૭	નવસારી	જનરલ	સાબરકાંઠા	કૃષિ અને સહકાર વિભાગ, ગાંધીનગર ખાતે આરકેવીવાય સેલ હેઠળ પુલના ધોરણે ફાળવતાં તા. ૧૯/૧૧/૨૦૧૧ નાં રોજ બપોર બાદ છુટા કરેલ છે. (ગાંધીનગરથી મુસા)
			"	-	-	-	"	૩. સુનિલભાઈ નાનુભાઈ પટેલ	-	૧૫/૦૭/૧૯૮૧	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	ફેબ્રુ-૨૦૦૮	"	૩૧/૦૭/૨૦૩૯	નવસારી	એસ.ટી.	નવસારી	
			"	-	-	-	"	૪. શ્રીમતિ જિગીષાબહેન રૂપેશભાઈ પટેલ	-	૦૮/૦૪/૧૯૮૩	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	૧૫/૦૫/૨૦૧૦	"	૩૦/૦૪/૨૦૪૧	નવસારી	ઓબીસી	નવસારી	
			"	-	-	-	"	૫. અલ્પાબહેન જિતેશભાઈ પટેલ	-	૨૭/૦૪/૧૯૭૯	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	માર્ચ-૨૦૧૦	"	૩૦/૦૪/૨૦૩૭	નવસારી	જનરલ	નવસારી	
			જુ.કલાર્ક	-	-	-	"	૬. સુરભિ મહેશભાઈ મેઘુરા	-	૨૯/૦૭/૧૯૯૧	૦૩/૦૮/૨૦૧૦	૦૩/૦૮/૨૦૧૦	જુન-૨૦૦૯	"	૩૧/૦૭/૨૦૪૯	નવસારી	એસ.સી.	નવસારી	
			જુ.કલાર્ક	-	-	-	૭૮૦૦ ફીકસ	૭. ડીમ્પી વિરલ નાયક	-	૧૩/૦૪/૧૯૮૧	૩૧/૦૮/૨૦૧૨	૩૧/૦૮/૨૦૧૨	જુન-૨૦૧૨	લાગુ પડતું નથી	૩૦/૦૪/૨૦૩૯	નવસારી	જનરલ	વલસાડ	
			"	-	-	-	૭૮૦૦ ફીકસ	૮. શ્રીમતિ કૃતિ પ્રિતેશકુમાર જોષી	-	૧૭/૧૧/૧૯૮૯	૨૮/૧૨/૨૦૧૨	૨૮/૧૨/૨૦૧૨	ફેબ્રુઆરી-૨૦૧૦	"	૩૦/૧૧/૨૦૪૭	નવસારી	અન્ય	બનાસકાંઠા	
			"	-	-	-	"	૯. શ્રી ધીરુભાઈ આર. પટેલ	-	૦૭/૦૪/૧૯૬૯	૧૩/૦૬/૧૯૯૦	૦૧/૦૬/૨૦૧૩	૦૧/૦૮/૨૦૦૭	"	૩૦/૦૬/૨૦૨૦	નવસારી	ઓબીસી	નવસારી	
			"	-	-	-	૭૮૦૦ ફીકસ	૧૦. શ્રીમતિ અર્યનાબહેન નિર્મલકુમાર પટેલ	-	૨૪/૦૨/૧૯૮૫	૨૯/૦૭/૨૦૧૩	૦૧/૦૯/૨૦૧૩	જુન-જુલાઈ-૨૦૦૮	"	૨૮/૦૨/૨૦૪૩	નવસારી	ઓબીસી	નવસારી	મેટરનીટી લીવ પર છે.

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
			જી.કલાર્ક				૫૨૦૦-૨૦૨૦૦/ ગ્રે.પે. ૧૯૦૦	૧૧. તૃપ્તિ રંજનકુમાર પટેલ		૦૪/૦૮/૧૯૮૪	૧૪/૦૩/૨૦૦૫	૦૧/૦૩/૨૦૧૪	૧૬/૦૫/૨૦૦૭	લાગુ પડતું નથી	૩૧/૦૮/૨૦૪૨	નવસારી	ઓબીસી	નવસારી	

નોંધ:- જુનીયર કલાર્ક:- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે જુનીયર કલાર્કની કુલ જગ્યા- ૧૮ મંજૂર થયેલ છે. જેમાંથી ૦૬ જગ્યા એબેચ-સમાં મુકવામાં આવેલ છે. અને ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી જુનીયર કલાર્કની મંજૂર થયેલ કુલ જગ્યા- ૧૧ દર્શાવવામાં આવેલ છે તેમજ ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ રદ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

૧૨.			લેબ. ટેકનીશીયન	૧૯	૩	-	૯૩૦૦-૩૪૮૦૦ ગ્રે.પે. ૪૨૦૦	૧. શ્રીમતી ધર્મિષ્ઠાબેન આશિષ પટેલ	-	૨૬/૧૧/૧૯૮૪	૩૦/૯/૨૦૦૮	૩૦/૯/૨૦૦૮	૨૧/૦૩/૨૦૧૦	લાગુ પડતું નથી	૩૦/૧૧/૨૦૪૨	નવસારી	ઓબીસી	નવસારી	
			"			-	૧૩૫૦૦ ફીક્સ	૨. શ્રીમતિ રૂપલ પથિકકુમાર પટેલ	-	૨૧/૦૫/૧૯૭૮	૨૦/૦૪/૨૦૧૦	૨૦/૦૪/૨૦૧૦	૧૮/૧૨/૨૦૧૦	"	૩૧/૦૫/૨૦૩૬	નવસારી	જનરલ	ખેડા	(પુલના ધોરણે પ્લાન્ટ પેથોલોજી)
			"			-	"	૩. શ્રીમતિ મેઘા તારક વ્યાસ	-	૨૦/૦૪/૧૯૮૬	૨૦/૦૪/૨૦૧૦	૨૦/૦૪/૨૦૧૦	નવેમ્બર-૨૦૦૮	"	૩૦/૪/૨૦૪૪	નવસારી	જનરલ	નવસારી	
			"			-	"	૪. આકૃતિ દિલીપ કુમાર પટેલ	-	૨૫/૦૨/૧૯૮૦	૨૧/૦૪/૨૦૧૦	૨૧/૦૪/૨૦૧૦	૨૮/૧૧/૨૦૦૮	"	૨૮/૦૨/૨૦૩૮	નવસારી	ઓબીસી	નવસારી	
			"			-	"	૫. શ્રીમતી બિનલબેન જિતેન્દ્રકુમાર પટેલ	-	૦૭/૦૯/૧૯૮૫	૨૧/૦૪/૨૦૧૦	૨૧/૦૪/૨૦૧૦	૧૮/૧૨/૨૦૧૦	"	૩૦/૦૯/૨૦૪૩	નવસારી	ઓબીસી	નવસારી	
			લેબ. ટેકનીશીયન			-	૧૩૫૦૦ ફીક્સ	૬. લીપ્સા સંજીવભાઈ દેસાઈ	-	૧૪/૧૧/૧૯૮૬	૨૨/૦૪/૨૦૧૦	૨૨/૦૪/૨૦૧૦	ઓક્ટોબર-૨૦૦૯	લાગુ પડતું નથી	૩૦/૧૧/૨૦૪૪	નવસારી	જનરલ	નવસારી	
			"			-	"	૭. શ્રીમતી કિંજલ આશિષકુમાર પટેલ	-	૦૮/૦૬/૧૯૮૬	૨૨/૦૪/૨૦૧૦	૨૨/૦૪/૨૦૧૦	૧૮/૧૨/૨૦૧૦	"	૩૦/૦૬/૨૦૪૪	નવસારી	ઓબીસી	નવસારી	
			"			-	"	૮. પંકજ કુમાર અરવિંદભાઈ ઢોડિયા	-	૨૨/૦૩/૧૯૮૧	૨૬/૦૪/૨૦૧૦	૨૬/૦૪/૨૦૧૦	૧૯/૦૩/૨૦૦૮	લાગુ પડતું નથી	૩૧/૦૩/૨૦૩૯	નવસારી	એસ.ટી.	તાપી	
			"			-	"	૯. રાજેશકુમાર જીવણભાઈ હેલેયા	-	૦૧/૦૬/૧૯૮૦	૨૭/૦૪/૨૦૧૦	૨૭/૦૪/૨૦૧૦	ઓક્ટોબર-૨૦૦૭	લાગુ પડતું નથી	૩૦/૦૬/૨૦૩૮	નવસારી	એસ.સી.	અમરેલી	
			"			-	"	૧૦. અમિષા દિનેશભાઈ ચૌધરી	-	૨૭/૦૭/૧૯૮૦	૦૩/૦૫/૨૦૧૦	૦૩/૦૫/૨૦૧૦	એપ્રિલ-૨૦૦૭	"	૩૧/૦૭/૨૦૩૮	નવસારી	એસ.ટી.	તાપી	મેડીકલ ઓફિસમાં પુલના ધોરણે
			"			-	"	૧૧. શ્રીમતિ જિગીષા જિજ્ઞેષકુમાર રાણા	-	૨૨/૦૪/૧૯૮૪	૨૩/૦૯/૨૦૧૦	૨૩/૦૯/૨૦૧૦	૧૭/૦૪/૨૦૧૦	"	૩૦/૦૪/૨૦૪૨	નવસારી	ઓબીસી	વલસાડ	
			"			-	"	૧૨. શ્રીમતિ કાજલબેન દુધ્યંતભાઈ પટેલ	-	૧૧/૬/૧૯૮૩	૦૭/૦૯/૨૦૧૦	૦૭/૦૯/૨૦૧૦	૨૦/૧૨/૨૦૧૦	"	૩૦/૦૬/૨૦૪૧	નવસારી	જનરલ	જૂનાગઢ	
			"			-	૧૩૫૦૦ ફીક્સ	૧૩. શ્રીમતિ દિપમાલા દીપકકુમાર ઢીમર	-	૦૫/૦૩/૧૯૮૪	૦૯/૦૯/૨૦૧૦	૦૯/૦૯/૨૦૧૦	૧૯/૧૨/૨૦૧૦	લાગુ પડતું નથી	૩૧/૦૩/૨૦૪૨	નવસારી	ઓબીસી	વલસાડ	
			લેબ.ટેકની			-	૧૩૫૦૦ ફીક્સ	૧૪. શ્રીમતિ કાજલ વિમલ ઘેટિયા	-	૨૧/૦૯/૧૯૮૧	૧૭/૦૯/૨૦૧૦	૧૭/૦૯/૨૦૧૦	૦૯/૦૨/૨૦૦૯	"	૩૦/૦૯/૨૦૩૯	નવસારી	જનરલ	સુરત	
			"			-	૯૩૦૦-૩૪૮૦૦ ગ્રે.પે. ૪૨૦૦	૧૫. શ્રીમતી કેલાશબેન નીતિનભાઈ પટેલ	-	૨૨/૦૯/૧૯૬૨	૦૬/૧૨/૧૯૮૯	૦૧/૦૬/૨૦૦૯	૦૫/૦૯/૨૦૦૭	"	૩૦/૦૯/૨૦૨૦	નવસારી	ઓબીસી	નવસારી	
			લેબ. ટેકનીશીયન			-	૧૩૫૦૦ ફીક્સ	૧૬. કુ. આકૃતિ જીતેન્દ્રભાઈ દેસાઈ	-	૨૮/૦૯/૧૯૮૮	૦૪/૦૨/૨૦૧૪	૦૪/૦૨/૨૦૧૪	૧૯/૧૧/૨૦૧૧	"	૩૦/૦૯/૨૦૪૬	નવસારી	જનરલ	નવસારી	

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
			લેબ. ટેકનીશીયન				૧૩૫૦૦ ફીક્સ	૧૭. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	અત્રેની કચેરીના કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ વીસીએન/ અ. ૧/ ૮૮૪- ૮૮/ ૨૦૧૫ તા. ૦૬/૦૨/૨૦૧૫ થી શ્રીમતિ સેજલ પટેલનો તા. ૦૧/૦૨/૨૦૧૫ ની અસરથી પગાર ભથ્થાનો ખર્ચ બ.સ. ૧૨૦૪૪ માં પાડવા આદેશ કરવામાં આવેલ છે.
					-	-	"	૧૮. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	અત્રેની કચેરીના કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ વીસીએન/ અ. ૧/ ૮૮૪- ૮૮/ ૨૦૧૫ તા. ૦૬/૦૨/૨૦૧૫ થી શ્રીમતિ રિક્તા પટેલનો તા. ૦૧/૦૨/૨૦૧૫ ની અસરથી પગાર ભથ્થાનો ખર્ચ બ.સ. ૧૨૦૪૩ માં પાડવા આદેશ કરવામાં આવેલ છે.

નોંધ:- લેબ. ટેકનીશીયન :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે લેબ. ટેકનીશીયનની કુલ જગ્યા- ૨૨ મંજૂર થયેલ છે. જેમાંથી ૦૨ જગ્યા એબેયન્સમાં મુકવામાં આવેલ છે. અને ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૮૧- ૨૮૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી લેબ. ટેકનીશીયનની મંજૂર થયેલ કુલ જગ્યા- ૧૮ દર્શાવવામાં આવેલ છે તેમજ ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ રદ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

૧૩.		લેબોરેટરી આસીસ્ટન્ટ	૧૩	૫	-	૧૩૫૦૦ ફીક્સ	૧. પુજાબેન જગદીશભાઈ ભટ્ટ	-	૨૨/૦૪/૧૯૮૬	૨૨/૦૩/૨૦૧૦	૨૨/૦૩/૨૦૧૦	૧૨/૦૬/૨૦૧૦	લાગુ પડતું	૩૦/૦૪/૨૦૪૪	નવસારી	જનરલ	નવસારી	
				-	-	"	૨. ભાવિનીબેન રમણભાઈ પટેલ	-	૨૪/૧૧/૧૯૮૭	૨૨/૦૩/૨૦૧૦	૨૨/૦૩/૨૦૧૦	૨૭/૦૮/૨૦૧૦	"	૩૦/૧૧/૨૦૪૫	નવસારી	ઓબીસી	નવસારી	
				-	-	"	૩. શ્રીમતી દિપાલી મિતાંગકુમાર	-	૨૮/૧૧/૧૯૭૯	૨૩/૦૩/૨૦૧૦	૨૩/૦૩/૨૦૧૦	૧૨/૦૬/૨૦૧૦	"	૩૦/૧૧/૨૦૩૭	નવસારી	જનરલ	વલસાડ	
				-	-	"	૪. શ્રીમતિ વિભા સુધિરકુમાર મહેતા	-	૨૬/૦૩/૧૯૮૫	૨૫/૦૩/૨૦૧૦	૨૫/૦૩/૨૦૧૦	૧૭/૦૫/૨૦૦૯	"	૩૧/૦૩/૨૦૪૩	નવસારી	જનરલ	બનાસકાંઠા	
				-	-	"	૫. કપિલભાઈ ગોપાળભાઈ ટેડેલ	-	૧૭/૦૮/૧૯૭૯	૩૦/૦૩/૨૦૧૦	૩૦/૦૩/૨૦૧૦	૨૮/૦૬/૨૦૧૦	"	૩૧/૦૮/૨૦૩૭	નવસારી	ઓબીસી	નવસારી	પોલીટેકનીકમાં પુલના ધોરણે
				-	-	"	૬. પ્રતિષ્ઠા ઈશ્વરભાઈ પટેલ	-	૧૭/૦૮/૧૯૮૨	૧૦/૦૮/૨૦૧૦	૧૦/૦૮/૨૦૧૦	૦૭/૧૨/૨૦૧૦	"	૩૦/૦૮/૨૦૪૦	નવસારી	ઓબીસી	નવસારી	
		લેબોરેટરી આસીસ્ટન્ટ		-	-	૧૩૫૦૦ ફીક્સ	૭. મનોજકુમાર ધુળાભાઈ ખાંટ	-	૨૬/૦૪/૧૯૮૮	૧૬/૦૮/૨૦૧૦	૧૬/૦૮/૨૦૧૦	ડીસેમ્બર-૨૦૦૬	"	૩૦/૦૪/૨૦૪૬	નવસારી	એસ.ટી.	દાહોદ	
				-	-	"	૮. સુનિલ ગોવિંદભાઈ વાઘ	-	૧૯/૦૮/૧૯૮૩	૦૮/૦૮/૨૦૧૦	૦૮/૦૮/૨૦૧૦	૨૭/૧૧/૨૦૧૦	"	૩૦/૦૮/૨૦૪૧	નવસારી	જનરલ	નવસારી	

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
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નોંધ:- લેબ.આસીસ્ટન્ટ :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે લેબ.આસીસ્ટન્ટની કુલ જગ્યા- ૧૩ મંજૂર થયેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી લેબ.આસીસ્ટન્ટની એક પણ જગ્યા દર્શાવવામાં આવેલ નથી. જેથી સદર આદેશમાં જરૂરી સુધારો કરવા વિનંતી.

૧૪.			લાઈવ સ્ટોક ઈન્સ્પેક્ટર	૫	૧	-	૫૨૦૦-૨૦૨૦૦ ગ્રેડ પે.૨૪૦૦	૧. શ્રી. જયંતકુમાર કેશવલાલ વાઘડિયા	-	૧૨/૦૯/૧૯૮૬	૨૨/૦૯/૨૦૦૮	૨૨/૦૯/૨૦૦૮	માર્ચ-૨૦૦૭	"	૩૦/૦૯/૨૦૪૪	નવસારી	જનરલ	મોરબી		
								૨. શ્રી સુમિતકુમાર અરવિંદભાઈ મોદી	-	૨૨/૦૭/૧૯૮૯	૨૨/૦૯/૨૦૦૮	૨૨/૦૯/૨૦૦૮	એપ્રિલ-૨૦૦૭	"	૩૧/૦૭/૨૦૪૭	નવસારી	ઓબીસી	સુરત		
								૩. શ્રી વિશાલ નરેન્દ્રભાઈ અમીન	-	૩૦/૧૦/૧૯૮૫	૨૪/૦૯/૨૦૦૮	૨૪/૦૯/૨૦૦૮	નવેમ્બર-૨૦૦૮	"	૩૧/૧૦/૨૦૪૩	નવસારી	જનરલ	નવસારી		
								૪. શ્રી દાનાભાઈ મધાભાઈ મીર	-	૦૧/૦૬/૧૯૮૫	૨૪/૦૯/૨૦૦૮	૨૪/૦૯/૨૦૦૮	ઓક્ટોબર-૨૦૦૯	"	૩૦/૦૬/૨૦૪૩	નવસારી	ઓબીસી	સુરત	પુલના ધોરણે એલઆરએસ	
								૫.ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	-	શ્રી અનિલ સી.રોહિત, એલ.આઈ.એ તા. ૩૧/૦૩/૨૦૧૫ ની અસરથી રાજીનામું આપતાં જગ્યા ખાલી

નોંધ:- લાઈવ સ્ટોક ઈન્સ્પેક્ટર :- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે લાઈવ સ્ટોક ઈન્સ્પેક્ટરની કુલ જગ્યા- ૦૬ મંજૂર થયેલ છે. જેમાંથી ૦૧ જગ્યા રદ કરવામાં આવેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી લાઈવ સ્ટોક ઈન્સ્પેક્ટરની કુલ મંજૂર થયેલ જગ્યા- ૦૫ દર્શાવવામાં આવેલ છે. અને રદ થયેલ ૦૧ જગ્યા દર્શાવવામાં આવેલ નથી.

૧૫.			વેટરનરી ઓફિસર	૫	૨	-	૧૩૭૦૦ ફીકસ	૧. ડૉ. ધર્મેશકુમાર ચંદ્રકાંતભાઈ પટેલ	-	૨૧/૦૩/૧૯૮૪	૦૩/૦૫/૨૦૧૦	૦૩/૦૫/૨૦૧૦	૨૪/૦૨/૨૦૧૧	લાગુ પડતું નથી	૩૧/૩/૨૦૪૨	નવસારી	જનરલ	પાટણ	
								૨. ડૉ. દિનેશ યુનિલાલ મોલિયા	-	૩૧/૦૮/૧૯૭૭	૦૯/૧૨/૨૦૧૦	૦૯/૧૨/૨૦૧૦	૩૧/૫/૨૦૧૨	"	૩૧/૦૮/૨૦૩૫	નવસારી	જનરલ	જામનગર	
			વેટરનરી ઓફિસર	-	-	-	૯૩૦૦-૩૪૮૦૦ ગ્રેડ પે-૪૪૦૦	૩. ડૉ. ફાલ્ગુની દશરથલાલ મોદી [સી.ની.રીસર્ચ.આસી. (વેટરનરી)]	-	૨૮/૦૧/૧૯૮૪	૨૬/૦૬/૨૦૦૯	૧૧/૦૩/૨૦૧૧	૦૯/૦૨/૨૦૧૦	લાગુ પડતું નથી	૩૧/૦૧/૨૦૪૨	નવસારી	ઓબીસી	બનાસકાંઠા	

નોંધ:- વેટરનરી ઓફિસર:- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે વેટરનરી ઓફિસરની કુલ જગ્યા- ૦૬ મંજૂર થયેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી વેટરનરી ઓફિસરની મંજૂર થયેલ કુલ જગ્યા- ૦૫ દર્શાવવામાં આવેલ છે. પરંતુ રદ કરવામાં આવેલ જગ્યાઓના અત્રેની કચેરીએ કોઈ આધાર નથી.

૧૬.			લાયબ્રેરી આસીસ્ટન્ટ	૨	-	-	૧૩૭૦૦ ફીકસ	૧. રાકેશકુમાર નરેશભાઈ ઢીમર	-	૦૪/૦૮/૧૯૮૪	૨૫/૦૩/૨૦૧૦	૨૫/૦૩/૨૦૧૦	૨૮/૦૬/૨૦૧૦	લાગુ પડતું નથી	૩૧/૦૮/૨૦૪૨	નવસારી	ઓબીસી	સુરત	પુલના ધોરણે સેન્ટ્રલ લાયબ્રેરી,
								૨. રિધિ કેયુર પટેલ	-	૧૦/૦૯/૧૯૮૩	૧૩/૦૯/૨૦૧૦	૧૩/૦૯/૨૦૧૦	૨૩/૦૩/૨૦૧૨	"	૩૦/૦૯/૨૦૪૧	નવસારી	જનરલ	વડોદરા	

નોંધ:- લાયબ્રેરી આસીસ્ટન્ટ:- સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે લાયબ્રેરી આસીસ્ટન્ટની કુલ જગ્યા- ૦૨ મંજૂર થયેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ રજી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧- ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી લાયબ્રેરી આસીસ્ટન્ટની મંજૂર થયેલ કુલ જગ્યા- ૦૩ દર્શાવવામાં આવેલ છે.

૧૭.			ડેટા કન્સલ ઓપરેટર	૧	-	-	૭૮૦૦ ફીકસ	૧. દિનેશકુમાર ધનજીભાઈ સૌંદરવા	-	૨૮/૦૭/૧૯૭૭	૧૧/૦૭/૨૦૧૨	૧૧/૦૭/૨૦૧૨	૨૫/૧૧/૨૦૧૦	"	૩૧/૦૭/૨૦૩૫	નવસારી	એસ.સી.	જૂનાગઢ	કુલસચિવશ્રીના કાર્યાલય આદેશથી તા. ૦૧/૦૩/૨૦૧૫ થી શ્રી સૌંદરવાને ડેટા ઓપરેટરની જગ્યા સામે મુકવામાં આવેલ છે.
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અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન/ નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૧૮.			કોમ્પ્યુટર પ્રોગ્રામર	૧	-	-	૧૩૭૦૦ ફીક્સ	૧. શૌનક ઉપેન્દ્રભાઈ માંકડ	-	૦૫/૦૨/૧૯૮૪	૦૪/૦૪/૨૦૧૧	૦૪/૦૪/૨૦૧૧	૨૩/૦૫/૨૦૧૨	લાગુ પડતું નથી	૨૮/૦૨/૨૦૪૨	નવસારી	જનરલ	વલસાડ	પુલના ધોરણે કે.વિ.કે., ન.કૃ.યુ., નવસારી
૧૯.			આસી. ફાર્મ મેનેજર	૧	-	-	૧૩૭૦૦ ફીક્સ	૧. રાજેશકુમાર કિશોરકુમાર પંચાલ	-	૦૫/૦૧/૧૯૮૮	૩૦/૦૬/૨૦૧૧	૩૦/૦૬/૨૦૧૧	મે-૨૦૦૬	"	૩૧/૦૧/૨૦૪૬	નવસારી	ઓબીસી	બનાસકાંઠા	
૨૦.			ઈન્ચાર્જ મેડીકલ સ્ટોર	૧	૧	-	-	૧. ખાલી જગ્યા	-	-	-	-	-	"	-	-	-	-	કિંજલ અનિલકુમાર પટેલએ તા. ૧૨/૦૪/૨૦૧૧ ની અસરથી રાજીનામું આપતાં જગ્યા ખાલી
૨૧.			એગ્રી. આસીસ્ટન્ટ	૧	-	-	૭૮૦૦	૧. શ્રી મહેશભાઈ જગુભાઈ આહિર	-	૦૭/૦૧/૧૯૮૦	૧૧/૦૭/૨૦૧૨	૧૧/૦૭/૨૦૧૨	ફેબ્રુઆરી -૨૦૧૩	"	૩૧/૦૧/૨૦૩૮	નવસારી	ઓબીસી	નવસારી	
૨૨.			ફાર્માસીસ્ટ	૧	-	-	૧૩૫૦૦ ફીક્સ	૧. શ્રી નિકુંજ ઝીણાભાઈ પટેલ	-	૨૯/૦૯/૧૯૮૪	૧૧/૧૦/૨૦૧૧	૧૧/૧૦/૨૦૧૧	૧૯/૦૫/૨૦૧૦	"	૩૦/૦૯/૨૦૪૮	નવસારી	ઓબીસી	ચીખલી	
૨૩.			એનીમલ એટેન્ડન્ટ	૨૦	૩	-	૭૧૦૦ ફીક્સ	૧. સંતોષભાઈ ઈશ્વરભાઈ પટેલ	-	૨૯/૧૨/૧૯૭૭	૧૯/૦૩/૨૦૧૦	૧૯/૦૩/૨૦૧૦	લાગુ પડતું નથી	લાગુ પડતું નથી	૩૧/૧૨/૨૦૩૭	નવસારી	એસ.ટી.	ડાંગ	આચાર્યશ્રીના વાહનના ડ્રાઇવર
					-	-	૭૧૦૦ ફીક્સ	૨. વિપુલકુમાર ઠાકોરભાઈ પટેલ	-	૦૧/૦૬/૧૯૮૦	૧૯/૦૩/૨૦૧૦	૧૯/૦૩/૨૦૧૦	"	લાગુ પડતું નથી	૩૦/૦૬/૨૦૪૦	નવસારી	એસ.ટી.	નવસારી	
			"		-	-	"	૩. પ્રમોદભાઈ બળવંતભાઈ સોલંકી	-	૩૧/૫/૧૯૮૨	૧૯/૦૩/૨૦૧૦	૧૯/૦૩/૨૦૧૦	"	"	૩૧/૦૫/૨૦૪૨	નવસારી	એસ.સી.	નવસારી	
			"		-	-	૪૪૪૦-૭૪૪૦ ગ્રેડ પે. ૧૩૦૦	૪. શ્રીમતી જયોતિબેન પ્રમોદભાઈ સોલંકી	-	૨૩/૦૫/૧૯૮૩	૨૧/૦૮/૨૦૦૭	૦૫/૧૧/૨૦૧૧	"	"	૩૧/૦૫/૨૦૪૩	નવસારી	એસ.સી.	નવસારી	
			એનીમલ એટેન્ડન્ટ		-	-	૭૧૦૦ ફીક્સ	૫. મોરારભાઈ બુધાભાઈ આહિર	-	૦૧/૦૬/૧૯૬૩	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	લાગુ પડતું નથી	લાગુ પડતું નથી	૩૦/૦૬/૨૦૨૩	નવસારી	ઓબીસી	નવસારી	
			"		-	-	"	૬. અરજણભાઈ ગોવાભાઈ બારડ	-	૦૪/૦૩/૧૯૮૯	૨૨/૦૩/૨૦૧૦	૨૨/૦૩/૨૦૧૦	"	"	૩૧/૦૩/૨૦૪૯	નવસારી	ઓબીસી	બનાસકાંઠા	
			"		-	-	"	૭. મુકેશકુમાર બબાભાઈ ચૌધરી	-	૧૬/૦૪/૧૯૭૯	૨૨/૦૩/૨૦૧૦	૨૨/૦૩/૨૦૧૦	"	"	૩૦/૦૪/૨૦૩૯	નવસારી	ઓબીસી	મહેસાણા	
			"		-	-	"	૮. તરૂણકુમાર ધીરુભાઈ સોલંકી	-	૦૩/૦૪/૧૯૭૯	૨૨/૦૩/૨૦૧૦	૨૨/૦૩/૨૦૧૦	લાગુ પડતું નથી	લાગુ પડતું નથી	૩૦/૦૪/૨૦૩૯	નવસારી	એસ.સી.	નવસારી	
			"		-	-	"	૯. શશીકાંત ભાણાભાઈ આહિર	-	૦૨/૧૧/૧૯૮૪	૨૩/૦૩/૨૦૧૦	૨૩/૦૩/૨૦૧૦	"	"	૩૦/૧૧/૨૦૪૪	નવસારી	ઓબીસી	નવસારી	
			"		-	-	"	૧૦. આશિષકુમાર દલપતભાઈ પટેલ	-	૧૪/૩/૧૯૮૬	૨૩/૦૩/૨૦૧૦	૨૩/૦૩/૨૦૧૦	"	"	૩૧/૦૩/૨૦૪૬	નવસારી	ઓબીસી	સુરત	પોલીટેકનીકમાં પુલના ધોરણે
			"		-	-	"	૧૧. ભગુભાઈ ચીમનભાઈ પટેલ	-	૧૨/૧૦/૧૯૮૩	૨૩/૦૩/૨૦૧૦	૨૩/૦૩/૨૦૧૦	લાગુ પડતું નથી	લાગુ પડતું નથી	૩૧/૧૦/૨૦૪૩	નવસારી	એસ.ટી.	સુરત	
			"		-	-	"	૧૨. શ્રીમતિ પારૂલબેન પ્રફુલભાઈ પટેલ	-	૧૩/૧૨/૧૯૮૨	૨૩/૦૩/૨૦૧૦	૨૩/૦૩/૨૦૧૦	"	"	૩૧/૧૨/૨૦૪૨	નવસારી	ઓબીસી	નવસારી	
			"		-	-	"	૧૩. સંજયકુમાર નટવરભાઈ પરમાર	-	૨૧/૧૦/૧૯૮૮	૨૫/૦૩/૨૦૧૦	૨૫/૦૩/૨૦૧૦	"	"	૩૧/૧૦/૨૦૪૮	નવસારી	એસ.સી.	ગાંધીનગર	
			"		-	-	૭૧૦૦ ફીક્સ	૧૪. પ્રિયંકાબેન જગદીશભાઈ પટેલ	-	૨૭/૦૪/૧૯૯૧	૨૫/૦૩/૨૦૧૦	૨૫/૦૩/૨૦૧૦	"	"	૩૦/૦૪/૨૦૫૧	નવસારી	ઓબીસી	નવસારી	
			"		-	-	"	૧૫. અશોક દાદાભાઈ રાજપુત	-	૦૯/૦૨/૧૯૮૪	૨૯/૦૪/૨૦૧૦	૨૯/૦૪/૨૦૧૦	"	"	૨૮/૦૨/૨૦૪૪	નવસારી	જનરલ	નવસારી	પુલના ધોરણે LRS
			"		-	-	"	૧૬. કમલેશભાઈ અમૃતભાઈ પટેલ	-	૧૫/૦૬/૧૯૭૧	૦૭/૦૯/૨૦૧૦	૦૭/૦૯/૨૦૧૦	"	"	૩૦/૦૬/૨૦૩	નવસારી	એસ.ટી.	નવસારી	
			"		-	-	"	૧૭. હિરેન મહેશભાઈ પટેલ	-	૨૭/૦૨/૧૯૯૧	૦૭/૦૯/૨૦૧૦	૦૭/૦૯/૨૦૧૦	"	"	૨૮/૦૨/૨૦૫૧	નવસારી	ઓબીસી	નવસારી	પુલના ધોરણે LRS
૨૪.			સ્વીપર	૨	૨	-	-	૧. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	
								૨. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	
૨૫.			પ્યુન	૨	૨	-	૭૧૦૦ ફીક્સ	૧. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	
								૨. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	
૨૬.			લાયબ્રેરી એટેન્ડન્ટ	૩	-	-	૭૧૦૦ ફીક્સ	૧. શ્રીમતી કરુણાબહેન તુષારકુમાર	-	૦૩/૦૮/૧૯૮૬	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	લાગુ પડતું નથી	લાગુ પડતું નથી	૩૧/૦૮/૨૦૪૬	નવસારી	ઓબીસી	નવસારી	
							"	૨. વિપુલકુમાર નરેશભાઈ પટેલ	-	૨૮/૦૧/૧૯૮૮	૨૦/૦૩/૨૦૧૦	૨૦/૦૩/૨૦૧૦	"	"	૩૧/૦૧/૨૦૪૮	નવસારી	ઓબીસી	નવસારી	પુલના ધોરણે સેન્ટ્રલ

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ	પ્લાન / નોન-પ્લાન/ આઈ.સી.એ .આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
			લાયબ્રેરી એટેન્ડન્ટ	—	—	—	૭૧૦૦ ફીક્સ	૩. મનોજભાઈ અશ્વિનભાઈ રાઠોડ	—	૧૯/૦૫/૧૯૮૭	૦૭/૦૮/૨૦૧૦	૦૭/૦૮/૨૦૧૦	લાગુ પડતું નથી	"	૩૧/૦૫/૨૦૪૭	નવસારી	એસ.ટી.	નવસારી	પુલના ધોરણ સેન્ટ્રલ લાયબ્રેરી, નવસારી
૨૭.			લેબોરેટરી બોય	૧	૧			ખાલી જગ્યા	—	—	—	—	—	—	—	—	—	—	

નોંધ:— એનીમલ એટેન્ડન્ટ, સ્વીપર, પ્યુન, લાયબ્રેરી એટેન્ડન્ટ, લેબોરેટરી બોય:— સરકારશ્રીના ઠરાવ અનુસાર અત્રેની મહાવિદ્યાલય ખાતે એનીમલ એટેન્ડન્ટની કુલ જગ્યા— ૨૦, સ્વીપરની કુલ જગ્યા—૦૨, પ્યુનની કુલ જગ્યા—૦૨, લાયબ્રેરી એટેન્ડન્ટની કુલ જગ્યા—૦૩, લેબોરેટરી બોયની કુલ જગ્યા —૦૧ મંજૂર થયેલ છે. પરંતુ કુલસચિવશ્રી, ન.કૃ.યુ., નવસારીના સુધારેલ કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/ ૨જી/ એકે/ સ્કીમ/ સુધારો/ ૨૮૯૧— ૨૯૨૦/૨૦૧૪ તા. ૧૭/૧૨/૨૦૧૪ થી સદર જગ્યાઓ આદેશમાં દર્શાવવામાં આવેલ જ નથી. તો આદેશમાં જરૂરી સુધારો થવા વિનંતી.

નોંધ:— આઉટ સોર્સિંગથી મંજૂર થયેલ જગ્યાઓ :

ડ્રાયવર	—	૦૮
લેબ.આસીસ્ટન્ટ/એટેન્ડન્ટ	—	૦૮
એનીમલ એટેન્ડન્ટ	—	૦૮
સ્વીપર	—	૧૫
પટાવાળા	—	૧૭
કુલ:—		૫૬

*પ્રાધ્યાપક—૦૨, સહ પ્રાધ્યાપક—૧૫, મદદ.વહીવટી અધિકારી—૦૧ સહિત અનેક જગ્યાઓ સરકારશ્રીના ઠરાવ મુજબ વર્ષ—૨૦૦૮ થી રદ કરવામાં આવેલ છે. જે પુનઃ જીવિત કરવા વિનંતી છે.

* ખાલી જગ્યાઓ સત્વરે ભરવા વિનંતી અન્યથા ના. સરકારશ્રી ધ્વારા જગ્યાઓ રદ થવાની પુરેપુરી શક્યતા છે.

આચાર્ય
વેટરનરી કોલેજ
ન.કૃ.યુ., નવસારી

સ્ટાફની પરિસ્થિતિ દર્શાવતું ત્રિમાસિક ચાર્જપત્રક તારીખ : ૦૧/૦૧/૨૦૧૫ થી ૩૧/૦૩/૨૦૧૫ અંતિત

યુનિટનું નામ:— વેટરનરી કોલેજ , નવસારી કૃષિ યુનિવર્સિટી, નવસારી

અ.નં.	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ સદર	પ્લાન /નોનપ્લાન / આઈ.સી. એ.આર/ અધર	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧	૧૨	૧૩	૧૪	૧૫	૧૬	૧૭	૧૮	૧૯	૨૦
૧.	એસ્ટાબ્લીશ મેન્ટ ઓફ લાઈવસ્ટોક ઈન્સ્પેક્ટર ટ્રેનીંગ સેન્ટર એટ નવસારી જીએચ/ડીઈઈ/ એસીસીટી-ટી/બીજીટી/ ૧૦૪૦૪-૩૩/૮૮ તા. ૩૧/૦૮/૮૮ બ.સ. ૭૨૫૩ અને વિસ્તરણ શિક્ષણ નિયામકશ્રીના પત્ર જા.નં. નકૃયુ/વિશિનિ/ બી.૩/બજેટ/૪૯૬૫-૭૦/૨૦૦૯ તા. ૧૫/૭/૨૦૦૯ થી તબદીલ થયેલ છે.	નોન પ્લાન	મ.વિ.શિ.શા.	૧	૧		૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	૧. ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	અત્રેની કચેરીના કાર્યાલય આદેશ ક્રમાંક: નકૃયુ/વીસીએન/ અ. ૧/૯૮૪-૮૯/૨૦૧૫ તા. ૦૬/૦૨/૨૦૧૫ થી ડા. સભાપરતનો તા. ૦૧/૦૨/૨૦૧૫ ની અસરથી પગાર ભથ્થાનો ખર્ચ બ.સ. ૧૨૦૪૩ માં પાડવા આદેશ કરવામાં આવેલ છે.
૩.			લેબ.એટેન્ડન્ટ	૧	૧	-	-	ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	પોલીટેકનીક કોલેજની કામગીરી માટે સત્વરે ભરવા વિનંતી છે.
૪.			લેબ.બોય	૧	-	-	૪૪૪૦-૭૪૪૦ ગ્રેડ પે. ૧૬૫૦	૧. શ્રી અતુલકુમાર સોમાભાઈ પટેલ	-	૦૬/૦૧/૧૯૬૭	૧૩/૦૯/૧૯૯૦	૦૧/૧૦/૨૦૧૪	લાગુ પડતું નથી	લાગુ પડતું નથી	૩૧/૦૧/૨૦૨૭	નવસારી	એસ.ટી	સુરત	
	કુલ			૩	૨														

* ઉપરોક્ત ખાલી જગ્યાઓ સત્વરે ભરવા વિનંતી કરવામાં આવે છે. કારણ કે ગત શૈક્ષણિક વર્ષથી એક વર્ષના પશુધન નિરીક્ષક તાલીમ કાર્યક્રમને અપગ્રેડ કરી ત્રણ વર્ષના કોર્ષમાં તબદીલ કરવામાં આવેલ છે. જગ્યા નહીં ભરવાથી ના. સરકારશ્રી તરફથી સદર કાયમ માટે જગ્યાઓ રદ કરી શકે તેવી શક્યતાઓ હોઈ તાકીદે ઘટતું કરવા વિનંતી સહ જણાવવામાં આવે છે.

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યુનિટનું નામ:- વેટરનરી કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ સદર	પ્લાન / નોનપ્લાન/ આઈ.સી.એ.આર/ અધર યોજના	જગ્યાનું નામ	મંજુર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજુર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણુંકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧	૧૨	૧૩	૧૪	૧૫	૧૬	૧૭	૧૮	૧૯	૨૦
૧	એસ્ટાબ્લીશ મેન્ટ ઓફ પોલ્ટ્રી યુનિટ એટ નવસારી -	પ્લાન	વેટરનરી ઓફીસર	-	-	-	-	ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	-
૨	બ.સ. ૧૨૦૪૦		લાઈવસ્ટોક ઈન્સ્પેક્ટર	-	-	-	-	ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	-
	કુલ:-																		

આચાર્ય
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સ્ટાફની પરિસ્થિતિ દર્શાવતું ત્રિમાસિક ચાર્જપત્રક તારીખ : ૦૧/૦૧/૨૦૧૫ થી ૩૧/૦૩/૨૦૧૫ અંતિત

યુનિટનું નામ:- વેટરનરી કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ સદર	પ્લાન / નોનપ્લાન/ આઈ.સી.એ.આર / અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓ ની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ઘોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કરેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧	૧૨	૧૩	૧૪	૧૫	૧૬	૧૭	૧૮	૧૯	૨૦
૧	એસ્ટાબ્લીશ મેન્ટ ઓફ પોલીટેકનીક ઈન એનીમલ હસબન્ડરી, નવસારી બ.સ. ૧૨૦૪૩	પ્લાન	મદદનીશ પ્રાધ્યાપક	૧	-	એલ.પી.એમ.	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	ડૉ. ઘનશ્યામભાઈ પ્રભુલાલ સબાપરા	એલ.પી.એમ.	૦૯/૦૮/૧૯૬૯	૨૧/૦૩/૧૯૯૫	૦૧/૦૮/૨૦૦૯	૦૨/૦૨/૨૦૧૧	૧૯/૦૨/૨૦૧૨	૩૧/૦૮/૨૦૩૧	નવસારી	જનરલ	રાજકોટ	
			લેબ.ટેકનીશીયન	૧	-		૧૩૫૦૦ ફીક્સ	શ્રીમતી રિકતાકુમારી ભવનભાઈ પટેલ	-	૧૨/૦૭/૧૯૭૯	૨૬/૦૪/૨૦૧૦	૨૬/૦૪/૨૦૧૦	૧૮/૧૨/૨૦૧૦	લાગુ પડતુ નથી	૩૧/૦૭/૨૦૩૬	નવસારી	ઓબીસી	નવસારી	
			લાઈવસ્ટોક ઈન્સ્પેક્ટર	૧	૧		૫૨૦૦-૨૦૨૦ ૦ ગ્રેડ પે.૨૪૦૦	ખાલી જગ્યા	-	-	-	-	-	-	-	-	-	-	
	કુલ:			૩	૧														

આચાર્ય
વેટરનરી કોલેજ
ન.કૃ.યુ. નવસારી

સ્ટાફની પરિસ્થિતિ દર્શાવતું ત્રિમાસિક ચાર્જપત્રક તારીખ : ૦૧/૦૧/૨૦૧૫ થી ૩૧/૦૩/૨૦૧૫ અંતિત

યુનિટનું નામ:— વેટરનરી કોલેજ, નવસારી કૃષિ યુનિવર્સિટી, નવસારી

અ.નં	યોજનાનું નામ, ઠરાવ નંબર, તારીખ અને બજેટ સદર	પ્લાન / નોનપ્લાન/ આઈ.સી.એ.આર/ અધર યોજના	જગ્યાનું નામ	મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાઓની સંખ્યા	મંજૂર થયેલ જગ્યાની ડીસીપ્લીન	પગાર ધોરણ (ગ્રેડ પે અલગથી બતાવવો)	ભરેલ જગ્યાની ઉપર ફરજ બજાવતા કર્મચારીઓના નામ	કર્મચારીની ડીસીપ્લીન	જન્મ તારીખ	પ્રથમ નિમણૂકની તારીખ	હાલની કચેરીમાં હાજર થયાની તારીખ	CCC+ /CCC પાસ કર્યાની તારીખ	NET પરીક્ષા પાસ કર્યાની તારીખ (શૈક્ષણિક સંવર્ગ)	વય નિવૃત્તિની તારીખ	મુખ્ય મથક	સી.કા, સી.ટા, બક્ષીપંચ, અન્ય	વતનનો જિલ્લો	નોંધ
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧	૧૨	૧૩	૧૪	૧૫	૧૬	૧૭	૧૮	૧૯	૨૦
૧	એસ્ટાબ્લીશ મેન્ટ ઓફ કોલેજ ઓફ ફીશરીઝ સાયન્સ, નવસારી -	પ્લાન	મદદનીશ પ્રાધ્યાપક	૧	—	ફીશરીઝ	૧૫૬૦૦-૩૯૧૦૦/ ગ્રે.પે. ૬૦૦૦	ડૉ. હરેશકુમાર ગોકળ સોલંકી	ફીશરીઝ	૦૧/૦૬/૧૯૭૫	૦૬/૧૨/૨૦૦૬	૦૧/૦૨/૨૦૧૫	૦૮/૧૦/૨૦૦૭	ઓક્ટોબર-૨૦૦૧	૩૦/૦૬/૨૦૩૭	નવસારી	ઓબીસી	દીવ	—
૨	બ.સ.૧૨૦૪૪		લેબ.ટેકનીશીયન	૧	—	—	૧૩૫૦૦ ફીક્સ	શ્રીમતિ સેજલ પરેશ પટેલ	—	૧૭/૦૯/૧૯૮૬	૨૨/૦૪/૨૦૧૦	૨૨/૦૪/૨૦૧૦	૧૮/૧૨/૨૦૧૦	લાગુ પડતું નથી	૩૦/૦૯/૨૦૪૪	નવસારી	ઓબીસી	તાપી	
	કુલ:—			૨	—														

આચાર્ય
વેટરનરી કોલેજ
ન.કૃ.યુ. નવસારી

બજેટ સદર મુજબ મંજૂર થયેલ કુલ જગ્યાઓની માહિતી

અ.નં	બજેટ સદર	મંજૂર થયેલ જગ્યાની સંખ્યા	ભરાયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાની સંખ્યા	આઉટ સોર્સીંગથી મંજૂર થયેલ જગ્યાની સંખ્યા	ખાલી જગ્યાની માહિતી
૧	૨	૩	૪	૫	૬	૭
૧	૭૨૫૩	૦૩	૦૧	૦૨	—	૧-મ.વિ.શિ.શા. ૧- લેબ.એટેન્ડન્ટ
૨	૧૨૪૦૪	૧૭૮ + *૫૬ = ૨૩૪	૧૪૦	૩૮	* ૫૬	૦૬- પ્રાધ્યાપક ૦૫- સહ પ્રાધ્યાપક ૦૬- મદદનીશ પ્રાધ્યાપક ૦૧- ઓફિસ સુપ્રિટેન્ડન્ટ ૦૩- લેબ.ટેકનીશીયન ૦૫-લેબોરેટરી આસીસ્ટન્ટ ૦૧- લાઈવ સ્ટોક ઈન્સ્પેક્ટર ૦૨- વેટરનરી ઓફિસર ૦૧ - ઈન્ચાર્જ મેડીકલ સ્ટોર ૦૩- એનીમલ એટેન્ડન્ટ ૦૨- સ્વીપર ૦૨ - પ્યુન ૦૧ - લેબોરેટરી બોય
					મંજૂર થયેલ જગ્યા	રોજમદારથી ભરાયેલ જગ્યા
					ડ્રાયવર - ૦૮	૦૨
					લેબ.આસીસ્ટન્ટ/એટેન્ડન્ટ-૦૮	૦૨
					એનીમલ એટેન્ડન્ટ- ૦૮	૦૩
					સ્વીપર-૧૫	૦૬
					પટાવાળા-૧૭	૦૧
					કુલ:- ૫૬	૧૪
૩	૧૨૦૪૩	૩	૨	૧		
૪	૧૨૦૪૪	૨	૨	—		
	કુલ :	૨૪૨	૧૪૫	૪૧	૫૬	

ખાસ નોંધ:-

- * ખાલી રહેલ શિક્ષક સંવર્ગોની જગ્યાઓ ભરવા જાહેરાત આપવા વિનંતી.
- * બધી જ ખાલી જગ્યાઓ ભરવા વિનંતી અન્યથા ના.સરકારશ્રી ધ્વારા જગ્યાઓ રદ કરવામાં આવી શકે છે.
- * બધી જ ખાલી જગ્યાઓ ભરવા વિનંતી અન્યથા ના.સરકારશ્રી ધ્વારા જગ્યાઓ રદ કરવામાં આવી શકે છે.

આચાર્ય
વેટરનરી કોલેજ
ન.કૃ.યુ. નવસારી



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : PLAN SCHEME

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES	
		GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	
		EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	
		BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	
									RECEIPT
GOVT BUDGET HEAD :		(03 P) 2415 01 277 027 AGRICULTURAL EDUCATUON							
343/12241/00	ESTABLISHMENT OF AGRO	0.00	0.00	0.00	400,000.00	0.00	0.00	400,000.00	
	ITI CENTRE FOR VETE	0.00	0.00	0.00	399,588.00	0.00	0.00	399,588.00	
	COLLEGE ,DAIRY,POLTRY &	0.00	0.00	0.00	412.00	0.00	0.00	412.00	
	FISHERIES NAVSARI							0.00	
343/12703/0C	FELLOSHIP FOR P.G. STUDIES	0.00	0.00	0.00	21,000.00	0.00	0.00	21,000.00	
	OF VARIOUS FACULTIES	0.00	0.00	0.00	18,000.00	0.00	0.00	18,000.00	
	VETERINARY NAVSARI	0.00	0.00	0.00	3,000.00	0.00	0.00	3,000.00	
								0.00	
343/12972/0C	SCHE FOR FELLOSHIP TO UG	0.00	0.00	0.00	60,000.00	0.00	0.00	60,000.00	
	STUDENTS OF VARIOUS	0.00	0.00	0.00	60,000.00	0.00	0.00	60,000.00	
	FACULTIES, VETE COLLEGE,	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	NAVSARI							0.00	



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND :

PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	481000.00	0.00	0.00	481000.00
	0.00	0.00	0.00	477588.00	0.00	0.00	477588.00
	0.00	0.00	0.00	3412.00	0.00	0.00	3412.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES	
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	
							RECEIPT	
GOVT BUDGET HEAD :								
(04 P) 2415 01 277 034 EXTIONSION EDUCATION PROGRAM IN AGRICUTLTURE FACULTY								
343/12253/00	ESTT. OF LIVE STOCK	0.00	0.00	0.00	700,000.00	200,000.00	0.00	900,000.00
	INSPECTOR TRAINING	0.00	0.00	0.00	699,532.00	189,000.00	0.00	888,532.00
	CENTRE, (VETERINARY)	0.00	0.00	0.00	468.00	11,000.00	0.00	11,468.00
	NAVSARI							65350.00
343/12318/00	STRENGTHENING OF MOBILE	0.00	0.00	0.00	250,000.00	0.00	0.00	250,000.00
	AMBULATOR CLINIC	0.00	0.00	0.00	247,454.00	0.00	0.00	247,454.00
	(VETERINARY) NAVSARI	0.00	0.00	0.00	2,546.00	0.00	0.00	2,546.00
								0.00
343/12994/00	ESTT OF VETE CLINICAL RES	0.00	0.00	0.00	990,000.00	1,725,000.00	0.00	2,715,000.00
	& EXPERIMENTAL LEARNING	0.00	0.00	0.00	989,070.00	313,792.00	0.00	1,302,862.00
	COMPLEX, (VETERINARY)	0.00	0.00	0.00	930.00	1,411,208.00	0.00	1,412,138.00
	NAVSARI							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND :

PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE
							RECEIPT
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	1940000.00	1925000.00	0.00	3865000.00
	0.00	0.00	0.00	1936056.00	502792.00	0.00	2438848.00
	0.00	0.00	0.00	3944.00	1422208.00	0.00	1426152.00
							65350.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : **PLAN SCHEME**

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD :	(05 P) 2415 01 796 049 EXTIONSION EDUCTION PROGRAM IN TRIBAL AREA						
343/12404/00 STRENGTHENING OF VETE	66565000.00	0.00	66,565,000.00	11,500,000.00	4,770,000.00	0.00	82,835,000.00
COLLGE PHASE-5	34179397.00	32,381,554.00	66,560,951.00	11,497,767.00	2,711,700.00	0.00	80,770,418.00
VETERINARY COLLEGE	32385603.00	-32,381,554.00	4,049.00	2,233.00	2,058,300.00	0.00	2,064,582.00
NAVSARI							4187922.00
GOVT BUDGET HEAD TOTAL :	66565000.00	0.00	66565000.00	11500000.00	4770000.00	0.00	82835000.00
	34179397.00	32381554.00	66560951.00	11497767.00	2711700.00	0.00	80770418.00
	32385603.00	-32381554.00	4049.00	2233.00	2058300.00	0.00	2064582.00
							4187922.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES	
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	
							RECEIPT	
GOVT BUDGET HEAD :	(06 P) 2415 01 796 056 AGRICULTURAL RESEARCH PROG.RAM IN TRIBAL AREA							
343/12049/00	ESTABLISHMENT OF	0.00	0.00	0.00	1,000,000.00	1,647,000.00	0.00	2,647,000.00
	REGIONAL ANIMAL DISEASE	0.00	0.00	0.00	999,984.00	1,646,219.00	0.00	2,646,203.00
	DIAGNOSIS AND RESEARCH	0.00	0.00	0.00	16.00	781.00	0.00	797.00
	LABORATORY AT NAU							0.00
343/12050/00	EVALUATION AND	0.00	0.00	0.00	1,000,000.00	0.00	0.00	1,000,000.00
	VALIDATION OF	0.00	0.00	0.00	996,600.00	0.00	0.00	996,600.00
	ANTIMICROBIAL AND ANTI	0.00	0.00	0.00	3,400.00	0.00	0.00	3,400.00
	INFLAMMATORY ACTIVITY							0.00
	OF MEDICINAL PLANTS USED							
	BY VANBANDHUS OF SOUTH							
	GUJARAT AT NAU							
GOVT BUDGET HEAD TOTAL :		0.00	0.00	0.00	2000000.00	1647000.00	0.00	3647000.00
		0.00	0.00	0.00	1996584.00	1646219.00	0.00	3642803.00
		0.00	0.00	0.00	3416.00	781.00	0.00	4197.00
								0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : **PLAN SCHEME**

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
		GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
		EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
		BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
								RECEIPT
GOVT BUDGET HEAD :		(15 P) 2415 01 796 032 AER 1 EDUCATION IN TRIBAL AREA						
343/12043/00	ESTABLISHMENT OF	103000.00	0.00	103,000.00	400,000.00	1,000,000.00	0.00	1,503,000.00
	POLYTECHNIQUE IN ANIMAL	53480.00	49,116.00	102,596.00	399,477.00	971,903.00	0.00	1,473,976.00
	HUSBANDRY, NAVSARI	49520.00	-49,116.00	404.00	523.00	28,097.00	0.00	29,024.00
								0.00
343/12044/00	ESTABLISHMENT OF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	COLLEGE OF FISHERIES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCIENCE, NAVSARI	0.00	0.00	0.00	0.00	0.00	0.00	0.00
								0.00
GOVT BUDGET HEAD TOTAL :		103000.00	0.00	103000.00	400000.00	1000000.00	0.00	1503000.00
		53480.00	49116.00	102596.00	399477.00	971903.00	0.00	1473976.00
		49520.00	-49116.00	404.00	523.00	28097.00	0.00	29024.00
								0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD :	(18 PWR) 2415 01 004 029 RESEARCH PLAN WORKS RE-VALID						
343/12318/00/R STRENGTHENING OF MOBILE	0.00	0.00	0.00	500,000.00	0.00	0.00	500,000.00
AMBULATOR CLINIC	0.00	0.00	0.00	476,870.00	0.00	0.00	476,870.00
(VETERINARY) NAVSARI	0.00	0.00	0.00	23,130.00	0.00	0.00	23,130.00
							0.00
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	500000.00	0.00	0.00	500000.00
	0.00	0.00	0.00	476870.00	0.00	0.00	476870.00
	0.00	0.00	0.00	23130.00	0.00	0.00	23130.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : **PLAN SCHEME**

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD :	(22 TSPWR) 2415 01 796 049 EDU. TSP PLAN WORKS RE-VALID						
343/12404/0R STRENGTHENING OF VETE	0.00	0.00	0.00	0.00	1,253,547.00	0.00	1,253,547.00
COLLGE PHASE-5	0.00	0.00	0.00	0.00	138,914.00	0.00	138,914.00
VETERINARY COLLEGE	0.00	0.00	0.00	0.00	1,114,633.00	0.00	1,114,633.00
NAVSARI							0.00
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	0.00	1253547.00	0.00	1253547.00
	0.00	0.00	0.00	0.00	138914.00	0.00	138914.00
	0.00	0.00	0.00	0.00	1114633.00	0.00	1114633.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD :	(23 P (NEW)) 2415 01 004 029 AGRICULTURAL RESEARCH (NEW)						
343/12040/00 ESTABLISHMENT OF	0.00	0.00	0.00	25,000.00	500,000.00	0.00	525,000.00
POULTRY UNIT AT NAVSARI.	0.00	0.00	0.00	10,239.00	64,488.00	0.00	74,727.00
	0.00	0.00	0.00	14,761.00	435,512.00	0.00	450,273.00
							0.00
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	25000.00	500000.00	0.00	525000.00
	0.00	0.00	0.00	10239.00	64488.00	0.00	74727.00
	0.00	0.00	0.00	14761.00	435512.00	0.00	450273.00
							0.00

**GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT**

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND :

PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE RECEIPT
FUND TOTAL :	66668000.00	0.00	66668000.00	16846000.00	11095547.00	0.00	94609547.00
	34232877.00	32430670.00	66663547.00	16794581.00	6036016.00	0.00	89494144.00
	32435123.00	-32430670.00	4453.00	51419.00	5059531.00	0.00	5115403.00
							4253272.00

**GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT**

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND :

PLAN SCHEME

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE RECEIPT
GRAND TOTAL :	66,668,000.00	0.00	66,668,000.00	16846000.00	11095547.00	0.00	94609547.00
	34232877.00	32430670.00	66663547.00	16794581.00	6036016.00	0.00	89494144.00
	32435123.00	-32430670.00	4453.00	51419.00	5059531.00	0.00	5115403.00
							4253272.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES	
		GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	
		EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	
		BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	
								RECEIPT	
GOVT BUDGET HEAD :		(01 I) ICAR-100% SCHEME - - - -							
343/02064/00	ICAR VETERINARY COLLEGE NAVSARI	6000.00	0.00	6,000.00	298,342.00	0.00	0.00	304,342.00	
		0.00	5,655.00	5,655.00	298,192.00	0.00	0.00	303,847.00	
		6000.00	-5,655.00	345.00	150.00	0.00	0.00	495.00	
								0.00	
343/02072/00	EXPERINTIAL LEARNING UNIT SETTING UP OF FACILITIES FOR ENTERPRENERUSHIP	0.00	0.00	0.00	1,000,000.00	1,000,000.00	0.00	2,000,000.00	
		0.00	0.00	0.00	51,875.00	226,980.00	0.00	278,855.00	
		0.00	0.00	0.00	948,125.00	773,020.00	0.00	1,721,145.00	
								0.00	
343/02082	Goat Production and Rearing Project	0.00	0.00	0.00	200,000.00	0.00	0.00	200,000.00	
		0.00	0.00	0.00	69,090.00	0.00	0.00	69,090.00	
		0.00	0.00	0.00	130,910.00	0.00	0.00	130,910.00	
								0.00	

**GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT**

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : ICAR

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE
GOVT BUDGET HEAD TOTAL :	6000.00	0.00	6000.00	1498342.00	1000000.00	0.00	2504342.00
	0.00	5655.00	5655.00	419157.00	226980.00	0.00	651792.00
	6000.00	-5655.00	345.00	1079185.00	773020.00	0.00	1852550.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE
							RECEIPT
FUND TOTAL :	6000.00	0.00	6000.00	1498342.00	1000000.00	0.00	2504342.00
	0.00	5655.00	5655.00	419157.00	226980.00	0.00	651792.00
	6000.00	-5655.00	345.00	1079185.00	773020.00	0.00	1852550.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE RECEIPT
GRAND TOTAL :	6,000.00	0.00	6,000.00	1498342.00	1000000.00	0.00	2504342.00
	0.00	5655.00	5655.00	419157.00	226980.00	0.00	651792.00
	6000.00	-5655.00	345.00	1079185.00	773020.00	0.00	1852550.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES	
		GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	
		EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	
		BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	
									RECEIPT
GOVT BUDGET HEAD :		(01 IA) ICAR DEVELOPMENT - - - -							
343/26003/00	3.1 Preparation of quislity instructional material, practical manuals and e-resources	0.00	0.00	0.00	500,000.00	0.00	0.00	500,000.00	
		0.00	0.00	0.00	433,378.00	66,622.00	0.00	500,000.00	
		0.00	0.00	0.00	66,622.00	-66,622.00	0.00	0.00	
								0.00	
343/26011/00	4.1 Faculty development, Feclitating within country perticipation in symposia, seminars, training	0.00	0.00	0.00	350,000.00	0.00	0.00	350,000.00	
		0.00	0.00	0.00	350,000.00	0.00	0.00	350,000.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
								0.00	
343/26018/00	5.1 Students amenities; students counseling and placement	0.00	0.00	0.00	650,000.00	100,000.00	0.00	750,000.00	
		0.00	0.00	0.00	354,653.00	395,347.00	0.00	750,000.00	
		0.00	0.00	0.00	295,347.00	-295,347.00	0.00	0.00	
								0.00	



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
		GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE
								RECEIPT
343/26022/00	5.2 National Talent Schoarship, Best Teacher Award; Gatalytic support for faculty exchange	0.00	0.00	0.00	50,000.00	0.00	0.00	50,000.00
		0.00	0.00	0.00	50,000.00	0.00	0.00	50,000.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00
343/26027/00	5.3 Presonality Development; Counselling of UG/PG students; Tutorials for SC/ST students.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00
343/26037/00	6.2 Faculty specific requirements for improving edudcation & Development & Strengthening of facilities.	0.00	0.00	0.00	900,000.00	0.00	0.00	900,000.00
		0.00	0.00	0.00	292,346.00	607,654.00	0.00	900,000.00
		0.00	0.00	0.00	607,654.00	-607,654.00	0.00	0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
		GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE	GRANT EXPENDITURE BALANCE RECEIPT
343/26055/00	3.1 Annual Maintenance Contracts of equipment, Repair of parts thereof, up gradation / replacement of facilities	0.00	0.00	0.00	300,000.00	0.00	0.00	300,000.00
		0.00	0.00	0.00	300,000.00	0.00	0.00	300,000.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00
								0.00
343/26078/00	1.3 Repair, Renovation, Refurbishing, Modernization and maintenance of existing structures	0.00	0.00	0.00	0.00	1,300,000.00	0.00	1,300,000.00
		0.00	0.00	0.00	1,053,377.00	246,623.00	0.00	1,300,000.00
		0.00	0.00	0.00	-1,053,377.00	1,053,377.00	0.00	0.00
								0.00
343/26083/00	7.1 Development and strengthening of facilities; reference and reading material/ text books; faculty specific requirements for improving education; support to examination	0.00	0.00	0.00	100,000.00	0.00	0.00	100,000.00
		0.00	0.00	0.00	100,000.00	0.00	0.00	100,000.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00
								0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	2850000.00	1400000.00	0.00	4250000.00
	0.00	0.00	0.00	2933754.00	1316246.00	0.00	4250000.00
	0.00	0.00	0.00	-83754.00	83754.00	0.00	0.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD :			(05 IA) JRF/SRF - - - -				
343/15089/00 JUNIOR RESEARCH	0.00	0.00	0.00	150,000.00	0.00	0.00	150,000.00
FELLOWSHIP(PGS)	0.00	0.00	0.00	150,000.00	0.00	0.00	150,000.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							0.00
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	150000.00	0.00	0.00	150000.00
	0.00	0.00	0.00	150000.00	0.00	0.00	150000.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							0.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

		PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES	
		GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	
		EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	
		BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	
								RECEIPT	
GOVT BUDGET HEAD :		(06 IAR) ICAR DEVELOPMENT - - - -							
343/26018/OR	5.1 Students amenities; students counseling and placement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
								75607.00	
343/26037/OR	6.2 Faculty specific requirements for improving education & Development & Strengthening of facilities.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
								96573.00	
343/26078/OR	1.3 Repair, Renovation, Refurbishing, Modernization and maintenance of existing structures	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
								750820.00	



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Period : 01 Apr 2014 To 31 Mar 2015

Account Name :

FUND : ICAR ADHOC

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GOVT BUDGET HEAD TOTAL :	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							923000.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
FUND TOTAL :	0.00	0.00	0.00	3000000.00	1400000.00	0.00	4400000.00
	0.00	0.00	0.00	3083754.00	1316246.00	0.00	4400000.00
	0.00	0.00	0.00	-83754.00	83754.00	0.00	0.00
							923000.00



GOVT. BUDGETHEADWISE GRANT EXPENDITURE REPORT

Account Name :

Period : 01 Apr 2014 To 31 Mar 2015

FUND : ICAR ADHOC

	PAY	ALLOWANCE	TOTAL (P+A)	RECURRING	NON RECURRING	WORKS	TOTAL EXPENSES
	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT	GRANT
	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE	EXPENDITURE
	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE	BALANCE
							RECEIPT
GRAND TOTAL :	0.00	0.00	0.00	3000000.00	1400000.00	0.00	4400000.00
	0.00	0.00	0.00	3083754.00	1316246.00	0.00	4400000.00
	0.00	0.00	0.00	-83754.00	83754.00	0.00	0.00
							923000.00

**NEW AND RESTRUCTURED
POST-GRADUATE CURRICULA & SYLLABI**

Basic Veterinary Subjects

Veterinary Anatomy & Histology

Veterinary & Animal Husbandry Extension

Veterinary Biochemistry

Veterinary Physiology



**Education Division
Indian Council of Agricultural Research
New Delhi**

January 2009

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PREAMBLE

Veterinary sciences have helped in reducing animal sufferings, minimizing risk of zoonotic diseases threatening human health and ensuring food security. There have been unprecedented advancements in all the branches of veterinary sciences. The futuristic requirements of the society such as integrated casualty management, public health, food security and safety, healthy eco-system, containing bio-terrorism, productivity, profitability and stability of livestock farming systems etc., have posed greater challenges for veterinary academics and scientific community. Veterinarians with higher qualifications are increasingly being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonoses, eco-health stewardship, monitoring and surveillance of diseases of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistant breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary sciences. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates

In this perspective, it is important that the veterinary profession responds to the futuristic societal needs to remain relevant and purposeful. Recent advances in veterinary medical sciences have led to wide spread use of animal disease surveillance and prediction system, 3-D holographic animal models, robotic tele-surgery, globe-wide virtual class rooms and demonstration centers, sensor diagnostic facilities etc. The dominant forces shaping the Veterinary-Business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. Informal discussions amongst veterinary academicians, over

the years, referred to the need to train good teachers and researchers with comprehensive subject knowledge rather than narrow sub-specialization of a discipline at Master's level. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was initiated.

Three BSMA committees, constituted by ICAR for restructuring of masters and doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committees consisted of ¹Basic Veterinary Sciences (Anatomy and Histology; Veterinary & Animal Husbandry Extension; Biochemistry and Physiology); ²Veterinary Para-clinical Sciences (Microbiology, Parasitology, Pathology, Pharmacology & Toxicology, Public Health) and ³Veterinary Clinical Sciences (Animal Reproduction, Gynaecology & Obstetrics; Clinical Medicine, Ethics and Jurisprudence; Epidemiology & Preventive Medicine and Surgery & Radiology).

The Master's programme in basic veterinary subjects aims at providing cutting edge concepts as well as practical applications of these exciting fields. The new and restructured Post-Graduate curricula and syllabi in respect of basic, paraclinical and clinical veterinary sciences documents contain several innovative and practically applicable courses and extensively revamped course contents viz. inclusion of imaging techniques, ultra-structural studies and clinical applications in the curricula of veterinary anatomy; emphasis on cell membrane dynamics, receptor biology and proteomics in relation to various animal diseases in veterinary biochemistry; focus on rumen microbiology and metabolism, immuno-physiology and physiology of stress in veterinary physiology; framing of courses on social psychology, group dynamics, gender and livestock development, planning and monitoring, organizational management and information and communication technology in the veterinary and animal husbandry extension.

Para-clinical veterinary subjects, which provide essential support by employing disease diagnostics technologies for prevention and control of animal diseases, directing efforts for Green Earth, maintenance of biodiversity etc., have been redesigned in the light of general recommendations of the BSMA committees on veterinary sciences. Courses have been re-designed in such a manner that an MVSc student in Microbiology studies all aspects of bacteriology, virology, mycology and immunology. The contents of 17 courses of microbiology and 14 courses of immunology have been reshaped and encapsulated into 9 mandatory courses of 600 series and 18 optional courses of 700 series have been carved

in veterinary microbiology. In veterinary parasitology, new courses on malacology, remote sensing and GIS have been introduced. In veterinary pathology, courses on veterolegal pathology and toxico-pathology have been introduced. A new course on ethno-pharmacology has been introduced in veterinary pharmacology while courses on fish, fish products and seafood hygiene; disaster management and bioterrorism; emerging and reemerging zoonoses; occupational health hazards; disposal and recycling of waste; biohazards and bio-security have been introduced in veterinary public health.

The new approach encompassed the latest knowledge for development of advanced diagnostics, clinical management, clinical epidemiology, bio-security, prevention and control of diseases of livestock and poultry including zoonoses like Bird Flu, Rabies, Tuberculosis, Brucellosis etc. New courses on 'Herd Health management', 'Ecology', 'Forensic Medicine', 'Emergency Medicine', 'Diagnostic Imaging Techniques,' 'Survey and Surveillance', 'Diseases of Zoo, Wild and Laboratory Animals' etc. have been framed and contents of other courses were heavily revised to include the latest developments. To encourage clinical practice in the veterinary clinics, courses of Clinical Practice each at MVSc and PhD level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course for special problems has been introduced in all the subjects.

Teaching Veterinary Clinical Service Complex, along with clinical departments and diagnostic laboratories, provides yeoman's service to stake holders in the field of animal health. The up-gradation of the clinical services will go a long way in meeting the expectations and demands for advanced diagnosis, therapeutics and prophylaxis. The state of infra-structure, manpower (both technical and support staff) and contingencies attached to clinical service units in veterinary colleges in India, requires immediate attention of policy planners to support and supplement in terms of liberal financial grants.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

Dharmeshwar Das, Convener, BSMAC (Basic Veterinary Sciences)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in veterinary science disciplines have been prepared in the light of PG programmes in vogue at different veterinary colleges in India and contemporary developments in veterinary sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each MVSc student should register for all the courses offered by the major department, e.g. an MVSc student in microbiology should study all basic courses of bacteriology, virology and immunology instead of opting for courses of 1 or 2 sub-disciplines only. However, flexibility has been retained at Ph.D. level.

II. Credit Requirements

Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the veterinary students as given below.

- ⊕ The total course work of 40 credit hours has been proposed at M.V.Sc. level instead of minimum requirement 35 credit hours, keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in Table-1) and supporting subjects together (as per requirement) -11 credits.
- ⊕ At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in Table-1) and supporting subject together (as per requirement) -11 credits.
- ⊕ Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credit should be taken from minor subject and courses with a minimum of 3 credit hours from supporting subject should be taken Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- ⊕ The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- ⊕ It is proposed that clinical practice of 0+3 credit hours should be made compulsory in the two semesters for all MVSc students in departments of Clinical Medicine, Ethics & Jurisprudence, Surgery & Radiology, and Animal Reproduction, Gynaecology & Obstetrics.
- ⊕ Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.

- ⊕ The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for MVSc and 700 for Ph. D. programme.

III. Major additions and alterations in the existing PG courses

Veterinary Anatomy and Histology

To enhance the comprehension, the courses have been redesigned to teach system-wise detailed anatomical structures, besides facilitating learning of regional anatomy. Latest anatomical, histological, histochemical and histoimmunochemical techniques in vogue, have been earmarked for practical classes to encourage hands on training to PG students. Major emphasis in re-designed courses has been clinical application of the basic knowledge of anatomy and histology. All the masters' and doctoral courses have been improved significantly to include the latest development in the field e.g. basics of bio-mechanics of the locomotor system, radiography of normal and developing bones; surgical sites for various operations and clinically significant areas for performing clinical examination. Ultra structural studies of organs and tissues have been incorporated wherever required.

- VAN 606 (General histology and ultrastructure) and VAN 607 (Systemic histology and ultrastructure) courses have included ultrastructural studies on General Histology.
- VAN 701 [Myology, angiology, neurology and anesthesiology of equine, canine and porcine]; VAN 706 [Theory and applications of electron microscope]; VAN 707 [Histoenzymology and immunocytochemistry]; VAN 708 [Applied embryology and teratology] and VAN 710 [Gross anatomy of laboratory animals] are newly designed doctoral courses.

Veterinary and Animal Husbandry Extension

To ensure that academic and scientific developments in all fields of veterinary sciences and Animal Husbandry get translated into adoption by the beneficiaries, framing of contemporary courses in VAHE became essential.

- The course AHE 607 [Social psychology and group dynamics] is redesigned to focus on social psychology and addition of group dynamics as an essentiality of today's work environment.
- The course AHE 609 [Developments in the concept of extension] is a new course designed to acquaint students with recent developments in extension education.
- The course AHE 611 [Gender and livestock development] is a new course designed to acquaint the students with the concept of gender, its importance in livestock development, livestock development policies and the government programmes to empower women.

- The course AHE 612 [Information and communication technology in livestock development] is a new course designed to apprise the students about information system, networking and use of various ICT tools.
- AHE 702 [Farm journalism and public relations] designed to sensitize students about the role of mass media, news papers, magazines, radio, T.V. and internet for promoting animal husbandry.
- AHE 705 [Policies & regulations in livestock sector] designed to sensitize the students about policies and regulations in animal husbandry sector.
- AHE 706 [Educational technology] designed to acquaint students with different concepts of education technology.
- AHE 708 [Organizational communication] designed to sensitize the students towards communication and networking to increase the efficiency of an organization.

Veterinary Biochemistry

- VBC 601 [Chemistry of animal cell] is refabricated to emphasize the application of organic chemistry principles to clinical diseases of animals
- VBC 603 [Applications of genomics and proteomics in molecular biology] is largely re-formatted to lay greater emphasis on clinical and industrial application of proteins and genome, e.g. drug resistance, regulation of pathogen pathways etc.
- VBC 605 [Enzyme catalysis, kinetics, inhibition and regulation] redesigned to lay more emphasis on animal disease control by regulation and inhibition mechanisms.
- VBC 608 [Metabolism-iii: integration and regulation] designed to highlight disorders due to failed integration and regulation, e.g. Obesity, diabetes, cancer, poisoning, stress, apoptosis, liver and renal diseases, acid base imbalance etc.
- VBC 613 [Biochemical basis of animal production] designed to teach biochemistry of draft capacity, meat production and dairy chemistry.
- VBC 701 [Advances in biochemistry of ruminant disorders] designed to give exposure to developments in ruminant disorders associated with metabolism.
- VBC 705 [Methods in protein analysis] designed to teach latest advances in characterization of proteins in health & disease.

Veterinary Physiology

- VPY 610 [Research techniques in veterinary physiology] designed to train students in recording of ECG, EMG, Physiograph, GLC, Electrophoresis, body composition using radio-isotopes, *in vitro* and *in sacco* rumen studies, ELISA.
- VPY 709 [Advances in rumen microbiology and metabolism] designed to teach rumen ecosystem and symbiotic relationship of flora and fauna, their structure and functions, rumen manipulation techniques etc.
- VPY 710 [Advances in immunophysiology] designed to study cells and organs of immune system, its development and role in physiological functions and immunomodulation.
- VPY 711 [Physiology of stress] designed to teach the mechanism and effect of stress on production and reproduction in domestic animals.

ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	60	75
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given in Table 1.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Table 1. Suggested list of specified minor subjects (Departments)

Major Subject	Minor Subjects*
Veterinary Anatomy and Histology	Veterinary Pathology, Veterinary Surgery and Radiology, Veterinary Physiology, Veterinary Biochemistry
Veterinary and Animal Husbandry Extension	Veterinary Epidemiology and Preventive Medicine, Veterinary Public Health, Animal Reproduction Gynecology & Obstetrics, Livestock Production and Management. Animal Nutrition, Animal Genetics & Breeding, Poultry Science
Veterinary Biochemistry	Veterinary Physiology, Veterinary Microbiology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Animal Nutrition, Animal Genetics & Breeding
Veterinary Physiology	Veterinary Anatomy and Histology, Veterinary Biochemistry, Veterinary Pharmacology & Toxicology, Animal Nutrition, Animal Reproduction Gynaecology and Obstetrics, Livestock Production and Management, Animal Genetics & Breeding

* The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the Department and Dean, Post Graduate Studies

VETERINARY ANATOMY AND HISTOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VAN 601	COMPARATIVE OSTEOLOGY AND ARTHROLOGY	1+2
VAN 602	COMPARATIVE SPLANCHNOLOGY	2+2
VAN 603	MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX	1+3
VAN 604	GROSS ANATOMICAL TECHNIQUES	0+2
VAN 605	THEORY AND PRACTICE OF HISTOLOGICAL AND HISTOCHEMICAL TECHNIQUES	1+2
VAN 606	GENERAL HISTOLOGY AND ULTRASTRUCTURE	3+1
VAN 607	SYSTEMIC HISTOLOGY AND ULTRASTRUCTURE	3+1
VAN 608	DEVELOPMENTAL ANATOMY	3+1
VAN 691	MASTER'S SEMINAR	1+0
VAN 699	MASTER'S RESEARCH	20
VAN 701	MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE	0+3
VAN 702	PRINCIPLES AND APPLICATIONS OF BIOMECHANICS	2+0
VAN 703	AVIAN ANATOMY	1+2
VAN 704	NEUROANATOMY	3+1
VAN 705	ENDOCRINE ANATOMY	2+1
VAN 706	THEORY AND APPLICATIONS OF ELECTRON MICROSCOPE	2+1
VAN 707	HISTOENZYMOLOGY AND IMMUNOCYTOCHEMISTRY	2+1
VAN 708	APPLIED EMBRYOLOGY AND TERATOLOGY	1+2
VAN 709	FUNCTIONAL VETERINARY ANATOMY	2+0
VAN 710	GROSS ANATOMY OF LABORATORY ANIMALS	1+1
VAN 790	SPECIAL PROBLEM	0+2
VAN 791	DOCTORAL SEMINAR I	1+0
VAN 792	DOCTORAL SEMINAR II	1+0
VAN 799	DOCTORAL RESEARCH	45

VETERINARY ANATOMY AND HISTOLOGY

Course Contents

VAN 601 COMPARATIVE OSTEOLOGY AND ARTHROLOGY 1+2

Objective

To make a student well versed with the bones and joints of different domestic animals.

Theory

UNIT I

Technical terms, structure, chemical composition and classification of bones.

UNIT II

Bones of appendicular skeleton of ox as a type and their comparison with those of horse, dog, pig and poultry.

UNIT III

Bones of axial skeleton of ox as a type and their comparison with those of horse, dog, pig and poultry.

UNIT IV

Classification and detailed study of different joints of the body.

UNIT V

Study the various indices for estimating race, sex and age of different animals. Basics of biomechanics of the locomotor system. Radiography of normal and developing bones.

Practical

Demonstration of all bones and dissection of joints of buffalo/Cattle.

Suggested Readings

Dyce KM, Sack WO & Wensing CJG. 1996. *Text Book of Veterinary Anatomy*. WB Saunders.

Nickel R, Schumer A, Seiferle E, Freewin J & Wills KH. 1986. *The Locomotor System of Domestic Mammals*. Verlag Paul Parey.

Sisson S & Grossman JD. 1975. *The Anatomy of the Domestic Animals*. Vols. I, II. WB Saunders.

VAN 602 COMPARATIVE SPLANCHNOLOGY 2+2

Objective

To give a detailed overview of different systems constituting splanchnology.

Theory

UNIT I

Descriptive anatomy of various organs of digestive system and associated glands of ox and their comparison with those of horse, dog, pig and poultry. Study of formation of thoracic, abdominal and pelvic cavities; reflection of these cavities.

UNIT II

Study of various organs/structures and associated glands constituting the respiratory system of ox and their comparison with those of horse, dog, pig and poultry.

UNIT III

Detailed study of organs and associated glands comprising the urinary system of ox as a type and their comparison with those of horse, dog, pig and poultry.

UNIT IV

Complete study of various organs and associated glands of male and female genital systems.

UNIT V

Surgical sites for various operations and clinically significant areas for performing auscultation, percussion and for carrying out surgical procedures such as laryngotomy, oesophagotomy, gastrotomy, rumenotomy, cystotomy, urethrotomy, caesarian section, exploratory laparotomy, mamnectomy, thoracotomy, thoracocentesis etc.

Practical

Demonstration of structure and placement of organs in body cavities of all the animals.

Suggested Readings

- Dyce KM, Sack WO & Wensing CJG. 1996. *Text Book of Veterinary Anatomy*. WB Saunders.
- Schummer A, Nickel R & Sack WO. 1979. *The Viscera of the Domestic Mammals*. Verlag Paul Parey.
- Sisson S & Grossman JD. 1975. *The Anatomy of the Domestic Animals*. Vols. I, II. WB Saunders.

VAN 603

MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX 1+3

Objective

To give a thorough knowledge about the muscles, course of blood vessels and nerves of the body in addition to various organs of circulatory, nervous and sensory systems of ox as a type animal.

Theory

UNIT I

Classification of muscle fibres. Origin, insertion and relations of muscles of different body parts.

UNIT II

Topographic anatomy of the vascular system comprising of heart, arteries, veins and lymphatics.

UNIT III

Study of various components of central nervous system, peripheral nervous system and autonomic nervous system.

UNIT IV

Complete study of the gross anatomy of various sense organs.

UNIT V

Study of different nerve blocks, intravenous sites and enucleation of eye ball.

Practical

Dissection of heart, different vessels, brain, cranial nerves, brachial plexuses and lumbo-sacral plexus. Dissection of eye, ear, hoof and horn of buffalo/cattle.

VAN 707

**HISTOENZYMOLOGY AND
IMMUNOCYTOCHEMISTRY**

2+1

Objective

To give a student hands-on practice for various advanced histoenzymic and histochemical techniques.

Theory

UNIT I

Classification of enzymes – Principles of enzymes histochemistry methods.

UNIT II

Substrates –combination–coupling azo-dye methods –capture reagents.

UNIT III

Localization of enzymes and controls in enzyme histochemistry.

UNIT IV

Fluorescence microscopy in enzyme histochemistry.
Immunohistochemistry- principles and techniques.

Practical

Preparation of fixatives and buffers used in histochemistry. Methods of preparations and microscopical examination of routine and special preparations showing different cell organelles and inclusions. Methods for tryptophan-SS, SH groups; Glycogen-glycoproteins; Mucopolysaccharides and lipids. Methods and identification of alkaline and acid phosphatases – succinic dehydrogenase, cytochrome- oxidase, choline-esterase, catecholamines by fluorescence microscopy. Immunohistochemistry – principles and techniques.

Suggested Readings

Selected articles from journals.

VAN 708

APPLIED EMBRYOLOGY AND TERATOLOGY

1+2

Objective

To apprise the students about the current trends in developmental processes.

Theory

UNIT I

Principles of experimental embryology and teratology.

UNIT II

Factors affecting the developmental mechanisms of embryo.

UNIT III

Use of organizers implants, chemical and hormonal preparations in the developmental models and available literature on teratogenic experimentation.

Practical

Collection and study of various teratological specimens from domestic animals. Class discussions on experimental models and available literature on teratogenic experimentation.

Suggested Readings

Selected articles from journals.

VAN 709 **FUNCTIONAL VETERINARY ANATOMY** **2+0**

Objective
To make the student understand the functional anatomy of various organs/systems in relation to structure.

Theory
UNIT I
The relationship of structure to form and function.
UNIT II
The relationship of structure for adaptation and behaviour.
UNIT III
Relationship of structure in relation to clinical conditions/ applications.

Suggested Readings
Selected articles from journals.

VAN 710 **GROSS ANATOMY OF LABORATORY ANIMALS** **1+1**

Objective
To give an overview of different body systems of laboratory animals.

Theory
UNIT I
Study of different organs of digestive system of different laboratory animals.

UNIT II
Detailed study of urinary, male and female reproductive systems of different laboratory animals.

UNIT III
Complete study of respiratory system of different laboratory animals

UNIT IV
Study of organs of circulation and nervous system of different laboratory animals.

UNIT V
Descriptive anatomy of endocrine glands of different laboratory animals.

Practical
Demonstration of placement and relations of different organs in the body cavities of different laboratory animals.

Suggested Readings
Papesko P, Rajtova V & Horak J. 2002. *A Colour Atlas of Anatomy of Small Laboratory Animals: Rabbit, Guinea Pig*. 2nd Ed. Wolfe Publ.

VAN 790 **SPECIAL PROBLEM** **0+2**

Objective
To provide expertise in handling practical research problem(s).

Practical
Short research problem(s) involving contemporary issues and research techniques.

VETERINARY ANATOMY AND HISTOLOGY

List of Journals

- * Acta Anatomica
- * American Journal of Anatomy
- * Anatomia Histologia and Embryologia
- * Anatomical Record
- * Anatomy and Embryology
- * Indian Journal of Veterinary Anatomy
- * Journal of Anatomy

e-Resources

- * <http://www.interscience.wiley.com/journal/117927935/grouphome/home.html> (American Journal of Anatomy)
- * <http://www.ovid.com/site/catalog/Journal/1057.jsp> (Journal of Anatomy)
- * <http://www.interscience.wiley.com/jpages/0003-276X/> (Anatomical Record)
- * <http://www.blackwellpublishing.com/submit.asp> (Anatomia Histologia and Embryologia)

Suggested Broad Topics for Master's and Doctoral Research

- * Gross anatomical disposition of various organs of animals of local interest
- * Light and ultra-structural studies of important organs and systems of animals of local importance
- * Developmental studies of different body systems

VETERINARY AND ANIMAL HUSBANDRY EXTENSION

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
AHE 601	FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1
AHE 602	COMMUNICATION FOR LIVESTOCK DEVELOPMENT	1+1
AHE 603	DIFFUSION AND ADOPTION OF ANIMAL HUSBANDRY PRACTICES	2+1
AHE 604	EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS	2+1
AHE 605	ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION	2+1
AHE 606	RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1
AHE 607	SOCIAL PSYCHOLOGY AND GROUP DYNAMICS	2+1
AHE 608	ANIMAL HUSBANDRY DEVELOPMENT PROGRAMMES	1+0
AHE 609	DEVELOPMENTS IN THE CONCEPT OF EXTENSION	1+0
AHE 610	HUMAN RESOURCE MANAGEMENT IN ANIMAL HUSBANDRY SECTOR	2+1
AHE 611	GENDER AND LIVESTOCK DEVELOPMENT	1+0
AHE 612	INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT	1+1
AHE 691	MASTER'S SEMINAR	1+0
AHE 699	MASTER'S RESEARCH	20
AHE 701	ORGANIZATIONAL MANAGEMENT	3+0
AHE 702	FARM JOURNALISM AND PUBLIC RELATIONS	2+1
AHE 703	ADVANCED RESEARCH TECHNIQUES IN SOCIAL RESEARCH	3+1
AHE 704	TRAINING FOR HUMAN RESOURCE DEVELOPMENT	2+1
AHE 705	POLICIES AND REGULATIONS IN LIVESTOCK SECTOR	2+0
AHE 706	EDUCATIONAL TECHNOLOGY	2+1
AHE 707	DYNAMICS OF CHANGE	2+0
AHE 708	ORGANIZATIONAL COMMUNICATION	2+1
AHE 790	SPECIAL PROBLEM	0+2
AHE 791	DOCTORAL SEMINAR I	1+0
AHE 792	DOCTORAL SEMINAR II	1+0
AHE 799	DOCTORAL RESEARCH	45

VETERINARY AND ANIMAL HUSBANDRY EXTENSION

Course Contents

AHE 601 **FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION** 2+1

Objective

To acquaint the students with the genesis, development and present status of animal husbandry extension and linkages among departments and various institutions.

Theory

UNIT I

Concept, philosophy, principles, genesis, growth and scope of extension education.

UNIT II

Earlier extension efforts and their implications. Emerging issues, problems and challenges of animal husbandry extension education.

UNIT III

Extension approaches of State and Central Governments, ICAR, SVUs/ SAUs, NGOs and other organizations in delivery of animal husbandry and veterinary services.

UNIT IV

Linkages between researcher-extension agent - livestock farmer-industry in the generation, dissemination and utilization of animal husbandry practices.

Practical

Study of the organizational set-up and functioning of State Animal Husbandry Department and dairy/rural development agencies. Study of indigenous technical know-how about animal husbandry practices in villages.

Suggested Readings

- Adams ME. 1982. *Agricultural Extension in Developing Countries*. Longman, Singapore Publ.
- Burton ES, Robert PB & Andrew JS. 1997. *Improving Agricultural Extension – A Reference Manual*. FAO.
- Dahama OP & Bhatnagar OP. 1987. *Education and Communication for Development*. Oxford & IBH.
- Mosher AT. 1966. *Getting Agriculture Moving- Essentials for Development and Modernization*. Praeger, New York.
- Mosher AT. 1978. *An Introduction to Agricultural Extension*. ADC.
- Owen E, Kitalyi A, Jayasuryia N & Smith T. (Ed). 2005. *Livestock and Wealth Creation – Improving of the Husbandry of Animals Kept by Resource Poor People in Developing Countries*. Nottingham Univ. Press.
- Roling N. 1988. *Extension Science. Information Systems in Agricultural Development*. Cambridge Univ. Press.
- Rivera WM & Schram SG. (Ed). 1987. *Agricultural Extension World wide – Issues, Practices and Emerging Priorities*. Croome Helm, London.
- Rivera WM. & Gustafson DJ. (Ed). 1991. *Agricultural Extension: Worldwide: Institutional Evolution and Forces for Change*, Elsevier.

- Samanta RK. (Ed). 1990. *Development Communication for Agriculture*. BR Publ. Corp., Delhi.
- Swanson BE. (Ed). 1984. *Agricultural Extension: A Reference Manual*. 2nd Ed. FAO.
- Van den Ban AW & Hawkins HS. 1998. *Agricultural Extension*. Longman Scientific Tech.

AHE 602 COMMUNICATION FOR LIVESTOCK DEVELOPMENT 1+1

Objective

To acquaint the students with concept and models of communication and to improve their communication skills

Theory

UNIT I

Communication- meaning, concept, purpose and process.

UNIT II

Models and theories of communication. Types of communication- intrapersonal, interpersonal, verbal and non-verbal. Criteria of effective communication, Determinants of communication- Empathy, credibility, fidelity, distortion, feed back and barriers to communication.

UNIT III

Group and mass communication. Modern communication technologies. Key communicators and their role in animal husbandry development.

Practical

Exercises in oral communication and group discussion. Exercises in written communication. Writing for newspapers, magazines. Script writing for radio and TV. Client management in veterinary clinics . Identification of key communicators in a village.

Suggested Readings

- Cragan FJ. & Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.
- Mcquail D & Windahl S. 1993. *Communication Models for the Study of Mass Communications*. Longman Publ.
- Ray GL. 1991. *Extension, Communication and Management*. Naya Prokash.
- Rogers EM & Shoemaker FF. 1971. *Communication of Innovations: A Cross – Cultural Approach*. The Free Press.
- Roloft Michael F. 1981. *Interpersonal Communication*. Sage Publ.
- Servaes J, Thomas LJ. & Whitle AS. (Ed). 1997. *Participatory Communication for Social Change*. Sage Publ.

AHE 603 DIFFUSION AND ADOPTION OF ANIMAL HUSBANDRY PRACTICES 2+1

Objective

To sensitize the students towards technology generation, dissemination and its adoption through effective communication.

Theory

UNIT I

Concept of diffusion. Elements in diffusion process, models and theories of diffusion. Decision-making, Stages in diffusion-adoption process.

UNIT II

Concepts and stages of adoption. Adoption models. Adopter categories and their characteristics. Factors influencing adoption. Attributes of innovations, rate of adoption and sources of information. Consequences of adoption of innovations.

UNIT III

Role of change agents in transfer of technology. Diffusion studies in veterinary extension. Role of communication in diffusion and adoption process.

Practical

Study of selected animal husbandry innovations- the adoption and non-adoption of various practices. Reasons for adoption and non-adoption of innovations

Suggested Readings

- Brown Lawrence A. 1981. *Innovation Diffusion: A New Perspective*. Methuen.
- Cragan FJ & Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.
- Rogers EM. 2003. *Diffusion of Innovations*. Free Press.
- Servaes J, Thomas LJ & Whitle AS. (Ed). 1997. *Participatory Communication for Social Change*. Sage Publ.

AHE 604

EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS 2+1

Objective

To train the students about various techniques/methods for transfer of animal husbandry technologies through suitable audio-visual aids.

Theory

UNIT I

Teaching learning process and its principles. Steps in extension teaching process, cone of experience. Learning situation. Criteria for effective teaching and learning.

UNIT II

Extension approaches in livestock development– individual, group and mass approach (electronic and non electronic). Relative merits and demerits of different teaching methods in animal husbandry extension.

UNIT III

Audio-visual aids– classification, use and evaluation. Selection criteria of audio-visual aids.

UNIT IV

Multi-media projection and computer aided teaching aids for animal husbandry extension.

UNIT V

Selection of different extension methods for dissemination of animal husbandry technologies and media-mix.

Practical

Preparation and presentation of various audio-visual aids. Use of different teaching methods in field situations. Review of research studies in teaching methods and A.V. aids.

Suggested Readings

- Dahama OP & Bhatnagar OP. 1987. *Education and Communication for Development*. Oxford & IBH.
- Hass KB & Packer HQ. 1962. *Preparation and Use of Audio-Visual Aids*. Prentice Hall.
- Mathialagan P. 2005. *Text Book of Animal Husbandry and Livestock Extension*. International Book Distributing Co.
- Mody Bella 1992. *Designing Messages for Development Communication. An Audience Participation based Approach*. Sage Publ.
- Oakley P & Garforth C. 1985. *Guide to Extension Training*. FAO.
- Priyanjam Kartik 2005. *Audio Visual Aids and Education*. Dominant Publ.
- Ray GL. 1991. *Extension, Communication and Management*. Naya Prokash.

AHE 605

ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION

2+1

Objective

To expose the students on planning, formulation, implementation and evaluation of various animal husbandry development programmes.

Theory

UNIT I

Importance of programme planning in veterinary and animal husbandry extension. Objectives, principles and steps in programme planning process. Role of animal husbandry extension agencies, local leaders, livestock owners and institutions in planning and implementation of need-based veterinary extension programmes.

UNIT II

Genesis, nature and principles of planning. Planning Commission and its role. Five Year Plans with reference to animal husbandry development. Organizational structure for planning at different levels.

UNIT III

Concept, principles, types and methods of evaluation. Importance of monitoring various livestock development programmes.

UNIT IV

Needs assessment– meaning, importance, classification and steps. Concept of FSR, Participatory Approaches- Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA)

UNIT V

Project management techniques- Programme Evaluation and Review Technique (PERT). Critical Path Method (CPM). Project formulation. Project appraisal in terms of social benefit analysis, logical frame work.

Practical

Preparation of livestock development plan for a village. Developing instruments for monitoring and evaluation of on-going development programme at village level (Logical Frame Work). Exercises on Participatory approaches (RRA,PRA, Case study, Problem Based Learning).

Suggested Readings

- Collinson M. 2000. *A History of Farming System Research*. CAB Publ.

- Guilford JP. 1971. *Psychometric Methods*. TATA McGraw Hill.
- Henerson EM, Morris LL. & Gibbon CT. 1987. *How to Measure Attitudes*. Sage Publ.
- Kerlinger FN. 1994. *Foundations of Behavioural Researches*. Holt, Rinehart & Winstons.
- Kumar, R. 1999. *Research Methodology – A Step by Step for Beginners*. Sage Publ.
- Miller Delbert C. 1991. *Handbook of Research Design and Social Measurement*. Indiana University. Sage Publ.
- Oppenheim AN. 1979. *Questionnaire Design and Attitude Measurement*. Heinemann Educational Books.

AHE 607 SOCIAL PSYCHOLOGY AND GROUP DYNAMICS 2+1

Objective

To acquaint the students with the structure and functioning of social groups and socio-psychological aspects in interacting with livestock farmers.

Theory

UNIT I

Meaning, scope and importance of psychology in animal husbandry extension work. Orientation of psychology.

UNIT II

Perception- nature, laws and selectivity in perception, factors in perception, importance of perception in extension work. Attitude- nature, theories, measurement and change of attitude towards livestock owners, formation of stereo types and prejudice, factors in attitude change.

UNIT III

Motivation– nature, characteristics, theories, types and techniques of motivating farm people. Emotion- nature, types of emotional response, theories and role of emotion in regulating the human behaviour. Learning- principles, theories of learning and experiential learning.

UNIT IV

Intelligence- nature, theories and measurement. Personality- nature, traits, types, biological and socio-cultural determinants of personality. Group and individual behaviour.

UNIT V

Concept and types of groups; Typology and importance in rural development; Group structures - attraction, coalition, communication and power; Processes in group development and group identity; Factors affecting group performance; Conflicts in groups; Group belongingness.

Practical

Study of structure and functioning of selected Self Help Groups (SHGs), factors influencing the success/ failure of SHGs, Milk Cooperative Societies.

Suggested Readings

- Baron RA. 1995. *Psychology*. Prentice Hall.
- Cragan, FJ & Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.
- Kagan J & Havemann E. 1980. *Psychology – An Introduction*. Harcourt Brace Javanovich Inc.

Morgan CT, King RA & Robinson NM. 1979. *Introduction to Psychology*. Tata McGraw-Hill.
Napier RW & Gershenfeld MK. 2006. *Groups – Theory and Experience*. AITBS Publ.
Secord PF & Backman CW. 1964. *Social Psychology*. McGraw-Hill.

AHE 608 ANIMAL HUSBANDRY DEVELOPMENT PROGRAMMES 1+0

Objective

To make the students aware of livestock development programmes launched by various agencies.

Theory

UNIT I

Concept of development, social and economic development; Historical overview on Rural Development in India

UNIT II

Ongoing Animal Husbandry Development Programmes - NPCBB, PM assistance livestock development programme, rural development programmes with special reference to livestock- SGSY, EGS

UNIT III

Transfer of Technology (TOT) programmes of ICAR– National Demonstration, Krishi Vigyan Kendra, Trainers’ Training Centres, Lab to Land Programme, Operational Research Project, National Agricultural Research Project, Agricultural Technology Management Agency, National Agricultural Innovative Project.

UNIT IV

Understanding the functioning of livestock development institutions - DRDA, NABARD, Insurance Companies, NGOs.

Suggested Readings

Candler W & Kumar N. 1998. *India. The Dairy Revolution – The Impact of Dairy Development in India and the World Bank Contribution*. The World Bank.
Dahama OP & Bhatnagar OP. 1987. *Education and Communication for Development*. Oxford & IBH.
Govt. of India 2005. *A Reference Manual*. Ministry of Information and Broadcasting, New Delhi. <http://www.dahd.nic.in>
Mathialagan P. 2005. Text Book of Animal Husbandry and Livestock Extension. *International Book Distributing Co*.
Ray GL. 1991. *Extension, Communication and Management*. Naya Prokash.

AHE 609 DEVELOPMENTS IN THE CONCEPT OF EXTENSION 1+0

Objective

To acquaint the students with the recent development in extension.

Theory

UNIT I

Important concepts in extension science; various schools of thought; Systems concept in extension.

UNIT II

Changing approaches – Farmer participatory approaches; Global concepts of extension as applied to Indian Context.

UNIT III

Recent trends in extension. Privatisation of extension. Public Private Partnership. Contract farming. Organic animal husbandry. Indicators of livestock sustainability. Animal welfare programmes

UNIT IV

Various stake holders in Livestock development; stakeholder analysis, problem tree

Suggested Readings

Blackburn DJ. 1989. *Foundations and Changing Practices in Extension*. Univ. of Guelph, Canada.

Jones GE. (Ed). 1985. *Investing in Rural Extension: Strategies and Goals*. Elsevier.

Roling N. 1988. *Extension Science*. Cambridge Univ. Press.

AHE 610

HUMAN RESOURCE MANAGEMENT IN

2+1

ANIMAL HUSBANDRY SECTOR

Objective

To expose the students in human resource management techniques and dealing with the hierarchical and organizational problems.

Theory

UNIT I

Concept, importance and functions of human resource management. Process of management- planning, organizing, staffing, directing, coordination, reporting and budgeting. Principles, levels and types of organization.

UNIT II

Training- models, methods, identification of training needs, training evaluation and developing strategies for human resource development in animal husbandry sector.

UNIT III

Supervision- meaning, process and techniques. Work motivation. job efficiency and job satisfaction.

UNIT IV

Organizational communication. Organizational climate. Conflict management.

UNIT V

Personnel management in animal husbandry organizations and disaster management.

Practical

Training needs assessment, development of training module, organization, evaluation of a training programme

Suggested Readings

Buford JA, Bedeian AG & Lindner JR. 1995. *Management in Extension*. Ohio State Univ., USA.

Dwivedi RS. 1979. *Human Relations and Organizational Behaviour – A Global Perspective*. 5th Ed. McMillan India.

Keith D. 2004. *Human Behaviour*. 8th Ed. Mc Graw Hill.

Lynton R & Pareek U. 1990. *Training for Development*. Vistar Publ.

Lynton R & Pareek U. 2000. *Training for Organizational Transformation*. Sage Publ.

- Mishra DC. 1990. *New Directions in Extension Training*. Directorate of Extension, Ministry of Agriculture, Govt. of India, New Delhi.
- Stoner JAF & Freeman RF. 1994. *Management*. 5th Ed. Prentice Hall.
- Turban E & Meredith J. 1991. *Fundamentals of Management Science*. 5th Ed. Home Wood I.L. Irwin.
- Weirich H & Koontz H. 1993. *Management – A Global Perspective*. McGraw-Hill.

AHE 611 GENDER AND LIVESTOCK DEVELOPMENT 1+0

Objective

To acquaint the students with the concept of gender, its importance in livestock development, livestock development policies and programmes of the government to empower women.

Theory

UNIT I

Basic concepts - gender, empowerment and livestock. Role of livestock sector in Indian economy and poverty alleviation. Enterprise integration- women in agriculture and livestock. Livestock and agrarian scenario – trends in numbers, growth, composition and exports and imports.

UNIT II

Policies and programmes in livestock for empowering women, Composition of livestock sector- dairying and poultry sector, Women entrepreneurship in livestock, Institutional structure in livestock production, processing and marketing- co-operatives, contract farming and SHGs, Case studies- success and failures- from the state, country and other countries.

UNIT III

Globalization and livestock development – opportunities and challenges, WTO- need for quality standards in livestock production- assurance and safety measures- SWOT analysis, Extension techniques for livestock development, Group project work- livestock feasibility report/live-in situation report.

Suggested readings

- Bura N, Deshmukh J, Ranadive & Murthy KR. (Ed). 2006. *Micro Credit, Poverty and Empowerment – Linking the Triad*. Sage Publ.
- NABARD. 2005. *SHG Bank Linkage Programme*. <http://www.nabard.org>
- Ramkumar S, Garforth C, Rao SVN & Waldie K. (Ed). 2001. *Landless Livestock Farming – Problems and Prospects*. RAGACOVAS, Pondicherry.
- Seth Mira 2001. *Women and Development – Indian Experience*. Sage Publ.
- Samanta RK. (Ed). *Women in Agriculture – Perspectives, Issues and Experiences*. MD Publ.
- Waldie K & Ramkumar S. 2002. *Landless Women and Dairying – Opportunities for Development within a Poverty Perspective*. RAGACOVAS, Pondicherry.

AHE 612 INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT 1+1

Objective

To apprise the students about information system, networking and use of various ICT tools.

Theory

UNIT I

ICT – concept, importance and types of tools; Development and application of ICT tools including information kiosks, E-learning

UNIT II

Concept of information system and networking, component of information system, information resources, sharing and networking. Types of net work – PAN, LAN, WAN, Internet, AGRINET, AKIS, Indian National Agricultural Research database.

UNIT III

ICT programmes in livestock development, Problems and prospects of ICTs in livestock development, Digitisation, Simulation models.

Practical

Study of various ICT tools in livestock development.

Suggested Readings

Anonymous 2002. *Handbook of Animal Husbandry*. ICAR.

Arnon I. 1989. *Agriculture Research and Technology Transfer*. Elsevier Science Publ. England.

Ramkumar S & Rao SVN. 2004. *Knowledge Dissemination on Cattle Health through Information Kiosks in Veterinary Centres*. RAGACOVAS, Pondicherry.

Singhal A & Rogers EM. 1989. *India's Information Revolution*. Sage Publ.

AHE 701 ORGANIZATIONAL MANAGEMENT

3+0

Objective

To acquaint the students with the general administration, management and motivational techniques for organizational change and development.

Theory

UNIT I

Concept, approaches and functions of management. Principles and process of organization, hierarchy of organization, departmentalisation. Authority and responsibility. Components of individual behaviour in organization. Organizational climate, decision making by consensus and participation by subordinates.

UNIT II

Motivation- nature and significance, motivational process, theories of motivation with respect to animal husbandry work. Importance of human needs, priority of needs, Managing work motivation.

UNIT III

Conflict – types and management. Leadership and its role in conflict resolution. Morale in organizations, organizational factors affecting morale, attitude, and productivity, methods of improving morale and evaluation of morale. Performance appraisal process.

UNIT IV

Supervision– principles, techniques and functions of supervision. Qualities of supervisor, supervisor-subordinate relationship and interaction process. Changing organizational structure and system, changing organizational climate and interpersonal style, issues and choice involved in making organizational climate.

UNIT V

Organization development– history, nature, characteristics, assumptions and process. Organization development interventions.

Suggested Readings

Selected articles from journals.

AHE 702 FARM JOURNALISM AND PUBLIC RELATIONS 2+1

Objective

To sensitize students about the role of mass media, news papers, magazines, radio, T.V. and internet for promoting animal husbandry.

Theory

UNIT I

Concept of farm journalism and communication. Journalism as a means of mass-communication and its role in livestock development. Opportunities, strength and limitations. Ethics and principles of journalism for effective writing.

UNIT II

Art of writing, news items, news stories, feature articles, success stories, magazines, bulletins, folders etc. Fundamentals of lay-out in writing. Writing of research papers and popular articles in journals and farm magazines.

UNIT III

Methods and techniques of broadcasting of farm programmes. Writing scripts for radio and televisions. Importance of public relations in veterinary and animal husbandry extension.

UNIT IV

Rapport building with different categories of clients involved in veterinary and animal husbandry extension programmes. Art of speaking. Importance of listening and reading. Relations with press media.

UNIT V

Event management, Organization of press meet. Qualities of a good public relation manager. Writing for press news.

Practical

Designing and preparation of news stories, feature articles, success stories related to animal husbandry. Designing and preparation of magazines, folders, popular research articles, radio and T.V. scripts. Visit to agricultural information and communication centre to record the activities of preparation, editing and publication of news articles and research publications. Exercise on the art of good speaking in class-room and field situations.

Suggested Readings

Selected articles from journals.

AHE 703 ADVANCED RESEARCH TECHNIQUES IN SOCIAL RESEARCH 3+1

Objective

To train the students about various research and management techniques/ methods applicable to animal husbandry researches.

Theory

UNIT I

Measurement– meaning and levels, tests, and scales. Different types of Variables.

UNIT II

Techniques of attitude scale construction viz. paired comparison, equal appearing interval, successive interval, summated ratings, scalogram analysis.

UNIT III

Measurement of reliability and validity of tests and scales. Sociometry. Critical incidence techniques. Q – sort technique, observation techniques, case studies.

UNIT IV

Experimental and quasi experimental research designs. Content analysis and projective techniques.

UNIT V

Multivariate analysis, systems analysis, principle component analysis, discriminant analysis and their application in extension education research.

Practical

Exercises on scaling techniques, attitude scale construction – Paired Comparison, Equal Appearing interval, Summated Rating Scale, Critical Incident Technique, Knowledge Test.

Suggested Readings

Selected articles from journals.

AHE 704 TRAINING FOR HUMAN RESOURCE DEVELOPMENT 2+1

Objective

To make the students aware of planning, implementation and evaluation of various training programmes.

Theory

UNIT I

Concept of training and education. Training infrastructure for extension personnel and farmers in India. Role of institution, organization and participants in success of training programme.

UNIT II

Assessment of training needs, curriculum design and development. Training strategies, models of training.

UNIT III

Planning, development and execution of training programmes.

UNIT IV

Training methods– Lecture, symposium, workshop, case studies, group discussion, conference, convention, panel discussion, buzz session, forum, debates, syndicate, simulation exercises, role playing, brain storming.

UNIT V

Evaluation and follow-up of training programmes.

Practical

Preparation of training programmes for extension personnel, livestock and poultry farmers. Evaluation of on-going training programmes.

Suggested Readings

Selected articles from journals.

AHE 705 POLICIES AND REGULATIONS IN LIVESTOCK 2+0
SECTOR

Objective

To sensitize the students about policies and regulations in animal husbandry sector.

Theory

UNIT I

World Trade Organization in relation to livestock sector. Impact of WTO on Indian international trade of food products of animal origin, Intellectual Property Rights in relation to animal husbandry.

UNIT II

HACCP, Sanitary and phyto-sanitary measures to protect the animals' life and health, food safety uses in relation to animal husbandry sector. Introduction to Agreement on Technical Barriers to Trade (ATBT).

UNIT III

Animal welfare laws- legislations in veterinary and animal sciences.

UNIT IV

Prevention of Cruelty to Animals Act-1960 and Rules. Animal Welfare Board, ABC Programme. Acts related to animals and animal diseases. Animal quarantine and certification.

Suggested Readings

Selected articles from journals.

AHE 706 EDUCATIONAL TECHNOLOGY 2+1

Objective

To acquaint students with different concepts of education technology and preparation of teaching aids

Theory

UNIT I

Educational Technology – Meaning, concepts and components. Curriculum development at macro and micro levels. Formulation of instructional objectives.

UNIT II

Preparation of course outline for instructions, lesson planning. Designing instructions for theory and practical, Instructional methods and devices in class room instruction, computer aided learning. Understanding learners' behavior, learning styles, motivating learners.

UNIT III

Student counselling and guidance, Student evaluation – meaning and methods, construction of measuring instrument – question banking.

UNIT IV

Performance appraisal of teachers –meaning and methods, construction of assessment instruments. Use of library for effective learning.

Practical

Preparation of course outline, Preparation of lesson plans, Planning and preparation of instructional aids, Individual classroom instructional exercises, Development of student evaluation instrument, Development of performance appraisal instrument for teachers.

Suggested Readings

Selected articles from journals.

AHE 707	DYNAMICS OF CHANGE	2+0
	Objective	
	To make the students aware of dynamics of change, group dynamics and social change.	
	Theory	
	<u>UNIT I</u>	
	Definition of change, development, social and cultural change. Dimensions, characteristics, types, rate and directions of social change. General conditions of social change.	
	<u>UNIT II</u>	
	Process of change. Concept, importance and problems of planned change. Role of change agents. Approaches of change agents towards planned change. Acceptance and rejection to planned change in animal husbandry. Techniques for accelerating change.	
	<u>UNIT III</u>	
	Theories of change: Darwin, Kurt, Lewin, Ogburn & influence process of change, assessment of resources, fixation of change objective, evaluating change effect. Barrier to change- psychological, social & economical, stimulants to change: psychological, social & economical.	
	<u>UNIT IV</u>	
	Agrarian changes with reference to livestock development.	
	Suggested Readings	
	Selected articles from journals.	
AHE 708	ORGANIZATIONAL COMMUNICATION	2+1
	Objective	
	To sensitize the students towards communication and networking to increase the efficiency of an organization.	
	Theory	
	<u>UNIT I</u>	
	Organizational communication– its importance, function and characteristics. Understanding of organizational communication. Types of organizational communication– upward, downward, diagonal and grapevine. Communication network.	
	<u>UNIT II</u>	
	Effectiveness and efficiency of organizational communication.	
	<u>UNIT III</u>	
	Essentials of a sound organizational communication system. Social and Psychological barriers to effective organization communication. Causes of poor organization communication.	
	Practical	
	Studies on organizational communication patterns in animal husbandry	
	Suggested Readings	
	Selected articles from journals.	
AHE 790	SPECIAL PROBLEM	0+2
	Objective	
	To provide expertise in handling practical research problem(s).	
	Practical	
	Short research problem(s) involving contemporary issues and research techniques.	

VETERINARY AND ANIMAL HUSBANDRY EXTENSION

List of Journals

- * Communicator
- * Development communication
- * Indian Dairyman
- * Indian journal of Adult Education
- * Indian Journal of Dairy Science
- * Indian Journal of Extension Education
- * Indian Journal of Psychology
- * Indian Journal of Public Administration
- * Journal of Dairy Research
- * Journal of Extension Systems
- * Journal of Rural Development
- * Journal of Training and Development
- * The Indian Journal of Animal Sciences
- * The Indian Veterinary Journal
- * Journal of Agriculture Extension and Education
- * Indian Journal of Animal Research
- * Indian Journal of Gender of Studies
- * Kurukshetra
- * Yojana
- * Economic and Political weekly
- * Indian Farming

e-Resources

- * www.informaworld.com (Journal of Agricultural Education and Extension)
- * www.blackwellpublishing.co (International Journal of Training & Development)
- * www.blackwellpublishing.co Educational Measurement: Issue and Practices
- * www.academicjournals.net (International Journal of Dairy Science)
- * www.cipav.org.co (Livestock Research for Rural Development)
- * www.joe.org Journal of Extension

Suggested Broad Topics for Master's and Doctoral Research

- * Veterinary Education
- * Training
- * Communication and development
- * Diffusion and adoption
- * Management and entrepreneurship
- * Livestock economics
- * Evaluation of animal husbandry programmes

VETERINARY BIOCHEMISTRY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VBC 601	CHEMISTRY OF ANIMAL CELL	2+0
VBC 602	TECHNIQUES IN BIOCHEMISTRY	0+2
VBC 603	APPLICATIONS OF GENOMICS AND PROTEOMICS IN MOLECULAR BIOLOGY	2+0
VBC 604	BIOCHEMISTRY OF BIOMOLECULES: CARBOHYDRATES, LIPIDS AND MEMBRANE'S STRUCTURE	2+0
VBC 605	ENZYME CATALYSIS, KINETICS, INHIBITION AND REGULATION	2+0
VBC 606	METABOLISM-I: CARBOHYDRATES AND LIPIDS	2+0
VBC 607	METABOLISM-II: NUCLEIC ACIDS AND AMINO ACIDS	2+0
VBC 608	METABOLISM-III: INTEGRATION AND REGULATION.	2+0
VBC 609	CENTRAL DOGMA AND PROTEIN FUNCTION	2+0
VBC 610	CLINICAL BIOCHEMISTRY OF ANIMALS	2+1
VBC 611	BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS	2+0
VBC 612	ENDOCRINOLOGY AND REPRODUCTIVE BIOCHEMISTRY	2+0
VBC 613	BIOCHEMICAL BASIS OF ANIMAL PRODUCTION	2+1
VBC 691	MASTER'S SEMINAR	1+0
VBC 699	MASTER'S RESEARCH	20
VBC 701	ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS	2+0
VBC 702	ADVANCES IN ENZYMOLOGY	2+0
VBC 703	ADVANCES IN CLINICAL BIOCHEMISTRY	0+2
VBC 704	MEMBRANE DYNAMICS AND SIGNAL TRANSDUCTION IN ANIMAL CELL	2+0
VBC 705	METHODS IN PROTEIN ANALYSIS	2+1
VBC 706	NUTRITIONAL BIOCHEMISTRY	2+0
VBC 707	ADVANCES IN INTERMEDIARY METABOLISM	2+0
VBC 708	ENDOCRINE CONTROL OF FUEL METABOLISM	2+0
VBC 709	DIAGNOSTIC ENZYMOLOGY-I	2+0
VBC 710	DIAGNOSTIC ENZYMOLOGY-II	2+0
VBC 711	BIOCHEMISTRY OF DEVELOPMENT AND DIFFERENTIATION	2+0
VBC 712	ADVANCES IN TECHNIQUES IN BIOCHEMISTRY	1+1
VBC 713	ADVANCES IN MINERAL AND VITAMIN METABOLISM AND RELATED DISEASES	2+0
VBC 790	SPECIAL PROBLEM	0+2
VBC 791	DOCTORAL SEMINAR I	1+0
VBC 792	DOCTORAL SEMINAR II	1+0
VBC 799	DOCTORAL RESEARCH	45

VETERINARY BIOCHEMISTRY

Course Contents

VBC 601	CHEMISTRY OF ANIMAL CELL	2+0
Objective	Teaching of principles of physical chemistry as applicable to veterinary sciences.	
Theory	<u>UNIT I</u> Pre-biotic world, chemical evolution. cellular architecture, molecular organization and metabolic function. <u>UNIT II</u> Thermodynamics, chemical equilibrium, standard state, living cell as steady state, open system obeying laws of thermodynamics. Minimum energy conformation, quantum mechanical calculation. ΔG and ATP. <u>UNIT III</u> Properties of water, homeostasis, pH, osmosis, viscosity, surface forces adsorption, dialysis, diffusion rate and the sizes of organisms. The blood buffering system. Chemical basis of oral and parental fluid/electrolyte therapies, Bacterial toxigenic diarrhoeas.	
Suggested Readings	Chang 2005. <i>Physical Chemistry for the Bioscience</i> . Univ. Science Books. Dvorak AM & Harris W. 1991. <i>Blood Cell Biochemistry</i> . 2 nd Ed. Plenum. Garby L. 1995. <i>Bioenergetics</i> . Cambridge. Voet D, Voet JG & Pratt CW. 2006. <i>Fundamentals of Biochemistry of Life at the Molecular Level</i> . 2 nd Ed. John Wiley & Sons.	
VBC 602	TECHNIQUES IN BIOCHEMISTRY	0+2
Objective	To make students well versed with methodologies used in biochemistry.	
Practical	Solving problems using Henderson–Hasselbalch equation, pH, pKa and buffer concentration, normality. Application of colorimetry, spectrophotometry and NMR-X ray crystallography. Paper, column and thin layer chromatography. Partition and adsorption coefficient, quantitative and qualitative chromatography of amino acids, lipids and sugars including elution. Gas chromatography. Packing of column and choice of detectors and densitometry. Application of electrophoresis. Electrophoresis of proteins and nucleic acids. Use of sodium dodecyl sulfate and molecular weight determination. Densitometry procedures and quantitative assays. Immunoelectrophoresis, its applications. Isoelectrofocussing and isotacophoresis. Molecular sieving and its application in Biochemistry. General properties of dextran, acrylamide, agar and other media used for gel filtration. Ultracentrifugation– its principle and use, preparative analytical and density gradient ultracentrifugation. Fractionation of sub-cellular components and molecular weight determination using ultracentrifuge.	
Suggested Readings	David L Nelson & Cox Michael M. 2007. <i>Lehninger's Principles of Biochemistry</i> . 4 th Ed. Freeman.	

- Garrity S. 1999. *Experimental Biochemistry*. 3rd Ed. Academic Press.
Gowenlock AH. 1996. *Varley's Practical Clinical Biochemistry*. 6th Ed. CBS.
Holme DJ & Hazel P. 1983. *Analytical Biochemistry*. Longman.

VBC 603 **APPLICATIONS OF GENOMICS AND** **2+0**
PROTEOMICS IN MOLECULAR BIOLOGY

Objective

To acquaint students about molecular basis of structure and functional aspects of NA and AA.

Theory

UNIT I

Nucleotides, nucleic acids, high order structures, cohesions and condensins in chromosome structure. SMC proteins, sequencing, mutation, evolution. DNA libraries. Bacterial RNA polymerase, RNA interference. DNA replication, RNA synthesis, control of gene expression. DNA microarrays/chips.

UNIT II

PCR, Recombinant DNA technology in improving domestic animals. RELP, Gene and gene products. Genetic changes in hereditary diseases, cancer and detection ion DNA probes. Gene Therapy DNA vaccines, anti-tumor antibodies. Telomerases and Topoisomerases in treatment of diseases. *Staphylococcus* resistance to erythromycin.

UNIT III

Peptide bonds, acid-base properties, stereochemistry, side chain modifications, biological activities. Green fluorescent protein. Polypeptide diversity, protein purification and analysis, protein sequencing, reconstructing the sequence. Gene duplication and protein families, protein modules, combinatorial peptide libraries folding. Structural bio-informatics. Protein structure prediction and design. Proteomics. Drug molecules, myoglobin and haemoglobin. Mechanism and co-operativity in Hb. High altitude adaptation in ruminants and equines. Use of amino acid analysis in disease diagnosis.

Suggested Readings

- David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.
Murray RK, Granner DK, Mayes PA & Rodwell, VK. 2000. *Harper's Biochemistry*. Lange Medical Book.
Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 604 **BIOCHEMISTRY OF BIOMOLECULES:** **2+0**
CARBOHYDRATES LIPIDS AND MEMBRANE'S
STRUCTURE

Objective

Teaching of molecular basis of structure and functional aspects of carbohydrates and lipids.

Theory

UNIT I

Carbohydrates: Structure, glycoconjugates in cell surface, extra cellular matrix, sugar code functions, peptidoglycan-specific antibiotics. Cellular effects of Insulin. Glucose supply and removal, Ruminant fermentation, role of liver, glucose tolerance, indirect monitoring of blood glucose, ketone bodies.

UNIT II

Lipid classification, metabolism of LCFA, TAG, PL, Sphingolipids, cholesterol, lipoproteins. Regulation of lipid metabolism in fed and fasted states. Regulation of FA oxidation. FAs as regulatory molecules. Glucose production and FAs in type II diabetes. Ketone bodies as fuel.

UNIT III

Lipid bilayers, lipid motility, integral membrane proteins, lipid linked proteins, peripheral membrane proteins, fluid mosaic model, membrane skeleton, lipid asymmetry, vesicle trafficking, secretory pathway, membrane rafts, caveolae fusion, lung surfactant, structure of bacterial rhodopsin. thermodynamics of membrane transport, ionophores, porins, ion channels, aquaporins, transport proteins, P and F types ($\text{Na}^+ - \text{K}^+$) ATPases, Ca^{2+} , Ion-gradient, Gap Junction, $\text{Cl}^- - \text{HCO}_3^-$ -exchanger, cardiac glycosides, abnormalities in cell membrane fluidity. Haemolytic anaemia.

Suggested Readings

Combs GF. 1992. *The Vitamins - Fundamental Aspects in Nutrition and Health*. Academic Press.

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

VBC 605

ENZYME CATALYSIS, KINETICS, INHIBITION AND REGULATION 2+0

Objective

To give thorough knowledge of molecular basis of enzyme action in relation to diagnostic importance.

Theory

UNIT I

Mechanisms: Enzyme activation energy and reaction co-ordination, acid-base, covalent, metal ion. Proximity and orientation effects. Preferential transitional state binding.

UNIT II

Chemical kinetics, enzyme kinetics, kinetic data analysis, bisubstrate reactions. Competitive, Uncompetitive, Mixed inhibitors. Allosteric regulation. Drug design, drug discovery, bioavailability and toxicity, clinical trials. Cytochrome P450 and adverse drug reactions; synthesis of bacterial peptidoglycans, oxygenases, mixed function oxidases. Enzyme linked diagnostics.

UNIT III

Lysozyme. Serine proteases, physiology and tumor cell metastasis. Nerve poisons, blood coagulation cascade, Equine immuno-deficiency enzyme inhibitors. Suicide activators (DFMO for inhibition of ornithine decarboxylases in trypanosomiasis).

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Hang C & Wang T. 1988. *Enzyme Dynamics and Regulation*. Springer-Verlag.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 606 METABOLISM-I: CARBOHYDRATES AND LIPIDS 2+0

Objective

To teach regulatory mechanisms of carbohydrates and lipids metabolism in health and diseases.

Theory

UNIT I

Metabolic control, analysis for enzymes limiting the flux through a pathway. Trophic strategies, universal mapping of metabolic pathways. Thermodynamic relationships. ΔG , ATP and phosphoryl group transfer, coupled reactions, thioesters, NAD⁺ and FAD.

UNIT II

Overview of carbohydrate and lipid cycles, control of glycolysis, glycolysis in cancer cells, control of pentose phosphate pathways, deficiency of glucose-6-phosphate dehydrogenase. Control of glycogen metabolism, control of gluconeogenesis. GSD. Regulation of citric acid cycle, pathways that use citric acid intermediates, Sugar interconversions and nucleotide – linked sugar formation. Disorders associated with impairment of metabolism.

UNIT III

Electron transport and oxidative phosphorylation. Generation of heat by uncoupling in brown adipose tissue.

UNIT IV

Regulation of fatty acid metabolism, inhibitors of fatty acids biosynthesis, sphingolipid degradation and lipid storage disease. Regulation of cholesterol synthesis. PGs in NSAID, leukotrienes, HETEs, hypersensitivity. Influence of glucose metabolism on lipid metabolism.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Glasel JA & Deutscher MP. 1995. *Introduction to Biophysical Methods for Protein and Nucleic Acid Research*. Academic Press.

Russell TR, Brew K, Faber H & Schultz J. 2001. *From Gene to Protein: Information Transfer in Normal and Abnormal Cells*. Miami Winter Symposium-16. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 607 METABOLISM-II: NUCLEIC ACIDS AND AMINO ACIDS 2+0

Objective

To understand regulatory mechanisms of amino acid and nucleic acid metabolism in health and diseases.

Theory

UNIT I

Overview of pathways of amino acid and nucleic acid metabolism. Lysosomal degradation, ubiquitin, proteasome, breakdown of amino acids, heme biosynthesis and degradation, biosynthesis of physiologically active amines. Nitric oxide, homocysteine as marker of disease. Diseases of amino acid metabolism, porphyrias.

UNIT II

Nucleotide synthesis and degradation, inhibition of thymidylate synthesis in cancer therapy. Mutation in coenzyme binding sites and diseases. Forces stabilizing NA structure, restriction endonucleases, small inhibitory RNAs. Chromatin organization. Inhibitors of topoisomerases as antibiotic and anti-cancer agents, interfering with purine and pyrimidine metabolism.

UNIT III

Viral nucleic acids, DNA damage and repair, telomerase, ageing and cancer. Topoisomerases as drug targets. Chemotherapy can target precursors of DNA synthesis. Antibiotics and toxins that target RNA polymerase. Lysosomal enzymes, gout, diseases in purine and pyrimidine nucleotide metabolic impairment.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Swenson MJ & Reece WO. 1996. *Dukes' Physiology of Domestic Animals*. 11th Ed. Panima.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 608

METABOLISM-III: INTEGRATION AND REGULATION 2+0

Objective

To give exposure in inter-relationship of cellular metabolism of various macromolecules.

Theory

UNIT I

Regulation and integration of all metabolic pathways.

UNIT II

Organ specialization in fuel metabolism : Brain, muscle, adipose tissue, liver, kidney, inter organ metabolic pathways, hormonal control of fuel metabolism. Tracing metabolic fates, perturbing the system.

UNIT III

Signal transduction, gated ion channels, G-proteins, adenylate cyclase, receptor tyrosine kinase, protein phosphatases, cGMP, Ca²⁺, interaction with phosphoserine/tyrosine, integrations, drugs and toxins, cell cycle and CDKs that affect cell signaling.

UNIT IV

Oncogenes and cancers. Mitochondrial genes and diseases. Reactive oxygen species. Cyanide and arsenic poisoning. Metabolic inter-relationships in obesity, diabetes, cancer, aerobic and anaerobic exercise in horses, pregnancy, lactation and stress injury. Mitochondria in apoptosis

and oxidative stress. Cell suicide, liver diseases, renal diseases, acid-base balance. Metabolic/sensory transduction in nervous tissue. Vision. Blood coagulation.

Suggested Readings

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Kurjan J & Taylor BL. 1993. *Signal Transduction*. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 609 CENTRAL DOGMA AND PROTEIN FUNCTION 2+0

Objective

Teaching of applied aspects of replication, transcription and translation.

Theory

UNIT I

Overview of transcription and translation in eukaryotes. Collision between DNA polymerase and RNA polymerase, inhibitors of transcription, introns, evolution and expansion of the genetic code.

UNIT II

The effects of antibiotics and toxins on protein synthesis. X – chromosome inactivation. Eukaryotic gene expression, protein targeting.

UNIT III

Actin structure, microfilament dynamics, actin-myosin reacting cycle, tubulin dimer, microtubules dynamics, kinensins, dyneins.

UNIT IV

Antigen-antibody binding, cytokines, principles of immunochemical methods: agglutination, precipitation, typing of major histo-compatibility antigens. Blood group substances in farm animals.

UNIT V

Proteins as infectious agents (prions – BSE). Protein misfolding and aggregation. Plasma proteins, synthesis, functions. Influences of physiological factors and inflammation on proteins. Dysproteinemias. Defects in collagen synthesis. Transmissible multiple drug resistance, transcription factors and cardiovascular diseases. Transferrin, Lactoferrin, Ferritin and Ceruloplasmin.

Suggested Readings

Creighton TE. 1993. *Protein Structures and Molecular Properties*. WH Freeman.

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 610 CLINICAL BIOCHEMISTRY OF ANIMALS 2+1

Objective

To make a student well versed with biochemical basis for diagnosis and prognosis of diseases in animals and poultry.

Theory

UNIT I

Disturbances of gastro-intestinal function, disturbances of rumen function. Lactic acidosis, Pickled pigs and malignant hyperthermia. Diagnosis of neuromuscular disorders.

UNIT II

Myocardial infarction, respiratory distress syndrome. Primary renal dysfunctions and test, doping. Problems in game horses.

UNIT III

Enzymes of diagnostic importance. Toxicity of ammonia in animals. Genetic defects in urea cycle. Lysosomal storage diseases. ATP synthase inhibitory protein during ischemia. Ischaemic – reperfusion injury.

UNIT IV

Molecular oncology and tumor markers. CSF characteristics in diseases. Clinical biochemistry in toxicology. Glycosylated hemoglobin, HbA1c, fructosamine. Deranged glucose metabolism in cancerous tissue. Free Radical damage.

Practical

Estimation of constituents (enzymes, metabolites and electrolytes) of body fluids during normal and pathological conditions. Estimation of hormones. Liver and kidney function tests. Total volatile fatty acids and the fractions in ruminants.

Suggested Readings

Devlin 2005. *Textbook of Medical Biochemistry with Clinical Correlations*. Wiley Liss.

Jurica I & Wigle D. 2006. *Knowledge and Discovery in Proteomics*. CRC.

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Liebler DL. 2002. *Introduction to Proteomics*. Humana Press.

Pryor WA. 1996. *Free Radicals in Biology*. Academic Press.

Searcy RL. 1969. *Diagnostic Biochemistry*. McGraw-Hill.

VBC 611

BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS

2+0

Objective

To give a detailed overview of role of biomolecules in health and diseases in animals and poultry.

Theory

UNIT I

Diabetes mellitus, hyperinsulemia, galactosemia, hypoglycaemia of baby pigs, Glycogen Storage Disease. Carbohydrate balance in ruminants. Biochemical alterations in body fluids of ruminants in hypoglycaemia, Ruminant ketosis.

UNIT II

Hypercholesterolemia, atherosclerosis, hyperlipidemia in canine, feline, equine. Pathophysiology of ketonemia. Ketosis associated with fasting, diabetes, pregnancy, lactation and post exercise.

UNIT III

Anemias of the newborn, cytosolic enzyme deficiencies and membrane abnormalities in erythrocytes. Porphyrins and porphyrias. Disorders of iron

metabolism, neutrophil function defects and its testing. Equine immunodeficiency.

UNIT IV

Hepatic insufficiencies and its laboratory assessment. Pancreatitis and insufficiency. Metabolic diseases of Ca, P, Mg metabolism. Iron overload and injection, inorganic polyphosphate metabolism.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Kaneko JJ, Harvey JH, Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 612 **ENDOCRINOLOGY AND REPRODUCTIVE** **2+0**
BIOCHEMISTRY

Objective

To give a conceptual discussion on role of biomolecules in health and diseases in animals and poultry.

Theory

UNIT I

Mechanism of hormone action, Receptor binding, biosynthetic and metabolic aspects in physio-pathology of hormones, factors, and minerals.

UNIT II

Metabolic functions of the hormones of the hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal, pineal, ovaries and testes. Biochemistry of prostaglandins and related agents. Clinical endocrine aspects in production and reproduction status in domestic animals and poultry.

Suggested Readings

Morgane PJ & Panksepp J. 2002. *Hand Book of Hypothalamus*. Dekker.

Nes WR & McKean ML. 1977. *Biochemistry of Steroids and other Isoprenoids*. University Park Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 613 **BIOCHEMICAL BASIS OF ANIMAL PRODUCTION** **2+1**

Objective

To teach about biochemistry of draft capacity, meat production and dairy chemistry.

Theory

UNIT I

Chemistry of milk lipids, proteins, carbohydrates, minerals, vitamins, pigments, and enzymes. Structure of milk lipids, fat globular membranes, modification of milk fat. Milk proteins – casein, amino acid composition, whey proteins, immunoglobulins, genetic polymorphism. Carbohydrates: structure and sweetness.

UNIT II

The biochemistry controlling postmortem energy metabolism mechanisms. Application of genomic technologies to the improvement of meat quality of

farm animals. Identification of meat quality parameters by proteomics. Application of proteomics to understand the molecular mechanisms behind meat quality. Oxidative stability of post mortem muscles from sheep of various ages.

UNIT III

Metabolic demands of draft animals, and biochemical aspects of work and kinesiology.

Practical

Biochemical tests for proteins of meat, milk and egg and analysis of wool structure.

Suggested Readings

Eston R & Reilly T. 1986. *Kinanthropometry and Exercise Physiology*. Laboratory Manual. E & FN SPON.
Hay JG. 2002. *Basic Mechanics of the Skeletal System*. Prentice Hall.
Hudson BJE. 1994. *New Developing Sources of Food Proteins*. Chapman & Hall.
Jenness R & Patton S. 2001. *Principles of Dairy Chemistry*. Wiley Eastern.
Miller GD, Jarus JK & McBean LD. 2004. *Dairy Food and Nutrition*. CRC.

**VBC 701 ADVANCES IN BIOCHEMISTRY OF RUMINANT 2+0
DISORDERS**

Objective

To give exposure about biochemical changes in diseases of ruminants.

Theory

UNIT I

Comparative ruminant metabolism, metabolism of various nutrients by microflora. Postruminal digestion of dietary and microbial biomolecules.

UNIT II

Metabolic disorders of rumen and recent development in disorders of ruminants associated with protein, carbohydrate and fat metabolism.

UNIT III

Recent development in disorders of ruminants associated with mineral and electrolyte metabolism.

Suggested Readings

Selected articles from journals.

VBC 702 ADVANCES IN ENZYMOLOGY 2+0

Objective

To teach current developments in actions of enzymes.

Theory

UNIT I

Current concept on how enzymes work.

UNIT II

Recent innovations in enzymes kinetics to understand mechanism.

UNIT III

Current topics on regulatory enzymes.

UNIT IV

Lysozymes, serine proteases, drug design.

Suggested Readings

Selected articles from journals.

VBC 703 ADVANCES IN CLINICAL BIOCHEMISTRY 0+2

Objective

To educate students about current developments in clinical biochemistry.

Theory

UNIT I

Scope of clinical biochemistry and its application in disease diagnosis.

UNIT II

Molecular basis of cell injury and diseases.

UNIT III

Molecular basis of autoimmunity, immunodeficiency, oncogenesis.

UNIT IV

Functional tests : DNA finger printing, micro and mini satellites, PCR-RFLP in clinical biochemistry, DNA microarrays. Biomolecular prospecting and molecular designing.

Practical

Nucleic acid extraction, protein arrays, RT-PCR, hybridization, electrophoretogram and chromatogram of macromolecules.

Suggested Readings

Selected articles from journals.

VBC 704 MEMBRANE DYNAMICS AND SIGNAL 2+0
TRANSDUCTION IN ANIMAL CELL

Objective

Discussions on recent developments in membrane function.

Theory

UNIT I

Developments in physical & chemical features of biological transport.

UNIT II

Developments in membrane dynamics.

UNIT III

Developments in solute transport across membrane.

UNIT IV

Developments in molecular mechanisms of signal transduction, regulation by steroid hormone, protein kinases.

UNIT V

Developments in signaling in microorganisms, special senses.

Suggested Readings

Selected articles from journals.

VBC 705 METHODS IN PROTEIN ANALYSIS 2+1

Objective

Discussions on contemporary information on techniques in protein research.

Theory

UNIT I

Separation, purification and characterization of proteins in ECF and membrane.

UNIT II

Subcellular organization of proteins fused with green fluorescent protein. High throughput methodologies for determining protein structure.

Theory

UNIT I

Hormone: Diverse structure for diverse functions.

UNIT II

Tissue specific metabolism.

UNIT III

Hormonal regulation of fuel metabolism.

UNIT IV

Regulation of body mass, production of beef, egg, poultry and fish.

Suggested Readings

Selected articles from journals.

VBC 709 DIAGNOSTIC ENZYMOLOGY - I 2+0

Objective

To expose students about use of enzymes in diagnostics.

Theory

UNIT I

History, development, validation of clinical enzyme assay.

UNIT II

Assay of enzymes in clinical cases. Enzyme urea. Enzymes in pathogenesis.

UNIT III

Enzyme histochemistry and cytochemistry, immobilized enzymes. Enzyme immuno diagnostics, molecular genetics.

Suggested Readings

Selected articles from journals.

VBC 710 DIAGNOSTIC ENZYMOLOGY - II 2+0

Objective

To provide in-depth knowledge about enzymes in diagnosis of diseases of animals and poultry.

Theory

UNIT I

Phosphatases, creatine kinase in diagnosis of diseases of animals and poultry.

Unit.II

Amino transferases, trypsin in diagnosis of diseases of animals and poultry.

UNIT III

Dehydrogenases in diagnosis of diseases of animals and poultry.

Unit.IV

Cholinesterase, lipase, amylase, GGT, GTPx, arginase, AST, ALT & SDH in diagnosis of diseases of animals in poultry. Enzymes in pathogenesis.

Suggested Readings

Selected articles from journals.

VBC 711 BIOCHEMISTRY OF DEVELOPMENT AND 2+0 **DIFFERENTIATION**

Objective

To develop understanding of biochemical basis of embryo development in mammals and aves.

Theory

UNIT I

Molecular basis of reproductive events including gametogenesis, fertilization, embryo development and differentiation, gene knock out

UNIT II

Homeotic gene maintenance and repair of body tissue.

UNIT III

Biochemical basis of chick and fetal development

Suggested Readings

Selected articles from journals.

VBC 712 ADVANCES IN TECHNIQUES IN BIOCHEMISTRY 0+2

Objective

To expose students about current developments in techniques used in animal biochemistry.

Practical

Tracer methodologies as applied to problems in biochemistry. Electrophoresis, HPLC, GLC & TLC, spectrometry as applied to problems in biochemistry. X-Ray-Crystallography, NMR Spectrometry. Atomic absorption spectrophotometry as applied to problems in biochemistry. Ultracentrifugation as applied to problems in biochemistry.

Suggested Readings

Selected articles from journals.

VBC 713 ADVANCES IN MINERAL AND VITAMIN 2+0
METABOLISM AND RELATED DISEASES

Objective

To expose students to latest class material to be given on recent trends in research on cofactor and mineral metabolism disorders in animals.

Theory

UNIT I

Biochemical basis of conditions related to nutrient deficiency & excess

UNIT II

Metabolism of Ca, P, Mg, Na, K and the related diseases in animals and poultry.

UNIT III

Minerals and B Vitamins as cofactors and their metabolism in livestock and poultry.

UNIT IV

Biochemical mechanisms of fat soluble and water soluble vitamins and their metabolism in livestock and poultry.

Suggested Readings

Selected articles from journals.

VBC 790 SPECIAL PROBLEM 0+2

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY BIOCHEMISTRY

List of Journals

- * Indian Journal of Chemical Technology
- * Indian Journal of Biochemistry and Biophysics
- * Indian Journal of Chemistry - Section B
- * Indian Veterinary Journal
- * Journal of Chemical Sciences
- * Journal of Indian Chemical Society
- * Meat Science - An International Journal
- * The EMBO Journal
- * Theriogenology
- * Trends in Biochemical Sciences

e-Resources

- * www.niscair.res.in/ScienceCommunication (Indian Journal of Biochemistry)
- * www.medind.nic.in/iaf/iafm.shtml (Indian Journal of Clinical Biochemistry)
- * www.ijcb.co.in (Indian Journal of Clinical Biochemistry)
- * www.mcponline.org (Molecular & Cellular Proteomics)
- * www.elsevier.com/vj/proteomics (Proteomics Virtual Journal)
- * www.elsevier.com (Journal of Proteomics)
- * www.elsevier.com (Clinical Biochemistry)
- * www.sciencedirect.com/science/journal (Science Direct –Clinical Biochemistry)
- * www.jbc.org (Journal of Biological Chemistry)

Suggested Broad Topics for Master's and Doctoral Research

- * Biochemical parameters in body fluids of patients in livestock and poultry
- * Assay of enzymes for diagnosis of diseases in poultry and livestock.
- * Endocrine studies on domestic and companion animals in relation to production and health status

VETERINARY PHYSIOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VPY 601	PHYSIOLOGY OF DIGESTION	2+1
VPY 602	CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY	2+1
VPY 603	RENAL PHYSIOLOGY AND BODY FLUID DYNAMICS	2+1
VPY 604	HAEMATOLOGY	2+1
VPY 605	VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY	2+0
VPY 606	PHYSIOLOGY OF ANIMAL REPRODUCTION	2+1
VPY 607	CLINICAL PHYSIOLOGY	2+1
VPY 608	NEUROMUSCULAR PHYSIOLOGY	2+1
VPY 609	CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS	3+0
VPY 610	RESEARCH TECHNIQUES IN VETERINARY PHYSIOLOGY	0+2
VPY 691	MASTER'S SEMINAR	1+0
VPY 699	MASTER'S RESEARCH	20
VPY 701	APPLIED PHYSIOLOGY OF BODY FLUIDS AND ELECTROLYTES	2+1
VPY 702	PHYSIOLOGY OF ANIMAL BEHAVIOUR	2+0
VPY 703	COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION	2+1
VPY 704	ADVANCES IN NEURO-ENDOCRINOLOGY	2+1
VPY 705	MYOPHYSIOLOGY AND KINESIOLOGY	2+1
VPY 706	AVIAN PHYSIOLOGY	2+1
VPY 707	PHYSIOLOGY OF LACTATION	2+1
VPY 708	ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH	2+1
VPY 709	ADVANCES IN RUMEN MICROBIOLOGY AND METABOLISM	2+1
VPY 710	ADVANCES IN IMMUNOPHYSIOLOGY	2+1
VPY 711	PHYSIOLOGY OF STRESS	2+1
VPY 790	SPECIAL PROBLEM	0+2
VPY 791	DOCTORAL RESEARCH I	1+0
VPY 792	DOCTORAL RESEARCH II	1+0
VPY 799	DOCTORAL RESEARCH	45

VETERINARY PHYSIOLOGY

Course Contents

VPY 601 PHYSIOLOGY OF DIGESTION 2+1

Objective

To teach comparative physiology of digestive system of monogastric animals, ruminants and birds, and basic techniques.

Theory

UNIT I

Basic characteristics and comparative physiology of digestive system of domestic animals.

UNIT II

Gastro-intestinal motility, secretory functions of gastro-intestinal tract, their regulation and gastro-intestinal hormones.

UNIT III

Absorption, metabolism and excretion of various nutrients, appetite and control of feed intake.

UNIT IV

Development of ruminant system and rumen environment. Ruminant microbial digestion, its advantages and disadvantages. Rumino-reticular motility, its significance and control.

UNIT V

Rumen microbiology. Digestion in birds.

Practical

Collection of saliva and its enzymatic studies. Activity of pepsin and trypsin enzymes. Gastric and intestinal motility. Estimation of digestive metabolites such as glucose, ketone bodies, triglycerides, cholesterol, urea-nitrogen and total proteins. Liver function tests. Method of collection of rumen liquor, merits and demerits. Determination of pH, total volatile fatty acids, ammonia-nitrogen and total-nitrogen in strained rumen liquor. Rate of passage of digesta and its estimation. Rumino-reticular movements. Artificial rumen, counting of protozoa and bacteria.

Suggested Readings

Cunningham JG. 1992. *Text book of Veterinary Physiology*. WB Saunders.
Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.
D.C. Church. (1988) *Digestive Physiology & Nutrition of Ruminants*. Praeice Hall.
Hungate R.E. 1966. *Rumen and its Microbes*. Acad. Press. N.Y.
Forbes JM. & France J. 1993. *Quantitative aspects of Ruminant Digestion & Metabolism*. CAB International. Cambridge. UK

VPY 602 CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY 2+1

Objective

To teach function and regulation of heart, recording of ECG and respiration in different animals and basic techniques.

Theory

UNIT I

Heart muscle, heart as pump, origin and propagation of heart beat. Electrophysiology of heart, rhythmic excitation of heart, cardiac cycle, heart sound and dynamics of valvular and congenital heart defect.

UNIT II

Cardiac output and its measurements, factors affecting cardiac output. Venous return and its regulation. Control of the heart.

UNIT III

Normal electro-cardiogram, electrocardiographic interpretation in cardiac myopathies and cardiac arrhythmias.

UNIT IV

Circulation and hemodynamics, coronary, systemic and pulmonary circulation, their regulation, energetics of circulation, pathophysiology of circulation.

UNIT V

Respiration, mechanism of ventilation, hemoglobin, oxygen and carbon-dioxide transport. Respiratory gas exchange. Respiratory adjustment at high altitude and deep swimming. Neural and chemical control of respiration, artificial respiration. Respiration in birds.

Practical

Determination and recording of cardiac output, blood pressure and electrocardiogram, blood volume. Estimation of lung volumes and capacities by spirometry, effect of various levels of exercise on lung functional capacities. Estimation of blood gases.

Suggested Readings

Cunningham JG. 1992. *Text book of Veterinary Physiology*. WB Saunders.
Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.
Patton 1989. *Howell's Text book of Physiology*. WB. Saunders.
Ganong FW. 2003. *Review of Medical Physiology*. Prentice-Hall.

VPY 603

RENAL PHYSIOLOGY AND BODY FLUID DYNAMICS 2+1

Objective

To impart knowledge regarding excretory system of mammals and birds, maintenance of body fluid homeostasis.

Theory

UNIT I

An overview of nephron structure and function. Renal homeostatic function and renal excretory function.

UNIT II

Quantitative analysis of renal function, renal haemodynamics. Glomerular filtration- its mechanism and measurement. Permeability of the glomerular capillary wall, structural basis of GFR, tubular reabsorption and transport.

UNIT III

Role of kidney in acid-base balance. Physiology of micturition, endocrine control of renal function. Non excretory functions of kidney.

UNIT IV

Skin- general anatomy of epidermis, dermis, hypodermis, mechanical protection, permeability, actinic irradiation, sweat glands, sebaceous glands. Skin grafting. Immune properties of skin.

UNIT V

Composition of body fluids and their regulation. Excretory system in birds.

Practical

Collection and preservation of urine. Physical and chemical analysis of urine and its interpretation in health and disease condition. Demonstration of various kidney function tests, glomerular filtration rate, creatinine clearance rate, urea clearance rate and glucose tolerance test.

Suggested Readings

Klahar S. 1983. *The Kidney and Body Fluids in Health and Diseases*. Plenum Press.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 604**HAEMATOLOGY****2+1****Objective**

To acquaint the students about haematology of different animals including hands-on training.

TheoryUNIT I

Red blood cells, anaemia, different types of anaemia, polycythemia and their effect on circulation in mammals and birds.

UNIT II

Resistance of the body to infection, leukocytes, tissue macrophage system and inflammation.

UNIT III

Immunity, immunoglobulins, immunogenetics, polymorphism in hemoglobin, transferrin etc. Changes in blood during diseases. Iatrogenic blood diseases, hemorrhagic diathesis, hemophilias.

UNIT IV

Hemostasis and coagulation factors, role of platelets, fibrinolysis. Blood groups, transfusion of blood. Tissue and organ transplantation. Conditions causing bleeding disorders.

Practical

Haemograms, platelet count, erythrocyte fragility. Estimation of serum iron and iron binding capacities of plasma. Separation of variants of hemoglobin and transferrin by electrophoresis. Examination of bone marrow. Isolation of different types of blood cells by sedimentation and column chromatography.

Suggested Readings

Dacie JV & Lewis SM.1991. *Practical Hematology*. Churchill Livingstone.

Jain NC. 1993. *Essentials of Veterinary Hematology*. Lea & Febiger.

Rapaport SI. 1987. *Introduction to Hematology*. JB Lippincott.

VPY 605**VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY 2+0****Objective**

To teach the importance of these nutrients in normal body functions and in disease conditions.

TheoryUNIT I

Introduction and brief history, definition, general properties and overview of functions.

UNIT II

Fat soluble vitamins, their functions and deficiency diseases.

UNIT III

Water soluble vitamins and vitamin-like compounds, their functions and deficiency diseases.

UNIT IV

Physiological functions of trace elements, their role in metabolism, toxicity, deficiency diseases.

Suggested Readings

McDowell LR. 1989. *Vitamins in Animal Nutrition*. Academic Press.

Underwood EJ. 1977. *Trace Elements in Human and Animal Nutrition*. Academic Press.

VPY 606 PHYSIOLOGY OF ANIMAL REPRODUCTION 2+1

Objective

To impart knowledge of male and female reproductive system of different species of animals including birds.

Theory

UNIT I

Functional histomorphology of male and female reproductive system, development of male and female sex organs. Endocrine and neuroendocrine relation in male and female reproductive function in different domestic animals.

UNIT II

Sexual cycles and mating behaviours in females, oogenesis, folliculogenesis and ovulation. Secretions of female reproductive tract in different species of animals.

UNIT III

Male mating behaviour, spermatogenesis, spermiogenesis, Seminiferous, epithelial cycles. Spermatozoa- structure and composition, maturation and transportation. Secretions of male reproductive tract.

UNIT IV

Transport of male and female gametes, fertilization, implantation. Pregnancy and parturition. Post-partum recovery in different species of domestic animals.

Practical

Heat detection in different animals, palpation of reproductive organs. Physical and biochemical evaluation of semen, determination of sperm enzyme, leakage during freezing. Preservation of semen, RIA of steroid hormones.

Suggested Readings

Hafeez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.

Pineda & Doley 2003. *McDonald's Veterinary Endocrinology*. Iowa State University Press, Ames.

Salisbury GW & Demark NL. 1978. *Physiology of Reproduction and Artificial Insemination*. WB Saunders.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 607 CLINICAL PHYSIOLOGY 2+1

Objective

To teach physiological basis of clinical abnormalities in body functions.

Theory

UNIT I

Cardiovascular, respiratory, hepatic and renal evaluation of body functions in relation to clinical conditions.

UNIT II

Carbohydrate, fat, protein and mineral metabolism in health and disease of various species.

UNIT III

Functions and dysfunctions of liver, kidney and gastro-intestinal tract.

UNIT IV

Clinico-immunological evaluation of immune responses and clinical enzymology.

Practical

Qualitative tests for glucose, ketone bodies, protein and calcium in urine. Quantitative determination of glucose in blood and urine. Electrophoresis of plasma proteins. Determination of sodium and potassium in serum. Determination of serum chloride. Separation of amino acids. Thin-layer chromatography of serum lipids.

Suggested Readings

Henry RJ. 1974. *Clinical Chemistry. Principles and Techniques*. Harper D Row Publishers.

Kaneko JJ, Harvey JW & Bruss ML. 1997. *Clinical Biochemistry of Domestic Animals*. Academic Press.

King EJ & Wooton IDP. 1956. *Microanalysis in Medical Biochemistry*. Churchill Livingstone.

Oser BL. 1976. *Hawk's Physiological Chemistry*. Tata McGraw-Hill.

Rose BD. 1989. *Clinical Physiology of Acid Base and Electrolyte Disorders*. McGraw-Hill.

Tietz NW. 1970. *Fundamentals of Clinical Chemistry*. WB. Saunders.

VPY 608

NEUROMUSCULAR PHYSIOLOGY

2+1

Objective

To impart knowledge of coordination of body functions and regulation of brain functions and sense organs.

Theory

UNIT I

Types and classification of muscles, comparative histopathology of muscles. Skeletal muscle fibers, membrane and action potential at myoneuronal junction. Molecular characteristics of contractile filaments, molecular mechanism of muscle contraction, relationship between actin and myosin filaments, overlap and tension developed by the contracting muscles. Contractile process of smooth muscles.

UNIT II

Length and tension relationship, force and velocity relationship. Skeletal muscle energetics, metabolism and lactate shuttle. Exercise, adaptation to training and performance. Neuromuscular disorders of domestic animals.

UNIT III

Nervous system, synapse, transmission and processing of information, receptors, brain and spinal reflexes, motor functions of brain stem, limbic system, memory, sleep, learning, autonomic nervous system.

UNIT IV

Special senses and somatic senses.

Practical

Recording of electro-myogram, fatigue, tetanus in muscles. Effect of temperature on different types of muscles, demonstration of intestinal movements, effect of drugs on all types of muscles, estimation of muscles specific enzymes.

Suggested Readings

Basmajian JV. 1978. *Muscle Alive: their Functions Revealed by Electromyography*. Williams & Wilkins.

Cooper R. 1980. *EEG Technology*. Butterworths, London.

Klemm. WR. 1969. *Animal Electroencephalography*. Acad. Press Inc. New York.

Smith R.F. 1978. *Fundamentals of Neurophysiology*. Springer Verlag.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 609

CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS

3+0

Objective

To acquaint the students about different endocrine glands of the body and their relationship with production.

Theory

UNIT I

Methods of study bioregulation including methods of endocrine analysis. Manipulation and disruption of biorhythms in homeostatic and natural ecosystem.

UNIT II

Hormonal relationship in animal production. Concepts in hormone function, classification and methods of study. Hormonal assay, mechanism of hormone synthesis, release and transport. Mechanisms of hormone action, target cell interactions.

UNIT III

Genetic and genomic approaches in endocrinology. Animal models and alternate uses of animal model. Regulation and metabolism of hypothalamic, hypophyseal, thyroid and adrenal hormones.

UNIT IV

Gonadal and placental hormones, their regulation and mechanism of action. Hormonal principles of pineal gland and its role in production.

UNIT V

Endocrine control of carbohydrate and calcium homeostasis. Hormones and adaptation to environment. Hormonal regulation of gastro-intestinal activity. Prostaglandins. Hormones in fertility regulation and production augmentation. Avian endocrinology.

Suggested Readings

Pineda MH & Doley MP. 2003. *McDonald's Veterinary Endocrinology*. Blackwell Publ.

Turner CD & Bagnara JT. 1976. *General Endocrinology*. WB Saunders.

Williams RH. 1982. *Text Book of Endocrinology*. WB Saunders.

VPY 610 **RESEARCH TECHNIQUES IN VETERINARY** **0+2**
PHYSIOLOGY

Objective

Training in various techniques for application in research in Animal Physiology.

Practical

Recording of ECG, EMG, blood pressure, pulse rate, movement of GI tract by Physiograph. Gas Liquid Chromatography. Electrophoresis. Estimation of various electrolytes. Estimation of bacterial production rate and VFA production rate, solid and liquid digesta flow rates and body composition using radio-isotopes, *in vitro* and *in sacco* rumen studies, ELISA. R.I. A. techniques of various hormones.

Suggested Readings

Abraham GE. 1977. *Handbook of Radioimmunoassay*. Marcel Dekker.
Armstrong ML. 1978. *Electrocardiograms: A Systematic Method of Reading Them*. KM Verghese.
Oser BL. 1976. *Hawk's Physiological Chemistry*. Tata McGraw-Hill.
Smorto MP & Basmajian JV. 1979. *Clinical Electroneurography - An Introduction to Nerve Conduction Tests*. Williams & Wilkins.

VPY 701 **APPLIED PHYSIOLOGY OF BODY FLUIDS** **2+1**
AND ELECTROLYTES

Objective

To teach physiological and clinical implication of changes in electrolytes and body fluids.

Theory

UNIT I

Volume and composition of body fluids, exchange of water and electrolytes between body compartments, blood and external environment. Osmolarity of fluid.

UNIT II

Regulation of volume and osmolarity of extra cellular fluid. Regulation of pH and acid base balance. Formation and composition of cerebrospinal fluid and lymph.

UNIT III

Clinical implications of change in electrolytes and body fluids. Structural and functional consideration of plasma and its composition. Diuresis and endocrine control of renal functions.

UNIT IV

Clinical feature in fluid and electrolyte imbalance, clinicopathological indicators of fluid and electrolytes imbalance.

Practical

Determination of electrolytes viz. sodium, potassium and chloride in plasma, determination of total body water and plasma volume by various techniques i.e. dye dilution and radioisotope technique, Estimation of osmolarity and osmolality of body fluids.

Suggested Readings

Selected articles from journals.

VPY 702 PHYSIOLOGY OF ANIMAL BEHAVIOUR 2+0

Objective

To impart knowledge on various aspects of animal behaviour viz. communication in animals, sexual behaviour, feeding behaviour etc.

Theory

UNIT I

Introduction to animal ethology. Neurophysiological basis of animal behaviour.

UNIT II

Behaviour in relation to changes in the environment. Feeding behaviour, grazing, stall feeding and rumination.

UNIT III

Sexual behaviour in the female and male. Maternal behaviour. Milk let down.

UNIT IV

Social behaviour, communication in animals, animal temperament. Response of dogs and horses to training.

Suggested Readings

Selected articles from journals.

VPY 703 COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION 2+1

Objective

To teach functional development of rumen and comparative digestive functions in different ruminant species.

Theory

UNIT I

Functional development of ruminant stomach. Rumen motility and its control.

UNIT II

Salivary secretion and its regulation. Intraruminal environment, rumen metabolites and their assimilation, NPN feeding, nitrogen recycling.

UNIT III

Synthesis of microbial proteins and vitamins. Rumen dysfunctions. Comparative efficiency of rumen function in different species. Stoichiometry of carbohydrate fermentation.

UNIT IV

Manipulation of rumen fermentation, protected nutrients feeding, probiotics supplementation etc. Rumen flow rate and rumen volume.

Practical

Reticulo-ruminal motility, artificial rumen techniques, total volatile fatty acids and their fractions, bacteria, protozoa and fungi in rumen. Flow rates of ruminal contents.

Suggested Readings

Selected articles from journals.

VPY 704 ADVANCES IN NEURO-ENDOCRINOLOGY 2+1

Objective

To acquaint the students about neuro-endocrine integrating mechanism in animals and birds.

Theory

UNIT I

Neuroendocrine integrating mechanism. Structure of hypothalamus, pituitary gland, limbic and other neural pathways and endocrine functions.

UNIT II

Neural control of oxytocin, adrenocorticotrophic hormone, aldosterone, thyrotropic hormone, growth hormone, gonadotrophins etc. Hypothalamic releasing factors and the neuro-vascular link between brain and anterior pituitary.

UNIT III

Role of afferent impulses from genitals and other regions in reproductive system. Influence of hormones on brain activity.

UNIT IV

Effects of drugs on neuro-endocrine system. Neuro-endocrine mechanisms in birds. Interaction of nervous, endocrine and immune system in animal production and reproduction.

Practical

Radio-immuno assay of progesterone, effects of ovariectomy, effects of testosterone treatment. Bioassay of estrogens. Estimation of T₃ and T₄ in blood.

Suggested Readings

Selected articles from journals.

VPY 705 MYOPHYSIOLOGY AND KINESIOLOGY 2+1

Objective

To impart the knowledge regarding exercise and work physiology, molecular basis of muscle contraction.

Theory

UNIT I

Structure of muscle, chemical composition, muscle contraction and irritability. Mechanical properties of skeletal muscle.

UNIT II

Thermal properties of muscles. Chemical correlates of contraction.

UNIT III

Molecular basis of muscular contraction of skeletal muscle. Pathophysiology of muscles and myocardium.

UNIT IV

Lever systems of body joints, Synovial fluid formation and its physiology. Principles of Kinesiology and its application in work physiology.

Practical

Electromyogram, Tetany. Electro-cardiogram. Intestinal movements. Effects of various drugs on all types of muscles.

Suggested Readings

Selected articles from journals.

VPY 706 AVIAN PHYSIOLOGY 2+1

Objective

To impart complete knowledge about physiology of domestic fowl and comparative physiology of other birds.

Theory

UNIT I

Digestive and urinary system.

UNIT II

Blood, cardiovascular and respiratory system.

UNIT III

Reproductive and endocrine system.

UNIT IV

Nervous system and musculo-skeletal system.

Practical

Study of blood cells, haemoglobin, packed cell volume (haematocrit) and erythrocyte sedimentation rate. Determination of glucose, calcium, uric acid and urea in blood. Electrophoretic separation of plasma proteins and egg proteins.

Suggested Readings

Selected articles from journals.

VPY 707

PHYSIOLOGY OF LACTATION

2+1

Objective

To acquaint students with physiology and mechanism of lactation.

Theory

UNIT I

Functional anatomy, histology and cytology of mammary gland in domestic animals.

UNIT II

Development of mammary gland, hormonal control of mammary gland growth.

UNIT III

Process of lactation, initiation of milk secretion, hormonal control of lactation. Biochemical and histological changes in mammary gland during lactation. Mechanism of galactopoiesis.

UNIT IV

Neural control of lactation, milk let down, milk ejection and inhibition of milk ejection. Induced lactation. Composition of milk in different species of animals.

Practical

Examination of normal udder of cow and buffalo. Composition of colostrum and milk during different phases of lactation. Effect of adrenalin and oxytocin on milk let down, artificial induction of lactation. Estimation of lactogenic hormones.

Suggested Readings

Selected articles from journals.

VPY 708

ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH

2+1

Objective

To acquaint the students about co-relation of various environmental factors on growth and performance of animals.

TheoryUNIT I

Ecology of farm animals, biological rhythms, mammalian circadian rhythms, their regulation. Components of physical environment, biometeorology and principles of thermoregulation in mammals and birds.

UNIT II

Physiological response of farm animals to heat and cold. Effect of various climatic components on health and production (growth and egg production), reproduction and climatic adaptation.

UNIT III

Concept and definitions of cellular, prenatal and postnatal growth- patterns in different species of domestic animals.

UNIT IV

Factors affecting live weight growth viz. nutrition, hormones, vitamins, antibiotics, environment. Ageing and senescence. Growth anomalies.

Practical

Growth measurement and growth curves, recording of various climatic variables, effect of climatic variables on growth and production.

Suggested Readings

Selected articles from journals.

VPY 709**ADVANCES IN RUMEN MICROBIOLOGY
AND METABOLISM****2+1****Objective**

Students will learn about rumen ecosystem and symbiotic relationship of flora and fauna, their structure and functions. Rumen manipulation techniques.

TheoryUNIT I

Introduction to rumen bacteria, protozoa and fungi. Development and natural fluctuation in rumen microbial population.

UNIT II

Microbial ecology and physiology of feed degradation within the rumen. Metabolism of nitrogen containing compounds.

UNIT III

Degradation of carbohydrate, fat and protein by rumen microbes, NPN utilization, Microbe-microbe interaction. Protected nutrients and other feed additives.

UNIT IV

Genetics and biotechnology of rumen microbes, rumen anaerobic fungi, their role and interaction with other rumen microbes.

Practical

Counting of total and differential protozoa, total and viable bacteria and fungi in rumen liquor. Individual VFA by GLC. Defaunation and manipulation of rumen fermentation. Culture of bacteria and fungi.

Suggested Readings

Selected articles from journals.

VPY 710

ADVANCES IN IMMUNOPHYSIOLOGY

2+1

Objective

To study cells and organs of immune system, its development and role in physiological functions and immunomodulation.

Theory

UNIT I

Introduction, history, body defense, organs of immune system, ontogeny and phylogeny of immune system, vertical transmission of immunity and difference between vertebrates and invertebrates

UNIT II

Immunoglobulins-basic structure and functions, hematopoiesis, T-cell and B-cell-evolution, development and their functions, species specific immunity, cytokines-sources and actions, MHC, genetic organization of immunoglobulin, MHC and complement system.

UNIT III

Immune-endocrine interactions, immune system in reproduction, ageing, stress and other physiological functions, immunomodulation.

UNIT IV

Hypersensitivity, diseases related to immune system, dysfunction, autoimmune disorders and their genesis, immunodeficiency.

Practical

Qualitative & quantitative analysis of immunoglobulins in body fluids, RIA, ELISA, Electrophoresis techniques in immunophysiology, raising hyperimmune sera and blood group immunophysiology.

Suggested Readings

Abbas AK, Lichtman AH & Pillai S. (Eds). 2007. *Cellular and Molecular Immunology*. 6th Ed. Elsevier.

Goldsby RA, Kindt TJ, Osborne PA & Kuby J. 2007. *Immunology*. 6th Ed. WH. Freeman.

Roitt IM. 1997. *Essential Immunology*. 9th Ed. Blackwell, Oxford.

Tizzard IR. 2004. *Veterinary Immunology*. 5th Ed. WB. Saunders.

VPY 711

PHYSIOLOGY OF STRESS

2+1

Objective

To teach the mechanism and effect of stress on production and reproduction in domestic animals.

Theory

UNIT I

Definition of stress, various types of stresses, their effect on animal production and reproduction.

UNIT II

Physico-chemical changes of blood composition due to exercise and work. Energy utilization and requirement of muscles during work and exercise.

UNIT III

Capacity of work under field and controlled laboratory conditions, factors that regulate it.

UNIT IV

Effect of various stresses on endocrine status of animals, endurance in animals.

Practical

Measurement of various biochemical parameters during stress and /or exercise in animals, measurement of various hormones during different stresses in animals, measurement of cardio-respiratory reactions during stresses.

Suggested Readings

Selected articles from journals.

VPY 790

SPECIAL PROBLEM

0+2

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PHYSIOLOGY

List of Journals

- * Acta Endocrinologica
- * Advances in Clinical Chemistry
- * Advances in Reproductive Physiology
- * Advances in Veterinary Sciences
- * American Journal of Clinical Nutrition
- * American Journal of Physiology
- * American Journal of Veterinary Research
- * Animal Nutrition and Feed Technology
- * Animal Reproduction Science
- * Animal Sciences
- * Annual Review of Physiology
- * Buffalo Journal
- * Domestic Animal Endocrinology
- * Indian Journal of Animal Reproduction
- * Indian Journal of Animal Nutrition
- * Indian Journal of Animal Physiology
- * Indian Journal of Animal Research
- * Indian Journal of Animal Science
- * Indian Veterinary Journal
- * Journal of Endocrinology
- * Journal of Physiology
- * Journal of Reproduction and Fertility
- * Neuroendocrinology

e-Resources

- * <http://intl-joe.endocrinology-journals.org> (Journal of Endocrinology)
- * <http://intl-ajpcon.physiology.org> (American Journal of Physiology)
- * <http://arjournals.annualreviews.org> (Annual Review of Physiology)
- * www.jneurosci.org (Journal of Neuroscience)
- * www3.interscience.wiley.com (Journal of Physiology & Animal Nutrition)
- * <http://jp.physioc.org> (Journal of Physiology)

Suggested Broad Topics for Master's and Doctoral Research

- * Manipulation of rumen fermentation to enhance growth and productivity in ruminants.
- * Normal renal functions of domestic animals.
- * To study the mechanism of regulation of various hormones involved in production and reproduction in domestic animals.
- * Dietary effects on growth and production in poultry.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
 Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
 Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
 James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
 Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
 Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
 Richard WS. 1969. *Technical Writing*. Barnes & Noble.
 Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
 Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
 Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503
(e-Course)

**INTELLECTUAL PROPERTY AND ITS
MANAGEMENT**

1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of animal varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
 Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer. Vol. V. Technology Generation and IPR Issues.* Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics.* CABI.

Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies.* Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 506
(e-Course)

DISASTER MANAGEMENT

1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management.* Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management.* Routledge.

Sharma VK. 2001. *Disaster Management.* National Centre for Disaster Management, India.

BSMA Committee on Basic Veterinary Sciences

(Vety. Anatomy, Basic Physiology, Biochemistry, Stat., Extension, Economics)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR
dated January 14, 2008)

Name	Address	Specialization
Dr. Dharmeshwar Das <i>Convenor</i>	IVRI, Izatnagar	Genetics
Dr. V. K. Kansal Head	Animal Biochemistry Division, NDRI, Karnal	Biochemistry
Dr. S. D. Singh Prof. & Head	CIFE, Mumbai	
Dr. Geetha Ramesh Prof. & Head	Dept. of Vety. Anatomy & Histology, Madras Vety. College, Chennai	Anatomy & Histology
Dr. S. K. Rastogi Prof. & Head	Dept. of Vety. Physiology, GBPUAT, Pantnagar	Physiology
Dr. S.V.N. Rao Prof. & Head	Dept. of VAHE, Rajiv Gandhi College of Vety. & Animal Sciences, Podicherry	Extension
Dr. Rajesh Nigam Registrar	Dept. of Vety. Biochemistry, Vety. College, Mathura	Biochemistry
Dr. J. S. Bhatia Prof. & Head	Dept of Vety. Physiology, Appolo College of Vety. Medicine, Jaipur	Physiology
Dr. S.K. Nagpal Dean <i>Member Secretary</i>	College of Vety. Sciences, CCS HAU Hisar	Anatomy

**NEW AND RESTRUCTURED
POST-GRADUATE CURRICULA & SYLLABI**

Veterinary Para-clinical Subjects

Veterinary Microbiology

Veterinary Parasitology

Veterinary Pathology

Veterinary Pharmacology and Toxicology

Veterinary Public Health



**Education Division
Indian Council of Agricultural Research
New Delhi**

January 2009

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PREAMBLE

Veterinary sciences have helped in reducing animal sufferings, minimizing risk of zoonotic diseases threatening human health and ensuring food security. There have been unprecedented advancements in all the branches of veterinary sciences. The futuristic requirements of the society such as integrated casualty management, public health, food security and safety, healthy eco-system, containing bio-terrorism, productivity, profitability and stability of livestock farming systems etc., have posed greater challenges for veterinary academics and scientific community. Veterinarians with higher qualifications are increasingly being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonoses, eco-health stewardship, monitoring and surveillance of diseases of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistant breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary sciences. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates

In this perspective, it is important that the veterinary profession respond to the futuristic societal needs to remain relevant and purposeful. Recent advances in veterinary medical sciences have led to wide spread use of animal disease surveillance and prediction system, 3-D holographic animal models, robotic tele-surgery, globe-wide virtual class rooms and demonstration centers, sensor diagnostic facilities etc. The dominant forces shaping the Veterinary-Business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. Informal discussions amongst veterinary academicians, over

the years, referred to the need to train good teachers and researchers with comprehensive subject knowledge rather than narrow sub-specialization of a discipline at Master's level. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was initiated.

Three BSMA committees, constituted by ICAR for restructuring of masters and doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committees consisted of ¹Basic Veterinary Sciences (Anatomy and Histology; Veterinary & Animal Husbandry Extension; Biochemistry and Physiology); ²Veterinary Para-clinical Sciences (Microbiology, Parasitology, Pathology, Pharmacology & Toxicology, Public Health) and ³Veterinary Clinical Sciences (Animal Reproduction, Gynaecology & Obstetrics; Clinical Medicine, Ethics & Jurisprudence; Veterinary Epidemiology & Preventive Medicine and Surgery & Radiology).

The Master's programme in basic veterinary subjects aims at providing cutting edge concepts as well as practical applications of these exciting fields. The new and restructured Post-Graduate curricula and syllabi in respect of basic, paraclinical and clinical veterinary sciences documents contain several innovative and practically applicable courses and extensively revamped course contents viz. inclusion of imaging techniques, ultra-structural studies and clinical applications in the curricula of veterinary anatomy; emphasis on cell membrane dynamics, receptor biology and proteomics in relation to various animal diseases in veterinary biochemistry; focus on rumen microbiology and metabolism, immuno-physiology and physiology of stress in veterinary physiology; framing of courses on social psychology, group dynamics, gender and livestock development, planning and monitoring, organizational management and information and communication technology in the veterinary and animal husbandry extension.

Para-clinical veterinary subjects, which provide essential support by employing disease diagnostics technologies for prevention and control of animal diseases, directing efforts for Green Earth, maintenance of biodiversity etc., have been redesigned in the light of general recommendations of the BSMA committees on veterinary sciences. Courses have been re-designed in such a manner that an MVSc student in Microbiology studies all aspects of bacteriology, virology, mycology and immunology. The contents of 17 courses of microbiology and 14 courses of immunology have been reshaped and encapsulated into 9 mandatory courses of 600 series and 18 optional courses of 700 series have been carved

in veterinary microbiology. In veterinary parasitology, new courses on malacology, remote sensing and GIS have been introduced. In veterinary pathology, courses on veterolegal pathology and toxico-pathology have been introduced. A new course on ethno-pharmacology has been introduced in veterinary pharmacology while courses on fish, fish products and seafood hygiene; disaster management and bioterrorism; emerging and reemerging zoonoses; occupational health hazards; disposal and recycling of waste; biohazards and bio-security have been introduced in veterinary public health.

The new approach encompassed the latest knowledge for development of advanced diagnostics, clinical management, clinical epidemiology, bio-security, prevention and control of diseases of livestock and poultry including zoonoses like Bird Flu, Rabies, Tuberculosis, Brucellosis etc. New courses on 'Herd Health management', 'Ecology', 'Forensic Medicine', 'Emergency Medicine', 'Diagnostic Imaging Techniques,' 'Survey and Surveillance', 'Diseases of Zoo, Wild and Laboratory Animals' etc. have been framed and contents of other courses were heavily revised to include the latest developments. To encourage clinical practice in the veterinary clinics, courses of Clinical Practice each at MVSc and PhD level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course for special problems has been introduced in all the subjects.

Teaching Veterinary Clinical Service Complex, along with clinical departments and diagnostic laboratories, provides yeoman's service to stake holders in the field of animal health. The up-gradation of the clinical services will go a long way in meeting the expectations and demands for advanced diagnosis, therapeutics and prophylaxis. The state of infra-structure, manpower (both technical and support staff) and contingencies attached to clinical service units in veterinary colleges in India, requires immediate attention of policy planners to support and supplement in terms of liberal financial grants.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

S. K. Jand, Convener BSMAC (Veterinary Para- Clinical Sciences)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in veterinary science disciplines have been prepared in the light of PG programmes in vogue at different veterinary colleges in India and contemporary developments in veterinary sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each MVSc student should register for all the courses offered by the major department, e.g. an MVSc student in microbiology should study all basic courses of bacteriology, virology and immunology instead of opting for courses of 1 or 2 sub-disciplines only. However, flexibility has been retained at Ph.D. level.

II. Credit Requirements

- Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the veterinary students as given below.
- The total course work of 40 credit hours has been proposed at M.V.Sc. level instead of minimum requirement 35 credit hours (Table 2), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table-1) and supporting subjects together (as per requirement) -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subjects (specified in table-1) and supporting subjects together -11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and courses with minimum of 3 credit hours from supporting subject should be taken. Thus, students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- It is proposed that clinical practice of 0+3 credit hours should be made compulsory in the two semesters for all MVSc students in departments of Clinical Medicine, Ethics & Jurisprudence, Surgery & Radiology, and Animal Reproduction, Gynaecology & Obstetrics.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.
- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary

Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for MVSc and 700 for Ph. D. programme.

III. Major additions and alterations in the existing PG courses

Veterinary Microbiology

- Specialization at Masters level in Veterinary Microbiology and Veterinary Immunology has been abolished and there will be one unified masters programme i.e. M.V.Sc (Veterinary Microbiology)
- Contents of existing 31 courses (17 of Microbiology and 14 of Immunology) have been encapsulated in to 9 courses which are all mandatory.
- To keep upfront with the latest developments at doctoral level, 16 out of 18 proposed courses have been framed afresh.

Veterinary Parasitology

- VPA 605 [Parasitological techniques] course contents upgraded to include the latest techniques e.g. Application of remote sensing and geographical information system in Parasitology.
- VPA 611 [Malacology] designed to emphasize the study of intermediate hosts.
- Courses namely VPA 701 [Applications of remote sensing and geographic information system in Parasitology]; VPA 702 [Molecular diagnostics and vaccine development in Parasitology]; VPA 703 [Host parasite interactions]; VPA 708 [*In vitro* cultivation of parasites]; VPA 709 [Emerging and re-emerging parasitic diseases]; VPA 710 [Bionomics of parasites] and VPA 711 [Environmental Parasitology] added to cope up with the unprecedented growth of information in the field

Veterinary Pathology

- VPP 605 and VPP 606 [Necropsy procedures and interpretations –I & II] are new practical oriented courses designed to enhance the interpretation skills.
- VPP 609 [Toxicopathology] previously a doctorate level course has been tailored for Masters.
- VPP 610 [Avian pathology] and VPP 707 [Advances in avian pathology] redesigned to include other avian species besides poultry.
- VPP 612 [Veterolegal pathology] designed in view of increasing veterolegal cases requiring specialized knowledge.
- VPP 704 [Ultrastructural pathology] designed to expose students to ultrastructural pathology.
- VPP 706 [Pathology of important and emerging diseases of pets and livestock] designed to teach emerging diseases of pets and livestock.
- VPP 709 [Molecular pathology of cell injury] and VPP 710 [Experimental pathology] designed in view of latest developments.

Veterinary Pharmacology and Toxicology

- VPT 610 [Pharmacological techniques] redesigned course to include latest techniques.
- VPT 612 [Ethnopharmacology] redesigned to include alternative system of medicine for animals.

Veterinary Public Health

- VPH 608 [Environmental pollution and safety] introduced at Masters level, earlier it was scheduled for doctoral students.
- VPH 609 (Fish, fish products and seafood hygiene) and VPH 610 (Disaster management and bioterrorism)- New course added to meet the present day requirements
- Doctorate level new courses designed to bring in novelty and advances in the field e.g. VPH 702 [Emerging and reemerging zoonoses]; VPH 703 [Quality control of animal food products]; VPH 704 [Occupational health hazards]; VPH 705 [Disposal and recycling of waste]; VPH 706 [Biohazards, bio-security and disaster management] and VPH 707 [Food plant sanitation].

ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	60	75
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given in Table 1.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Table 1. Suggested list of specified minor subjects (departments)

Major Subject	Minor Subjects
Veterinary Microbiology	Animal Biotechnology, Veterinary Epidemiology & Preventive Medicine, Veterinary Pathology, Veterinary Public Health, Veterinary Biochemistry
Veterinary Parasitology	Veterinary Epidemiology & Preventive Medicine, Veterinary Microbiology, Veterinary Pharmacology & Toxicology, Animal Biotechnology, Veterinary Pathology, Veterinary Biochemistry
Veterinary Pathology	Veterinary Microbiology, Veterinary Anatomy and Histology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Parasitology, Veterinary Pharmacology & Toxicology, Animal Nutrition
Veterinary Pharmacology and Toxicology	Veterinary Physiology, Veterinary Biochemistry, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Pathology, Animal Biotechnology
Veterinary Public Health	Veterinary Epidemiology and Preventive Medicine, Veterinary Microbiology, Veterinary Pathology, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Veterinary Parasitology, Livestock Product Technology

* The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean post graduate studies

VETERINARY MICROBIOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VMC 601	BACTERIOLOGY – I	3+1
VMC 602	BACTERIOLOGY – II	3+1
VMC 603	VETERINARY MYCOLOGY	1+1
VMC 604	GENERAL VIROLOGY	2+1
VMC 605	SYSTEMATIC ANIMAL VIROLOGY	3+1
VMC 606	PRINCIPLES OF IMMUNOLOGY	2+1
VMC 607	VACCINOLOGY	2+0
VMC 608	DIAGNOSTICS OF INFECTIOUS DISEASES	1+2
VMC 609	TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY	0+3
VMC 691	MASTER’S SEMINAR	1+0
VMC 699	MASTER’S RESEARCH	20
VMC 701	ADVANCES IN BACTERIOLOGY	2+1
VMC 702	ADVANCES IN MYCOLOGY	2+1
VMC 703	BACTERIAL GENETICS	2+1
VMC 704	MICROBIAL TOXINS	2+1
VMC 705	MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS	2+1
VMC 706	ADVANCES IN VIROLOGY	2+1
VMC 707	MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS	2+1
VMC 708	STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES	3+0
VMC 709	ONCOGENIC VIRUSES	2+0
VMC 710	SLOW VIRAL INFECTIONS AND PRIONS	2+0
VMC 711	MOLECULAR IMMUNOLOGY	2+1
VMC 712	ADVANCES IN CELLULAR IMMUNOLOGY	2+1
VMC 713	CYTOKINES AND IMMUNOMODULATORS	2+0
VMC 714	ADVANCES IN VACCINOLOGY	2+0
VMC 715	ADVANCES IN IMMUNODIAGNOSTICS	1+1
VMC 716	MODERN IMMUNOTECHNOLOGY	1+2
VMC 717	CURRENT TOPICS IN INFECTION AND IMMUNITY	3+0
VMC 718	VETERINARY MICROBIAL BIOTECHNOLOGY	2+1
VMC 790	SPECIAL PROBLEM	0+2
VMC 791	DOCTORAL SEMINAR I	1+0
VMC 792	DOCTORAL SEMINAR II	1+0
VMC 799	DOCTORAL RESEARCH	45

VETERINARY MICROBIOLOGY

Course Contents

VMC 601	BACTERIOLOGY - I	3+1
Objective	To impart knowledge on general microbiology and important aerobic bacteria.	
Theory	<u>UNIT I</u> Introduction to historical development of cellular organization, genetic & chemical characteristics of eukaryotic and prokaryotic cells. Classification, nomenclature and identification; genetic characterization and numerical taxonomy. Bacterial cell structure, physiology and antigenic structure.	
	<u>UNIT II</u> Determinants of pathogenicity and its molecular basis. Bacteriophages: temperate and virulent phages; lysogeny and lysogenic conversion. Bacterial genetics: bacterial variation, genetic transfer mechanisms (transformation, transduction and conjugation); plasmids, transposons and drug resistance; recombinant DNA technology.	
	<u>UNIT III</u> Systemic study of following bacteria: Gram negative- aerobic rods and cocci, family <i>Pseudomonadaceae</i> , <i>Legionellaceae</i> , <i>Neisseriaceae</i> , and genus <i>Brucella</i> . Facultative anaerobic Gram negative rods, family- <i>Vibrionaceae</i> , <i>Pasteurellaceae</i> , <i>Enterobacteriaceae</i> and other genera.	
Practical	Morphological characterization, cell fractionation, enrichment & isolation technology, various methods used in growth measurement and bacterial preservation, gene transfer experiment. Detailed characterization (biochemical, serological, pathogenicity) of bacteria.	
Suggested Readings	Glen Sonder J & Karen W Post 2005. <i>Veterinary Microbiology: Bacterial & Fungal Agents of Animal Diseases</i> . Cold Spring Harbor Lab. Press. Prescot LM, Harley JP & Klen DA. 2005. <i>Microbiology</i> . Wm. C. Brown Publ. Tortora GJ, Funke BR & Case CL. 2004. <i>Microbiology: An Introduction</i> . Benjamin/Cummins Publ.	
VMC 602	BACTERIOLOGY - II	3+1
Objective	To learn about spore forming bacteria and some important aerobes and anaerobes.	
Theory	<u>UNIT I</u> Systematic study of following pathogenic bacteria: Gram positive cocci, family <i>Micrococaceae</i> , endospore forming Gram positive rods and cocci, family <i>Bacillaceae</i> genus <i>Bacillus</i> , <i>Sporolactobacillus</i> and <i>Clostridium</i> . Spirochetes. Family <i>Spirochetaceae</i> and other families like <i>Spirillaceae</i> , coryneform bacteria, <i>Dermatophilaceae</i> , <i>Streptomyetaceae</i> .	

UNIT II

Mycobacteria and *Nocardia*, family *Actinomycetaceae*. Atypical prokaryotes such as *Chlamydia*, *Rickettsiae*, *Mycoplasma*, *Acholeplasma*, *Spiroplasma*, *Anaeroplasma* and *Thermoplasma*.

UNIT III

Regular non-sporing Gram positive rods such as *Listeria* and *Erysipelas*. Anaerobic Gram negative straight, curved and helical rods, family *Bacteriodaceae* and genus *Bacteroides* and *Fusobacterium*.

Practical

Detailed and comparative study of morphology, biochemical reactions, physiology, serology and pathogenicity of various bacteria studied in theory, isolation of bacteria from field materials leading to their characterization and identification.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.
Prescot LM, Harley JP & Klen DA. 2005. *Microbiology*. Wm. C. Brown Publ.
Tortora GJ, Funke BR & Case CL. 2004. *Microbiology: An Introduction*. Benjamin/Cummins Publ.

VMC 603

VETERINARY MYCOLOGY

1+1

Objective

To learn general and pathogenic mycology.

Theory

UNIT I

Morphology, physiology, reproduction, cultural characters, classification of fungi, immunology of pathogenic fungi.

UNIT II

Systematic study of animal mycoses such as aspergillosis, candidiasis, cryptococcosis, epizootic lymphangitis, mycetomas, sporotrichosis, histoplasmosis, blastomycosis, coccidioidomycosis, haplomycosis, rhinosporidiosis, zygomycosis, mycotic abortion, mycotic mastitis, mycotic dermatitis, dermatophytoses, mycotoxicosis etc.

Practical

Collection and processing of clinical material for isolation of fungi. Study of gross and microscopic characters of pathogenic fungi.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.

VMC 604

GENERAL VIROLOGY

2+1

Objective

To study general aspects of viral structure, classification, replication, interactions and immunity to viruses.

Theory

UNIT I

History of virology; origin and nature of viruses; biochemical and morphological structure of viruses; nomenclature and classification of viruses.

UNIT II

Replication of DNA and RNA viruses, viral genetics and evolution.

UNIT III

Genetic and non-genetic interactions between viruses, virus-cell interactions, viral pathogenesis, viral persistence, oncogenic viruses, epidemiology of viral infections.

UNIT IV

Immune response to viruses, viral vaccines, viral chemotherapy.

Practical

Orientation to a virology laboratory, preparation of equipment for sterilization, collection, preservation, transportation of samples and their processing, isolation and cultivation of viruses in animals/ birds, embryonated chicken eggs; media and reagents for cell culture, trypsinization and maintenance of monolayer cell cultures, isolation of virus in cell cultures, titration of viruses by 50% end-point cytopathogenicity, and haemagglutination; detection of viral antibodies by serum neutralisation test, agar gel precipitation test, haemagglutination inhibition and ELISA.

Suggested Readings

Acheson NH. 2006. *Fundamentals of Molecular Virology*. Wiley.

Carter J & Saunders V. 2007. *Virology: Principles and Applications*. 1st Ed. Wiley.

Knipe DM, Howley PM, Griffin DE. 2006. *Fields Virology*. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.

Mahy BWJ & Kangaroo HO. 1996. *Virology Methods Manual*. Academic Press.

Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. *Veterinary Virology*. 3rd Ed. Academic Press.

VMC 605

SYSTEMATIC ANIMAL VIROLOGY

3+1

Objectives

To study viral properties, epidemiology, pathogenesis, diagnosis and control of diseases caused by animal viruses.

Theory

UNIT I

Studies on animal viruses belonging to various families, and prion agents given below with reference to antigens, cultivation, pathogenesis, epidemiology, disease status in India, diagnosis, immunity and control.

Capripoxvirus, avipoxvirus, cowpoxvirus; bovine herpes viruses, equine herpes viruses, infectious laryngotracheitis virus, Marek's disease virus, pseudorabies virus, malignant catarrh fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis-hydropericardium virus, papillomatosis, canine parvoviruses, feline panleucopenia virus.

UNIT II

New castle disease virus, canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

UNIT III

Infectious bronchitis virus, transmissible gastroenteritis virus; equine arteritis virus, equine encephalomyelitis viruses; swine fever virus, BVDV-mucosal disease virus; foot and mouth disease virus, duck hepatitis virus; visna/maedi virus, equine infectious anemia virus, avian leucosis complex virus, bovine leukemia virus, chicken anemia virus; prions: scrapie, bovine spongiform encephalopathy.

Practical

Isolation of viruses in embryonated eggs and cell cultures; cytopathogenicity of representative animal viruses viz., cell death, syncytia formation, inclusion body etc.; diagnosis of animal viruses employing various serological tests, viz., haemagglutination and haemagglutination inhibition for Newcastle disease virus, agar gel diffusion and virus neutralization test for infectious bursal disease viruses; diagnosis of IBD virus and rotavirus by latex agglutination test, serotyping of FMD virus by ELISA, electropherotyping of rotavirus, PCR for diagnosis of viral infections.

Suggested Readings

- Acheson NH. 2006. *Fundamentals of Molecular Virology*. Wiley.
Carter J & Saunders V. 2007. *Virology: Principles and Applications*. 1st Ed. Wiley.
Knipe DM, Howley PM, Griffin DE. 2006. *Fields Virology*. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.
Mahy, BWJ & Kangaroo HO. 1996. *Virology Methods Manual*. Academic Press.
Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. *Veterinary Virology*. 3rd Ed. Academic Press.

VMC 606

PRINCIPLES OF IMMUNOLOGY

2+1

Objective

To impart knowledge about fundamental principles of immunology and its applications in the field of infectious diseases.

Theory

UNIT I

History of immunology, immunity types, cardinal features, phylogeny. Vertebrate immune system: lymphoid organs and tissues; development of B and T lymphocyte repertoires and other leukocytes, differentiation markers and other distinguishing characters of leukocytes; lymphoid cells trafficking.

UNIT II

Antigens: fundamental features, types, factors affecting immuno-genicity, adjuvants. Antibodies: structure, functions and classification; theories of antibody production; immunoglobulin genes and genetic basis of antibody diversity. Complement system: activation pathways and biological activities.

UNIT III

Major histocompatibility complex: structure, functions and gene organization. T lymphocyte subsets. Antigen-specific T cell receptors: structure, gene organization and genetic basis of diversity. Immune response development: phases of humoral and cell-mediated immune response development, cellular interactions, properties and classification of various cytokines, immunoregulation.

UNIT IV

Immunity against veterinary infectious agents, immunological surveillance and cancer immunity, immunological tolerance, its breakdown and autoimmunity, immuno-deficiencies: types and examples, hypersensitivity: classification, mechanisms of induction and examples.

Practical

Preparation of antigens for laboratory animals immunization; production, collection and preservation of antisera; quantitation of immunoglobulins in antisera by zinc sulphate turbidity and single radial immunodiffusion; examination of lymphoid organs of animals; tests for *in vivo* and *in vitro* phagocytosis; separation and counting of peripheral blood lymphocytes; separation and concentration of immunoglobulin by ammonium sulphate precipitation and dialysis; demonstration of antigen- antibody interactions in serological tests such as agar gel precipitation, immunoelectrophoresis, bacterial agglutination, direct and passive hemagglutination, latex agglutination, complement fixation, enzyme-linked immunosorbent assay, immunoblotting.

Suggested Readings

- Kindt TJ, Goldsby RA & Osborne BA. 2007. *Kuby Immunology*. 6th Ed. WH Freeman.
- Male D, Brostoff J, Roth DB & Roitts I. 2007. *Immunology*. 7th Ed. Mosby-Elsevier.
- Tizard IR. 2004. *Veterinary Immunology: An Introduction*. 7th Ed. Saunders/Elsevier.

VMC 607

VACCINOLOGY

2+0

Objective

To understand science and practice of vaccines for prevention of bacterial and viral diseases.

Theory

UNIT I

History of veterinary vaccinology. Vaccines: classification, comparison of major types. Components of various types of vaccines: immunogens, adjuvants, stabilizers, preservatives, vehicles. Vaccine qualities: definitions and methods of testing. Vaccine development: cost-effectiveness of preventive immunization programmes, stages of development, clinical trials and regulatory requirements.

UNIT II

Traditional vaccines: inactivated, attenuated and toxoid vaccines. Methods of construction of traditional vaccines: microbial cultures, embryonated eggs, cell culture. Seed-lots of vaccine organisms. Methods of inactivation and attenuation of pathogens.

UNIT III

Modern vaccines: nucleic acids, vectored vaccines, recombinant expressed immunogens, synthetic peptides, marker vaccines, etc. Combination/multivalent vaccines. Novel immunomodulators and delivery systems. Modern methods of vaccine construction: methods based on synthetic chemistry and rDNA technology.

UNIT IV

Vaccine formulation: pharmacopeal requirements. Vaccine stability and preservation: cold chain. Immunization schedules of veterinary vaccines, logistic problems and vaccination failure. Strategies of disease control and eradication by vaccination.

Suggested Readings

- Dodds WJ & Schulz R. (Eds). 1999. *Veterinary Vaccines and Diagnostics*. Vol. 41 (*Advances in Veterinary Medicine*) 1st Ed. Academic Press.
- Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Marcel-Dekker.
- Pastoret PP, Blancou J, Vannier C & Verschuere C. 1997. *Veterinary Vaccinology*. Elsevier.

VMC 608 DIAGNOSTICS OF INFECTIOUS DISEASES 1+2

Objective

To provide training in essential immunological and molecular diagnostic techniques.

Theory

UNIT I

Diagnosis of infectious diseases: an overview. Principles of serodiagnostic: agglutination-reaction based tests, precipitation-reaction based tests, complement fixation test and enzyme immunoassays.

UNIT II

Principles of molecular diagnostic tests: PCR, RT-PCR, Southern blotting, northern blotting, western blotting, dot-blot. DNA diagnostics versus serodiagnostics. Development and validation of diagnostic tests.

Practical

Serodiagnostic tests for infectious diseases: bacterial slide and microtitre plate agglutination, agar gel immunodiffusion test, passive hemagglutination, hemagglutination inhibition and latex agglutination tests, complement fixation test, enzyme linked immunosorbent immunoassays, dot-ELISA, fluorescent antibody technique, immuno-electron microscopy, virus neutralization test, etc.

Molecular diagnostic techniques: protein profiling of infectious agents by SDS-polyacrylamide gel electrophoresis, antigen profiling of infectious agents by immunoblotting, nucleic acids isolation from infectious agents, detection of infectious agent nucleic acids by various formats of polymerase chain reaction and reverse transcription-PCR, dot-blot technique, etc.

Suggested Readings

- Detrick B & Hamilton RG. (Eds). 2006. *Manual of Molecular and Clinical Laboratory Immunology*. 7th Ed. American Society for Microbiology.

- Rose NR, Friedman H & Fahey JL. (Eds). 1986. *Manual of Clinical Laboratory Immunology*. American Society for Microbiology.
- Weir DM. 1986. *Handbook of Experimental Immunology*. Vol. IV. Blackwell.

VMC 609 **TECHNIQUES IN MICROBIOLOGY** **0+3**
AND IMMUNOLOGY

Objective

To learn various important techniques of bacteriology, virology and immunology.

Practical

Preparation of different media used in bacteriology and mycology; isolation and identification of bacteria and fungi; antibiotic sensitivity of microorganisms from clinical specimens. Plasmid profiling, pathogenicity test in cell culture or laboratory animals, maintenance and preservation of bacteria and fungi.

Cryopreservation and reconstitution of preserved cell lines; Concentration and purification of animal viruses by chemical agents, differential centrifugation, density gradient centrifugation, and ultra filtration, etc. Storage of animal viruses by freeze drying and ultra freezing. Biophysical and biochemical characterization of animal viruses; Molecular characterization of viral protein and nucleic acid.

Immunoglobulin purification by salt precipitation and chromatographic techniques, anti-species antibody production, enzyme-linked immunosorbent assays for antigen and antibody detection, neutrophils and peritoneal macrophage isolation and demonstration of phagocytic activity, lymphocyte separation, lymphocyte proliferation assay, tuberculin-type delayed type hypersensitivity reaction.

Suggested Readings

- Coligan JE, Kruisbeek AM, Margulies DH, Shevach EM & Strober W. 2003. *Current Protocols in Immunology*. 3rd Ed. John Wiley & Sons.
- Detrick B & Hamilton RG. (Eds). 2006. *Manual of Molecular and Clinical Laboratory Immunology*. 7th Ed. American Society for Microbiology.
- Hay FC & Westwood OMR. 2002. *Practical Immunology*. 4th Ed. Blackwell.
- Mahy BWJ & Kangaro HO. 1996. *Virology Methods Manual*. Academic Press.
- Quinn PJ, Carter ME, Markey B & Carter GR. 1994. *Clinical Veterinary Microbiology*. Wolfe Publ.

VMC 701 **ADVANCES IN BACTERIOLOGY** **2+1**

Objective

To learn about the latest development in the field of bacteriology

Theory

UNIT I

Advanced studies on cytology, biochemical activities, antigenic structure and molecular biology of bacteria

UNIT II

Advanced studies on pathogenicity, immunology and serology of bacteria.

Practical

Biochemical, physiological and pathogenesis studies of various bacterial diseases.

Suggested Readings

Selected articles from journals

VMC 702 ADVANCES IN MYCOLOGY 2+1**Objective**

To learn about the latest development in the field of mycology.

TheoryUNIT I

Advanced studies on taxonomic genetics, physiology and antigenic characterization of pathogenic fungi.

UNIT II

Advanced studies on molecular approaches for identification of fungi and immunology and serology of mycoses.

Practical

Biochemical, physiological and pathogenesis studies of various fungal diseases.

Suggested Readings

Selected articles from journals

VMC 703 BACTERIAL GENETICS 2+1**Objective**

To learn the basic aspects of bacterial genetics.

TheoryUNIT I

Prokaryotic and Eucaryotic genome. Replication of eucaryotic and prokaryotic DNA. Structure, classification and replication of plasmids. Molecular basis of mutations.

UNIT II

Biochemical genetic and gene mapping by recombination, fine gene structure analysis. Gene transfer in bacteria through transduction, transformation and conjugation and gene mapping by these processes.

UNIT III

Transposable elements. Gene cloning and gene sequencing. Regulation of gene expression.

Practical

Mutagenesis of microorganisms by different methods. Production, isolation and characterization of mutants. Determination of mutation rate. Isolation, characterization and curing of plasmids. Transfer of plasmid by conjugation, electroporation. Tetrad and random spore analysis.

Suggested Readings

Selected articles from journals.

VMC 704 MICROBIAL TOXINS 2+1**Objective**

To learn about the bacterial and fungal toxins.

TheoryUNIT I

The role of microbial toxins in the pathogenesis of diseases; biochemical and biological characteristics of toxins produced by various bacteria. Toxin

producing Gram positive and negative bacteria. Properties and clinical conditions produced by different bacterial toxins.

UNIT II

Production, characterization, and study of pathogenicity of various fungal toxins.

Practical

Isolation of toxigenic strains of bacteria from suspected material, production of toxins in suitable media, purification and characterization of toxins; biological characterization in animal and in tissue culture; immunobiological studies of toxins.

Suggested Readings

Selected articles from journals.

VMC 705 MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS 2+1

Objective

To learn the molecular mechanisms of bacterial pathogenesis.

Theory

UNIT I

Molecular structure, production and mode of action of bacterial adhesins, invasions, impedins, agressins, modulins, capsule, flagella, enzymes, components of cell wall and siderophores.

UNIT II

The production, structure and molecular mechanism of actions of various exotoxins and endotoxins, siderophores and cytotoxins, and plasmids in causation of disease.

Practical

To study the production and effects of exotoxins and endotoxins, LPS and various enzymes produced by the bacteria on various cell culture and live animals.

Suggested Readings

Selected articles from journals.

VMC 706 ADVANCES IN VIROLOGY 2+1

Objective

Advanced study of virus structure, their nucleic acids and proteins; latest trends in animal virus research.

Theory

UNIT I

Biology of RNA and DNA virus replication.

UNIT II

Current concepts in animal virus research with respect to viral structure and architecture, viral virulence, viral pathogenesis, persistence and oncogenesis.

UNIT III

Latest trends in the development of antivirals.

UNIT IV

Cloning and expression in viral vectors.

Practical

Separation and characterization of viral proteins, and nucleic acid by polyacrylamide gel electrophoresis, column chromatography, blotting

UNIT III

Understanding the relationship between structure and function of animal DNA and RNA viruses, development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses.

Suggested Readings

Selected articles from journals.

VMC 709 ONCOGENIC VIRUSES 2+0

Objective

To study mechanisms of viral oncogenesis.

Theory

UNIT I

General features of cell transformation and characterization of transformed cells; Oncogenic RNA and DNA viruses; expression of viral and cellular oncogenes.

UNIT II

Mechanisms of viral oncogenesis; Diagnosis of viral oncogenesis.

Suggested Readings

Selected articles from journals.

VMC 710 SLOW VIRAL INFECTIONS AND PRIONS 2+0

Objective

To study slow viral infections; properties and replication of prions, and diseases caused by them.

Theory

UNIT I

Epidemiology, pathogenesis, diagnosis and control of slow viral infections.

UNIT II

Properties, replication and epidemiology of prions. Pathogenesis, immunity, diagnosis and control of various diseases caused by prions; recent trends in prion research.

Suggested Readings

Selected articles from journals.

VMC 711 MOLECULAR IMMUNOLOGY 2+1

Objective

To familiarize with advances in research on immune system molecules such as antigens, antibodies, complement, cytokines, surface molecules, etc.

Theory

UNIT I

Pathogen associated molecular patterns and pattern recognition receptors in immunity. Advances in characterization of antigens and superantigens, epitope mapping. Novel functions of immunoglobulins and their fragments produced by rDNA technology.

UNIT II

Cytokines and cytokine receptors: structure and function. Complement components genes and polymorphism. MHC genes. Evolutionary aspects of recombination activating genes-mediated immunity in vertebrates.

UNIT III

Immunoinformatics as applied to MHC molecules-peptide complexes and other molecules. Immunomics.

Practical

Purification of immunoglobulin classes and IgG subclasses, IgG fragments production by pepsin and papain digestion, cytokine quantitation and detection by ELISPOT assay, IgV gene amplification and sequencing, use of immunoinformatic tools to Ig genes.

Suggested Readings

Selected articles from journals.

VMC 712 ADVANCES IN CELLULAR IMMUNOLOGY 2+1

Objective

To learn advances in research on immune cell biology and cellular interactions in immune responses.

Theory

UNIT I

Hematopoietic stem cells and differentiation pathways of various leukocytes. B and T lymphocyte repertoires. Lymphocyte- endothelial cell interactions during lymphocyte emigration and recirculation. Antigen presenting cells, T cell subsets, regulatory T cells, memory B and T cells. NK cell biology.

UNIT II

Cellular interactions during immune response development: microenvironments, antigen processing and presentation, activation of B and T cells, co-stimulatory molecules, cytokines in intercellular communication. Signal transduction pathways in B and T cell activation.

UNIT III

Immunoregulation of B and T cell response. Mucosal immune system. Oral tolerance and its breakdown. Advances in transplantation immunology. SCID, gene-knockout and transgenic animals in immunobiology research.

Practical

Fluorescence activated and magnetic cell sorting of lymphocyte subsets, Lymphocyte proliferation assays using non-radioisotope methods, adoptive transfer of lymphocyte subsets, cytotoxic T cell assays, ELISPOT assays for enumeration of lymphocyte subsets secreting cytokines.

Suggested Readings

Selected articles from journals.

VMC 713 CYTOKINES AND IMMUNOMODULATORS 2+0

Objective

To learn about structure and function of various cytokines and other immunomodulators.

Theory

UNIT I

Cytokines and immunomodulators: definitions and classification. Cytokines structure and functions. Cytokine receptors: structural types and presence on different cells. Roles in activation, division and differentiation of immune cells, and immunoregulation.

UNIT II

Cytokine networks. cytokines in reproductive processes and neuro-endocrino- immunological interactions. Immunomodulators in control of diseases. Cytokines as adjuvants and immunomodulators. Colony stimulating factors and other cytokines in stem cell research.

Suggested Readings

Selected articles from journals.

VMC 714 ADVANCES IN VACCINOLOGY 2+0

Objective

To learn about advances in vaccine research and modern approaches to vaccine development.

Theory

UNIT I

Advances in vaccine development research. Antigen identification and characterization employing newer molecular technologies such as microarrays, *in vivo* expression technology, signature-tagged mutagenesis and phage display technology, etc.

UNIT II

Immunoinformatics as applied to epitope mapping, T cell epitopes, identification of pathogenic epitopes, etc. Novel vaccines: nucleic acids, marker vaccines, mucosal vaccines, bacterial ghosts as vaccines, virus-like particles. Futuristic vaccines: anti-allergic, anti-autoimmune diseases, de-addiction vaccines, transplant survival/ prolonging vaccines etc.

Suggested Readings

Selected articles from journals.

VMC 715 ADVANCES IN IMMUNODIAGNOSTICS 1+1

Objective

To learn and employ modern approaches to immunodiagnosis.

Theory

Newer methods of immunodiagnosis: simple, rapid, penside immunodiagnostic tests such as immunochromatofocussing, immunofiltration tests, etc. Development of highly sensitive enzyme immunoassays such as immuno-PCR, use of luminescent substrates, etc. Discriminant immunoassays for differentiating cross-reactive antigens. Antibodies in biosensors.

Practical

Development of immunofiltration test using monoclonal antibody for diagnosis of any veterinary infectious disease. Blocking ELISA to differentiate cross-reactive antigens.

Suggested Readings

Selected articles from journals.

VMC 716 MODERN IMMUNOTECHNOLOGY 1+2

Objective

To provide training on production of monoclonal antibody and other immunobiologicals by various modern methods.

Theory

UNIT I

Historical developments in modern immunotechnology. Hybridoma technology: advances in monoclonal antibody production. Chimeric and humanized monoclonal antibodies.

UNIT II

Recombinant DNA technology for expression of antibody fragments: Fab, scFv, bispecific antibody, nanobody and various other antibody formats. Modern uses of antibody fragments: biosensors, catalysis, therapeutics, *in vivo* imaging, microarrays, proteomics, etc.

Practical

Production of murine monoclonal antibody against antigens of infectious agents by hybridoma technique. Production of phage display library of scFv or camel nanobody. Selection of antigen-specific phage displayed antibody fragment by panning or other techniques.

Suggested Readings

Selected articles from journals.

VMC 717 CURRENT TOPICS IN INFECTION AND IMMUNITY 3+0

Objective

Discussions on recent developments in the immunobiology of major viral, bacterial and fungal diseases of animals.

Theory

UNIT I

Introduction and historical developments. Host-pathogen relationship.

UNIT II

Effector mechanisms of specific and non specific immunity to different groups of microbes.

UNIT III

Immunobiology of major viral, bacterial and fungal diseases of animals. Types of vaccines in infectious diseases and current trends in vaccine development.

Suggested Readings

Selected articles from journals.

VMC 718 VETERINARY MICROBIAL BIOTECHNOLOGY 2+1

Objective

To understand as to how microbial processes and activities can be used for development of medically and industrially important products and processes.

Theory

UNIT I

History of microbial biotechnology. Microbes in nature. Microbes as infectious agents of human and animals. Host-microbe relationships. Microbial metabolism and growth characteristics. Microbial genetics.

UNIT II

Introduction to molecular biology of microorganisms: DNA, RNA and proteins structure and functions. DNA replication, RNA transcription,

reverse transcription, protein translation, regulatory mechanisms. Bacterial extrachromosomal DNA elements.

UNIT III

Genetic engineering: restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases, other enzymes. DNA sequencing. Plasmids and phage-derived vectors, bacterial hosts for cloning and expression of transgenes. Genomic libraries and sequencing. Blotting of DNA, RNA and proteins. Polymerase chain reaction. Microarrays. Metagenomics.

UNIT IV

Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. PCR and blotting techniques in infectious disease diagnosis. Nucleic acid vaccines. Vectored viral and bacterial vaccines. Construction of defined mutants and marker vaccines using genetic manipulation techniques. Display technologies for production of immunobiologicals. Manipulation of microbial processes for production of industrially useful substances.

Practical

Extraction of nucleic acids from viruses and bacteria. Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis. PCR amplification of DNA. RT-PCR of RNA. Insertion of DNA fragments into plasmid/phagemid/phage vectors. Construction of competent *E. coli* host cells. Transformation and transfection of competent *E. coli* cells. Screening of transformants and isolation of clones. DNA sequencing of clones/PCR amplicons. Expression of genes of bacterial/viral antigens. Use of PCR for infectious disease diagnosis.

Suggested Readings

Selected articles from journals.

VMC 790

SPECIAL PROBLEM

0+2

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY MICROBIOLOGY

List of Journals

- * Advances in Immunology
- * Advances in Virus Research
- * Annual Review of Immunology
- * Current Topics in Microbiology and Immunology
- * Immunology
- * Indian Journal of Virology
- * Infection and Immunity
- * Journal of Bacteriology
- * Journal of General Virology
- * Journal of Immunology
- * Journal of Virology
- * Nature
- * Nature Immunology
- * Nature Reviews Immunology
- * Science
- * Trends in Biotechnology
- * Trends in Immunology
- * Vaccine
- * Veterinary Immunology and Immunopathology
- * Veterinary Microbiology
- * Virology

e-Resources

- * www.virology.com (Virology Journal)
- * www.elsevier.com/locate/vetmic (Veterinary Microbiology)
- * www.jb.asm.org (Journal of Bacteriology)
- * www.jac.oxford.journals.org (Clinical Bacteriology)
- * www.bentham.org/open/tomycj (The Open Mycology Journal)
- * www.nature.com/nrmicro (Nature Review of Microbiology)
- * www.trends.com/tim (Trends in Microbiology)
- * www.arjournals.annualreviews.org/loi/micro (Annual Reviews of Microbiology)
- * www.jcm.asm.org (Journal of Clinical Microbiology)
- * www.trends.com/it (Trends in Immunology)
- * www.arjournals.annualreviews.org/loi/immunol (Annual Reviews of Immunology)
- * www.elsevier.com/locate/vaccine (Vaccine)
- * www.nature.com/immunol (Nature Review of Immunology)
- * www.iac.asm.org (Infection and Immunity)
- * www.jaconline.com (Journal of Allergy and Clinical Immunology)
- * www.elsevier.com/locate/molimm (Molecular Immunology)
- * www.blackwellpublishing.com/journals/pim (Parasite Immunology)
- * www.jleukbio.org (Journal of Leucocyte Biology)
- * www.ocw.mit.edu (MIT Open Course Ware/Health Sciences and Technology)

Professional Course Ware Web Sites:

- * www.jbpub.com
- * www.bact.wisc.edu
- * www.textbookbacteriology.net
- * www.mhhe.com/Prescott5
- * www.Highwirepress.stanford.edu
- * www.vibno/Epid/supercourseforvirology

Suggested Broad Topics for Master's and Doctoral Research

- * Isolation, identification and characterization of pathogenic bacteria for developing diagnostics and vaccines
- * Development of genetically modified bacteria for improved vaccine and genetically modified signatred bacteria for developing vaccine candidate that can differentiate vaccinated from infected animals
- * Development of molecular tools for studying evolution, quick diagnosis and molecular epidemiology of microbes
- * Molecular characterization and antigenic relationship of field isolates of important viruses of animals and poultry.
- * Isolation and characterization of field isolates of important viruses of livestock and poultry with the aim of development of diagnostics and candidate vaccines
- * Studies on immune responses and immunity to animal and poultry viruses
- * Investigation of the roles of proinflammatory cytokines in ovarian activity of buffaloes
- * Production of phage display libraries of bovine scFv for diagnostic and therapeutic uses
- * Development of novel delivery systems for developing mucosal veterinary vaccines

VETERINARY PARASITOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VPA 601	VETERINARY HELMINTHOLOGY-I	2+1
VPA 602	VETERINARY HELMINTHOLOGY-II	2+1
VPA 603	VETERINARY ENTOMOLOGY AND ACAROLOGY	2+1
VPA 604	VETERINARY PROTOZOOLOGY	2+1
VPA 605	PARASITOLOGICAL TECHNIQUES	0+2
VPA 606	CLINICAL PARASITOLOGY	1+1
VPA 607	TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES	1+1
VPA 608	IMMUNOPARASITOLOGY	2+1
VPA 609	PARASITIC ZONOSSES	2+0
VPA 610	PARASITES OF ZOO AND WILD ANIMALS	2+1
VPA 611	MALACOLOGY	1+1
VPA 691	MASTER'S SEMINAR	1+0
VPA 699	MASTER'S RESEARCH	20
VPA 701	APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY	1+2
VPA 702	MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY	2+1
VPA 703	HOST PARASITE INTERACTIONS	2+0
VPA 704	ADVANCES IN PROTOZOOLOGY	2+1
VPA 705	ADVANCES IN HELMINTHOLOGY-I	2+1
VPA 706	ADVANCES IN HELMINTHOLOGY-II	2+1
VPA 707	ADVANCES IN ENTOMOLOGY AND ACAROLOGY	2+1
VPA 708	<i>IN VITRO</i> CULTIVATION OF PARASITES	1+2
VPA 709	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0
VPA 710	BIONOMICS OF PARASITES	3+0
VPA 711	ENVIRONMENTAL PARASITOLOGY	1+1
VPA 790	SPECIAL PROBLEM	0+2
VPA 791	DOCTORAL SEMINAR I	1+0
VPA 792	DOCTORAL SEMINAR II	1+0
VPA 799	DOCTORAL RESEARCH	45

VETERINARY PARASITOLOGY

Course Contents

VPA 601 VETERINARY HELMINTHOLOGY - I 2+1

Objective

To learn about various aspects of trematode and cestode parasites of veterinary importance.

Theory

UNIT I

Introduction, history, classification, general account and economic importance of platyhelminths.

UNIT II

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Dicrocoeliidae, Opisthorchiidae, Strigeidae and Fasciolidae.

UNIT III

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Echinostomatidae, Heterophyidae, Plagiorchiidae, Troglotrematidae, Prosthogonimidae, Nanophyetidae and Paragonimidae.

UNIT IV

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Notocotylidae, Brachylemidae, Cyclocoelidae, Paramphistomatidae and Schistosomatidae.

UNIT V

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Mesocestoididae, Anoplocephalidae, Thysanosomidae, Dipylidiidae and Dilepididae.

UNIT VI

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Davaineidae, Hymenolepididae, Taeniidae and Diphyllbothriidae.

Practical

Identification of trematode and cestode parasites; their eggs and intermediate hosts. Observation on parasitic stages in host tissues and associated pathological lesions.

Suggested Readings

- Chowdhury N. and Toda I. 1994. *Helminthology*. Springer Verlag, Narosa Publishing House.
- Dalton JP. 1999. *Fasciolosis*. CABI.
- Gibson DI. 2002. *Keys to the Trematoda*, Vol.1. CABI.
- Khalil LF, Jones A & Bray RA. 1994. *Keys to the Cestode Parasites of Vertebrates*. CABI.
- Kumar V. 1998. *Trematode Infections and Diseases of Man and Animals*. Kluwer Academic Publishers.
- Lapage G. 2000. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.

Mehlhorn H. 1988. *Parasitology in Focus: Facts and Trends*. Springer Verlag.

Singh G & Prabhakar S. 2002. *Taenia solium Cysticercosis*. CABI

Sood ML. 2003. *Helminthology in India*. International Book Distributors.

Soulsby E.J.L. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindal.

VPA 602

VETERINARY HELMINTHOLOGY - II

2+1

Objective

To learn about various aspects of nematodes, thorny-headed worms and leeches of veterinary importance.

Theory

UNIT I

Introduction, history, classification, general account and economic importance of nematodes and thorny-headed worms

UNIT II

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Ascarididae, Anisakidae, Oxyuridae, Heterakidae and Subuluridae.

UNIT III

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Rhabditidae, Strongyloididae and Strongylidae.

UNIT IV

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichonematidae, Amidostomidae, Stephanuridae, Syngamidae and Ancylostomatidae.

UNIT V

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Metastrongylidae, Protostrongylidae, Filaroididae, Trichostrongylidae, Ollulanidae, Crenosomatidae and Dictyocaulidae.

UNIT VI

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Spiruridae, Thelaziidae, Acuariidae, Tetrameridae, Physalopteridae, Gnathostomatidae, Filariidae, Setariidae, Onchocercidae and Dracunculidae.

UNIT VII

Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichinellidae, Trichuridae, Capillariidae, Dioctophymatidae, Polymorphidae, Oligacanthorhynchidae and Gnathobdellidae.

Practical

Identification of nematode parasites; their eggs and intermediate hosts, differentiation, study of their stages in the tissues and associated pathological lesions.

Suggested Readings

- Andersen RC. 2000. *Nematode Parasites of Vertebrates, their Development and Transmission*. CABI.
- Kennedy MW & Harnett W. 2001. *Parasitic Nematodes: Molecular Biology, Biochemistry and Immunology*. CABI.
- Lapage G. 2000. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.
- Lee DL. 2002. *The Biology of Nematodes*. Taylor and Francis.
- Soulsby E.J.L. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindal.

VPA 603 VETERINARY ENTOMOLOGY AND ACAROLOGY 2+1

Objective

To learn various aspects of arthropods of veterinary importance.

Theory

UNIT I

Introduction, history, classification and economic importance.

UNIT II

Distribution, life cycle, seasonal pattern, pathogenesis, economic significance and control of arthropods belonging to the families: Culicidae, Ceratopogonidae, Simuliidae and Psychodidae.

UNIT III

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Tabanidae, Gasterophilidae, Muscidae, and Glossinidae.

UNIT IV

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Oestridae, Sarcophagidae, Calliphoridae and Hippoboscidae.

UNIT V

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Pediculidae, Haematopinidae, Linognathidae, Menoponidae, Philopteridae and Trichodectidae

UNIT VI

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Siphonapteridae, Cimicidae and Reduviidae,

UNIT VII

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Dermanyssidae, Argasidae and Ixodidae

UNIT VIII

Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Sarcoptidae, Psoroptidae, Demodicidae, Trombiculidae, Cytoditidae and Linguatulidae.

UNIT IX

Strategic control measures of arthropods with special emphasis on improved versions of chemical, biological and immunological control and integrated pest management.

Practical

Collection, preservation, identification and differentiation of various arthropods and their developmental stages; associated pathological changes and lesions; skin scraping examination.

Suggested Readings

Gupta SK & Kumar R. 2003. *Manual of Veterinary Entomology and Acarology*. International Book Distr. Co.

Harwood RF & James MT. 1979. *Entomology in Human and Animal Health*. MacMillan.

Kettle DS. 1995. *Medical and Veterinary Entomology*. CABI.

Lehane M. 2005. *The Biology of Blood Sucking Insects*. 2nd Ed. Cambridge University Press.

Marquardt WC. 2000. *Parasitology and Vector Biology*. Academic Press

Mullen G & Durben L. 2002 *Medical and Veterinary Entomology*. Academic Press

Wall R & Shearer D. 1997. *Veterinary Entomology*. Chapman & Hall.

VPA 604

VETERINARY PROTOZOOLOGY

2+1

Objective

To project the importance and to impart detailed knowledge on various aspects of protozoan parasites.

Theory

UNIT I

Introduction, history, classification, general account, economic importance of protozoan parasites.

UNIT II

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Trypanosomatidae, Monocercomonadidae, Trichomonadidae, Hexamitidae and Endamoebidae.

UNIT III

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Eimeriidae, Cryptosporidiidae and Sarcocystidae.

UNIT IV

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Plasmodiidae, Babesiidae, Theileriidae, Haemogregarinidae and Balantidiidae.

UNIT V

Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of Rickettsiales like *Anaplasma*, *Ehrlichia* and *Haemobartonella*.

Practical

Identification of protozoan parasites and observation on parasite stages in host tissues and the attendant pathological lesions. Diagnosis of protozoan parasites of veterinary importance.

Suggested Readings

- Bhatia BB & Shah HL. 2000. *Protozoa and Protozoan Diseases of Domestic Livestock*. ICAR.
- Bhatia BB. 2000. *Textbook of Veterinary Protozoology*. ICAR.
- Dobbelaere DAE & McKeever D. 2002. *Theileria*. Springer Verlag.
- Dubey JP & Beattie CP. 1988. *Toxoplasmosis of Animals and Man*. CRC Press.
- Dubey JP, Speer CA & Fayer R. 1989. *Sarcocystosis of Animals and Man*. CRC Press.
- Dubey JP, Speer CA & Fayer R. 1990. *Cryptosporidiosis in Man and Animals*. CRC Press.
- Kreier JP. 1991-95. *Parasitic Protozoa*. Ed. JR Baker. Academic Press.
- Levine ND. 1985. *Veterinary Protozoology*. Iowa State Univ. Press.
- Lindsay DS & Weiss LM. 2004. *Opportunistic Infections :Toxoplasma Sarcocystis and Microsporidia*. Kluwer Academic Press.
- Maudlin I. 2004. *The Trypanosomiases*. Oxford Univ. Press.
- Sterling CR. and Adam RD. 2004. *The Pathogenic Enteric Protozoa*. Kluwer Academic Press.
- Thompson A. 2003. *Cryptosporidium*. Elsevier

VPA 605

PARASITOLOGICAL TECHNIQUES

0+2

Objective

To impart practical knowledge on various techniques used in veterinary parasitology.

Practical

Microscopy, micrometry, camera lucida drawings, micro- and digital photography.

Collection, processing and examination of faecal and blood samples; lymph node biopsies, skin scrapings and nasal washings from animals for parasitological findings. Quantitative faecal examination.

Evaluation of the efficacy and resistance of drugs against parasites.

Maintenance of tick and fly colonies in laboratory for experimental purposes and testing of drugs; tick dissection for vector potential.

Collection of aquatic snails from field and their examination for the presence of different parasitic stages.

Collection, fixation, staining, whole mounts and identification of parasites.

Cryopreservation of parasites, culturing techniques for important parasites and pasture larval count, worm count and assessment of worm burden.

Remote sensing (RS) and geographic information system (GIS) as tools for mapping parasitic diseases.

Suggested Readings

- Chaudhri SS & Gupta SK. 2003. *Manual of General Veterinary Parasitology*. International Book Distr. Co.
- Durr P & Gatrell A. 2004. *GIS and Spatial Analysis in Veterinary Science*. CABI.
- Ministry of Agriculture, Fisheries and Food (MAFF). 1986. *Manual of Veterinary Parasitological Laboratory Techniques*. 3rd Ed. Tech. Bull. 18, HMSO.
- Rathore VS & Sengar YS. 2005. *Diagnostic Parasitology*. Pointer Publ.

VPA 606	CLINICAL PARASITOLOGY	1+1
Objective		
Collection and examination of clinical material for parasitological investigations and study of clinical cases.		
Theory		
<u>UNIT I</u>		
History, clinical signs, gross and microscopic examination of secretions and excretions of clinical cases.		
<u>UNIT II</u>		
Collection and dispatch of material to laboratory for diagnosis.		
<u>UNIT III</u>		
Animal sub-inoculation tests; blood and biopsy smear examination; histopathology of affected organs.		
Practical		
Identification, observation of parasitic stages in host tissues, excretions, secretions and associated pathological lesions.		
Suggested Readings		
Faust EC, Russell PF & Jung RC. 1971. <i>Craig and Faust's Clinical Parasitology</i> . Lea & Febiger.		
Sloss MW, Kemp RL & Zajac AM. 1994. <i>Veterinary Clinical Parasitology</i> . Indian Ed. International Book Distr. Co.		
Soulsby E.J.L. 1965. <i>Textbook of Veterinary Clinical Parasitology</i> . Blackwell.		

VPA 607	TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES	1+1
Objective		
To learn about integrated approach for the control of helminths, arthropods and protozoan parasites of veterinary importance.		
Theory		
<u>UNIT I</u>		
Conventional and novel methods of control of helminth – anthelmintics, their mode of action, characteristic of an ideal anthelmintic, anthelmintic resistance, spectrum of activity, delivery devices, integrated control method and immunological control Formulation of deworming schedule. Snail and other intermediate host control.		
<u>UNIT II</u>		
Conventional and novel methods of control of protozoan parasites – antiprotozoan drugs, their mode of action, integrated control method and immunological control.		
<u>UNIT III</u>		
Conventional and novel methods of control of insects – Insecticides / acaricides - methods of application, their mode of action, insecticide resistance , integrated control method and immunological control.		
Practical		
<i>In vivo</i> and <i>in vitro</i> detection of efficacy of and resistance to parasitocidal agents.		
Suggested Readings		
Kaufmann J. 1996. <i>Parasitic Infections of Domestic Animals</i> . Birkhauser Verlag.		

Mehlhorn H (Ed). 2001. *Encyclopedic Reference of Parasitology: Diseases, Treatment, Therapy*. Springer Verlag.

VPA 608 **IMMUNOPARASITOLOGY** **2+1**

Objective

To impart knowledge about the immunology, immunodiagnosis and immunoprophylaxis of ecto- and endoparasites of veterinary importance.

Theory

UNIT I

Introduction, types of parasitic antigens and their characterization.

UNIT II

Types of immunity in parasitic infections. Cellular and humoral immunity to parasites, hypersensitivity, regulation of the immune response.

UNIT III

Evasion of immunity, immunomodulations and their uses.

UNIT IV

Immune responses in helminths, arthropods and protozoa of veterinary importance.

UNIT V

Immunodiagnostic tests and their techniques; application of biotechnological tools in the diagnosis and control of parasitic diseases.

UNIT VI

Vaccines and vaccination against parasitic infections.

UNIT VII

Genetic control of parasites.

Practical

Preparation of various antigens (somatic, secretory and excretory) and their fractionation and characterization; raising of antisera and demonstration of various immunodiagnostic methods for the diagnosis of parasitic infections.

Suggested Readings

Behnkey JM. 1990. *Parasites, Immunity and Pathology*. Taylor & Francis.

Boothroyd JC & Komuniecki R. 1995. *Molecular Approaches to*

Cohen S & Sadun EH. 1976. *Immunology of Parasitic Infections*. Blackwell.

Cox FEG. 1993. *Modern Parasitology*. Blackwell.

Marr JJ, Nilsen TW & Komuniecki RW. 2003. *Molecular Medical Parasitology*. Elsevier.

Parasitology. Wiley-Liss Publication, New York.

Waklin D. 1996. *Immunity to Parasites*. Cambridge University Press.

VPA 609 **PARASITIC ZOOSES** **2+0**

Objective

To provide the students with an in-depth knowledge of occurrence and importance of parasitic zoonoses and how these parasites are diagnosed and controlled.

Theory

UNIT I

Introduction to the concept of zoonotic infections, definitions, various classifications of zoonoses, host-parasite relationships, modes of infections, factors influencing prevalence of zoonoses.

UNIT II

A detailed study of transmission, epidemiology, diagnosis and control of major protozoa of zoonotic importance.

UNIT III

A detailed study of transmission, epidemiology, diagnosis and control of major helminths of zoonotic importance.

UNIT IV

A detailed study of transmission, epidemiology, diagnosis and control of major arthropods of zoonotic importance.

Suggested Readings

Miyazaki 1991. *Helminthic Zoonoses*. International Medical Foundation of Japan.

Palmer SR, Soulsby EJJ & Simpson DIH. 1998. *Zoonoses*. Oxford

Parija SC. 1990. *Review of Parasitic Zoonoses*. AITBS Publ.

Rathore VS. 2005. *Parasitic Zoonoses*. Pointer Publishers.

Shakespeare M. 2002. *Zoonoses*. Pharmaceutical Press.
University Press.

VPA 610

PARASITES OF ZOO AND WILD ANIMALS

2+1

Objective

To learn about biological and control aspects of parasitic diseases of zoo and wild animals.

Theory

UNIT I

A detailed study of major protozoa of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

UNIT II

A detailed study of major arthropod parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

UNIT III

A detailed study of major helminth parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

Practical

Methods for investigating parasitic diseases in wild animals. Collection of parasites at post-mortem. Identification and quantification of parasites. Visit to Zoo and Wild Life Parks/ Sanctuaries.

Suggested Readings

Chowdhury N & Alonso Aquirre A. 2001. *Helminths of Wild Life*.

Friend M & Franson JC. 1999. *Field Manual of Wildlife Diseases: General Field Procedures and Diseases of Birds*. Free of charge at: www.nwhc.usgs.gov/publications/field_manual/field_manual_of_wildlife_diseases.pdf

NBII Wildlife Diseases Information Node can be reached at: <http://wildlifediseases.nbii.gov>

Oxford & IBH Publishing Co. Pvt. Ltd.

Samual W, Pybus M & Kocan A. (Eds). 2001. *Parasitic Diseases of Wild Mammals*. Iowa State Univ. Press.

VPA 611	MALACOLOGY	1+1
Objective		
To learn about the details of various snails involved in diseases transmission.		
Theory		
<u>UNIT I</u>		
Characters and classification of Mollusca.		
<u>UNIT II</u>		
Occurrence, distribution, ecology, life history, morphology and control of vector snails belonging to families, Planorbidae, Lymnaeiidae, Thiridae, Amnicolidae, Helicidae, Succineidae and Zonitidae.		
<u>Unit III</u>		
Examination of vector molluscs for parasitic infections.		
<u>Unit IV</u>		
Haematology, internal defense mechanisms, parasite-induced pathology and molluscan tissue culture.		
Practical		
Collection and identification of vector molluscs, study of their shells and internal organs. Breeding, rearing and maintenance of vector molluscs in the laboratory. Examination of molluscs for various developmental stages of parasites.		
Suggested Readings		
Malek EA & Cheng TC. 1974. <i>Medical and Economic Malacology</i> . Academic Press.		
Sturm CF, Pearce TA & Valdés A. 2006. <i>The Mollusks: A Guide to Their Study, Collection and Preservation</i> . American Malacological Society, Pittsburgh and Universal Publishers, Boca Raton.		
VPA 701	APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY	1+2
Objective		
To study the emerging applications of Remote Sensing and Geographic Information System in parasitology.		
Theory		
<u>UNIT I</u>		
Basic principles of Remote Sensing, satellite and imagery sensor systems, spectral signatures, interpretation of satellite imagery, digital image processing.		
<u>UNIT II</u>		
Fundamentals of GIS, raster data representation, vector data representation, GIS data management, data input, editing, analysis and modeling. GIS output as maps.		
<u>UNIT III</u>		
Integration of RS and GIS. Applications of RS and GIS in parasitology, case studies related to vector and vector-borne parasitic diseases, soil transmitted helminths.		
Practical		
Understanding maps and map projections, maps as models. IRS data products, visual interpretation of image, Digital image processing, contrast		

Theory

UNIT I

Introduction, distribution of parasites on/in the host, morphological specializations for life on the host.

UNIT II

Behavioural defenses, host immune responses and genetic resistance to parasites.

UNIT III

Establishment of parasites in immuno-competent, susceptible, intermediate and abnormal hosts, chronicity of parasitic infections, immuno-evasive strategies of the parasites, host-parasite equilibrium.

UNIT IV

Pathology of host parasite interactions, host parasite interactions in relation to malnutrition and micronutrient metabolism.

Suggested Readings

Selected articles from journals.

VPA 704 ADVANCES IN PROTOZOOLOGY 2+1

Objective

To discuss the latest scientific developments on various aspects of protozoan parasites.

Theory

UNIT I

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of intestinal protozoa.

UNIT II

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of haemoprotozoans.

UNIT III

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of tissue and other protozoa

Practical

Morphological, pathological and immunodiagnostic studies on various protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 705 ADVANCES IN HELMINTHOLOGY – I 2+1

Objective

To discuss the latest scientific developments on various aspects of trematodes and cestodes.

Theory

UNIT I

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of trematodes and their larval stages.

UNIT II

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of cestodes and metacestodes.

Practical

Morphological, pathological and immunodiagnostic studies on various trematodes and cestodes.

Suggested Readings

Selected articles from journals.

VPA 706 ADVANCES IN HELMINTHOLOGY – II 2+1**Objective**

To discuss the latest scientific developments on various aspects of nematodes and thorny-headed worms.

TheoryUNIT I

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of nematodes and their larval stages.

UNIT II

Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of thorny-headed worms.

Practical

Morphological, pathological and immunodiagnostic studies on various nematodes and thorny-headed worms.

Suggested Readings

Selected articles from journals.

VPA 707 ADVANCES IN ENTOMOLOGY AND ACAROLOGY 2+1**Objective**

To discuss latest scientific developments on various aspects of arthropods.

TheoryUNIT I

Origin, evolution, regional and seasonal distribution, forecasting insect and acarine population through biological modelling.

UNIT II

Population dynamics of insects and acarines in relation to biotic and abiotic factors.

UNIT III

Recent developments pertaining to insects of veterinary importance.

UNIT IV

Recent developments pertaining to arachnids of veterinary importance.

UNIT V

Chemical, biological, immunological control measures and in-depth study of integrated pest management. Modulation of vector competence to transmit parasitic infections using molecular genetics by developing transgenic vectors.

Practical

Identification of arthropods of veterinary importance in the region. Dissection of arthropods for recovery of infective stages of parasites. Immunopathological changes in the host tissues due to haemato-phagous arthropods.

Suggested Readings

Selected articles from journals.

VPA 708	IN VITRO CULTIVATION OF PARASITES	1+2
Objective		
Development of skills for cultivation of various parasites in the laboratory for research and practical control.		
Theory		
<u>UNIT I</u>		
Introduction, problems and goals.		
<u>UNIT II</u>		
<i>In vitro</i> cultivation of genital flagellates, intestinal flagellates and intestinal ciliates.		
<u>UNIT III</u>		
<i>In vitro</i> cultivation of intestinal and tissue protozoa.		
<u>UNIT IV</u>		
<i>In vitro</i> cultivation of haemoprotozoans.		
<u>UNIT V</u>		
<i>In vitro</i> techniques, media and tissue culture for cultivation of helminths and their larval stages.		
<u>UNIT VI</u>		
<i>In vitro</i> mass rearing and colonization of ticks, flies and other insects.		
Practical		
Preparation of media and cultivation of important parasites, raising and maintenance of cell-lines of important parasites.		
Suggested Readings		
Selected articles from journals.		
VPA 709	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0
Objective		
To study the emerging and re-emerging parasitic diseases.		
Theory		
<u>UNIT I</u>		
Emerging and re-emerging helminthic diseases.		
<u>UNIT II</u>		
Emerging and re-emerging protozoan diseases.		
<u>UNIT III</u>		
Emerging and re-emerging vector-borne diseases.		
Suggested Readings		
Selected articles from journals.		
VPA 710	BIONOMICS OF PARASITES	3+0
Objective		
To study ultrastructure, physiology, biochemistry and bionomics of important parasites.		
Theory		
<u>UNIT I</u>		
Ultrastructure, physiology, biochemistry and bionomics of trematodes and cestodes of veterinary importance.		
<u>UNIT II</u>		
Ultrastructure, physiology, biochemistry and bionomics of nematodes of veterinary importance.		

UNIT III

Ultrastructure, physiology, biochemistry and bionomics of important arthropod parasites.

UNIT IV

Ultrastructure, physiology, biochemistry and bionomics of important protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 711 ENVIRONMENTAL PARASITOLOGY 1+1

Objective

To study the effect of environmental changes and ecological disturbances on the emergence, proliferation and transmission of parasitic diseases.

Theory

UNIT I

Environmental changes and ecological disturbances due to natural phenomenon and human interventions (demographic, societal and agricultural changes, global warming, floods, hurricanes and pollution etc.).

UNIT II

Effect of environmental changes and ecological disturbances on the proliferation and transmission of helminthic diseases

UNIT III

Effect of environmental changes and ecological disturbances on the proliferation and transmission of protozoan diseases.

UNIT IV

Effect of environmental changes and ecological disturbances on the proliferation of intermediate hosts and vectors and their role in transmission of diseases.

Practical

Examination of water, soil, meat and vegetables etc. to record the contamination with parasites due to environmental changes. Assessment of effect of temperature and humidity on the development of parasites. Use of Process-based (mathematical) models to express the scientifically documented relationship between climatic variables and biological parameters e.g., vector breeding, survival and biting rates; parasite incubation rates.

Suggested Readings

Selected articles from journals.

VPA 790 SPECIAL PROBLEM 0+2

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PARASITOLOGY

List of Journals

- * Advances in Parasitology
- * Trends in Parasitology
- * Veterinary Parasitology
- * International Journal for Parasitology
- * Journal of Helminthology
- * Journal of Parasitic Diseases
- * Journal of Protozoology
- * Journal of Protozoology Research
- * Journal of Veterinary Parasitology
- * Medical and Veterinary Entomology
- * Parasitology
- * Parasitology International
- * Experimental Parasitology

e-Resources

- * <http://www.sciencedirect.com/science/journal/03044017> (Veterinary. Parasitology)
- * <http://www.sciencedirect.com/science/journal/14714922> (Trends in Parasitology)
- * <http://www.sciencedirect.com/science/journal/00207519> (International Journal for Parasitology)
- * <http://www.sciencedirect.com/science/journal/13835769> (Parasitology International)
- * <http://www.sciencedirect.com/science/journal/00144894>(Experimental Parasitology)
- * <http://journals.Cambridge.org> (Parasitology)
- * <http://asp.unl.edu> (Journal of Parasitology)
- * <http://www.bentham.org/open/toparaj> (The open Parasitology Journal)
- * <http://www.springer.com/biomed/medical+microbiology>)Journal/436 (Parasitology Research)
- * <http://parasitologyindia.org> (Journal of Parasitic Diseases)
- * <http://www.waap.org> (World Assoc. for Advancement of Vety. Parasitology)

Suggested Broad Topics for Master's and Doctoral Research

- * Detection and management of antiparasitic drug resistance
- * Studies on the efficacy of medicinal plants/herbal preparations against various parasites affecting domestic animals and poultry and the effect of these plants on pathogenicity and immunology of parasites
- * Development of immunoprophylactic measures and immunodiagnostic techniques using modern molecular and biotechnological based tools for important parasitic diseases prevalent in the state
- * Application of remote sensing and GIS for the management of parasitic diseases.
- * Studies on application of host's resistance as a part of integrated parasite management programme.

VETERINARY PATHOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VPP 601	GENERAL PATHOLOGY	2+1
VPP 602	TECHNIQUES IN PATHOLOGY	1+1
VPP 603	ANIMAL ONCOLOGY	1+1
VPP 604	CLINICAL PATHOLOGY	1+2
VPP 605	NECROPSY PROCEDURES AND INTERPRETATIONS –I	0+1
VPP 606	NECROPSY PROCEDURES AND INTERPRETATIONS –II	0+1
VPP 607	SYSTEMIC PATHOLOGY	2+1
VPP 608	PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS	2+1
VPP 609	TOXICOPATHOLOGY	2+1
VPP 610	AVIAN PATHOLOGY	2+1
VPP 611	PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS	2+1
VPP 612	VETEROLEGAL PATHOLOGY	1+0
VPP 691	MASTER’S SEMINAR	1+0
VPP 699	MASTER’S RESEARCH	20
VPP 701	PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES	2+1
VPP 702	ADVANCES IN TOXICOPATHOLOGY	2+1
VPP 703	ADVANCES IN DIAGNOSTIC PATHOLOGY	1+2
VPP 704	ULTRASTRUCTURAL PATHOLOGY	1+1
VPP 705	IMMUNOPATHOLOGY	2+1
VPP 706	PATHOLOGY OF IMPORTANT AND EMERGING DISEASES OF PETS AND LIVESTOCK	1+1
VPP 707	ADVANCES IN AVIAN PATHOLOGY	2+1
VPP 708	PATHOLOGY OF FUNGAL DISEASES	2+1
VPP 709	MOLECULAR PATHOLOGY OF CELL INJURY	2+1
VPP 710	EXPERIMENTAL PATHOLOGY	1+1
VPP 790	SPECIAL PROBLEM	0+2
VPP 791	DOCTORAL SEMINAR I	1+0
VPP 792	DOCTORAL SEMINAR II	1+0
VPP 799	DOCTORAL RESEARCH	45

VETERINARY PATHOLOGY

Course Contents

VPP 601	GENERAL PATHOLOGY	2+1
Objective		
To acquaint students with different types of degenerations, cell injuries caused by different types of irritants and inflammation.		
Theory		
<u>UNIT I</u>		
Introduction and history of pathology, principles of pathology including etiology, course and termination of disease.		
<u>UNIT II</u>		
Advanced study of various degenerations, infiltrations, necrosis, endogenous and exogenous pigmentations.		
<u>UNIT III</u>		
Circulatory and growth disturbances. Reversible and irreversible cell injury.		
<u>UNIT IV</u>		
Inflammation including vascular and cellular alterations with emphasis on chemical mediators. Hypersensitivity and immune mediated mechanisms, Mechanism of healing and fever.		
Practical		
To study the gross and microscopic changes in degenerations, infiltrations, pigmentations, circulatory and growth disturbances and different types of necrosis in different tissues of domestic animals. Study of gross and histopathological features of different types of inflammation.		
Suggested Readings		
McGavin MD & Zachary JF. 2006. <i>Pathologic Basis of Veterinary Diseases</i> . 4 th Ed. Elsevier		
Vegad JL. 2007. <i>Text Book of Veterinary General Pathology</i> . 2 nd Ed. International Book Distr.		
VPP 602	TECHNIQUES IN PATHOLOGY	1+1
Objective		
To acquaint students with different techniques used frequently in Veterinary Pathology.		
Theory		
<u>UNIT I</u>		
Basic histopathological techniques, collection of tissues, fixation, processing and section cutting, staining by routine and special methods.		
<u>UNIT II</u>		
Principles of dark ground, phase contrast and fluorescent microscopy and micrometry.		
<u>UNIT III</u>		
Histochemical techniques for demonstration of fat, glycogen and fibrous connective tissue, mucopolysaccharides and common enzymes.		

Practical

Collection of tissues for histopathological, histochemical, toxic, bacterial and viral examination. Use of different fixatives for preservation of museum specimens. Application of different techniques- histopathological, cryosectioning, micrometry, routine and special staining. Demonstration of different inclusions, bacteria and fungi in tissues. Histochemical techniques to demonstrate different tissue constituents.

Suggested Readings

Culling CFA. 1969. *Handbook of Histological Techniques*. Butter Worths.
Lillie RD. 1965. *Histopathologic Techniques and Practical Histochemistry*. 3rd Ed. McGraw-Hill.

VPP 603 ANIMAL ONCOLOGY 1+1**Objective**

To acquaint students with different types of neoplasms of domestic animals, their nature, cause, pathology and diagnosis.

TheoryUNIT I

Study of different neoplasms of animals including their identification, and epidemiology.

UNIT II

Etiology, histogenesis and experimental production.

UNIT III

Tumour immunology, cell cultures, transplantation and biological behaviour.

Practical

To study the gross and microscopic changes in different types of neoplasms.

Suggested Readings

Meuten DJ. 2002. *Tumors in Domestic Animals*. 4th Ed. Blackwell.

VPP 604 CLINICAL PATHOLOGY 1+2**Objective**

To acquaint students with clinical alterations in blood, urine, CSF and other body fluids due to different diseases.

TheoryUNIT I

Study of changes in blood, urine, faeces, cerebrospinal fluid and biopsy specimens and their interpretation.

UNIT II

Exfoliative cytology, organ function tests and their interpretation.

UNIT III

Biochemical profile of blood/plasma/serum and its correlation with disease conditions in domestic animals.

Practical

Evaluation of laboratory investigations on blood, urine, faeces and biopsy specimens from natural and experimentally produced disease conditions.

Suggested Readings

Benzamin MM. 1978. *Outline of Veterinary Clinical Pathology*. 3rd Ed. Iowa State Univ. Press.
Coles EH. 1967. *Veterinary Clinical Pathology*. WB Saunders.

urinary (kidneys, ureter, urinary bladder and urethra) and genital (male and female organs including mammary gland) systems. Study of etiology, pathology and pathogenesis of specific infectious and non-infectious diseases of domestic animals related to the above mentioned systems.

UNIT III

Advanced study of pathological conditions affecting different organs of nervous (brain and spinal cord), endocrine (pituitary, thyroid, parathyroid, pancreas), musculo-skeletal systems (muscles and bones), and organs of special senses (eye, ear), skin and its appendages (hoof, tail). Study of etiology, pathology and pathogenesis of specific infectious and non-infectious diseases of domestic animals related to the above mentioned systems/organs.

Practical

To study the gross and histopathological changes in important conditions affecting various systems. Study of gross and microscopic lesions in specific diseases pertaining to above said systems.

Suggested Readings

Jubb KVF & Kennedy PC. 2005. *Pathology of Domestic Animals*. Academic Press.

VPP 608	PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS	2+1
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Objective

To teach the students about the important infectious disease conditions of domestic animals

Theory

UNIT I

Pathology of various viral diseases of domestic animals.

UNIT II

Pathology of various bacterial and fungal diseases of domestic animals.

UNIT III

Pathology of various rickettsial and parasitic diseases of domestic animals.

Practical

To study the slides, museum specimens including autopsy specimens concerned with specific diseases.

Suggested Readings

Jones TC, Hunt RD & King NW 1997. *Veterinary Pathology*. Blackwell Publishing.

Jubb KVF & Kennedy PC 2005. *Pathology of Domestic Animals*. Academic Press.

VPP 609	TOXICOPATHOLOGY	2+1
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Objective

To teach students about toxicity in livestock due to plants and extraneous poisons.

Theory

UNIT I

Introduction, mode of action, diagnosis and treatment of different poisons and their classification.

UNIT II

Pathogenesis, gross and microscopic pathology of diseases caused by toxic plants, organic and inorganic poisons commonly taken or administered maliciously to different species of domestic animals.

Practical

To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.

Suggested Readings

Jones TC, Hunt RD & King NW 1997. *Veterinary Pathology*. Blackwell Publishing.

VPP 610 AVIAN PATHOLOGY 2+1

Objective

To teach the students about the different disease conditions of poultry including pathology and diagnosis.

Theory

UNIT I

Pathology of infectious diseases of chickens, turkeys, ducks and other birds.

UNIT II

Pathology of non-infectious diseases of chickens, turkeys, ducks and other birds.

Practical

Necropsy examination of the different species of poultry; study of gross and histopathological lesions in naturally occurring and artificially produced diseases of birds.

Suggested Readings

Calnek BW. 1991. *Diseases of Poultry*. 9th Ed. Iowa State Univ. Press.
Saif YM, Barnes FJ, Glisson JR, Fadly AM, Mc Dougald LR & Swayne D. 2008. *Diseases of Poultry*. 11th Ed. Blackwell Publishing.

VPP 611 PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS 2+1

Objective

To teach the pathology and diagnosis of different disease conditions of laboratory animals, fish and wild animals.

Theory

UNIT I

Introduction, disease transmission and inter-phase.

UNIT II

Pathology of important infectious diseases (viz. bacterial, viral, fungal and parasitic) of fish, laboratory and wild/zoo animals.

UNIT III

Pathology of non-infectious diseases of fish, lab/ wild/zoo animals.

Practical

Post-mortem examination of wild animals including wild birds. Study of gross and microscopic lesions of important infectious and non - infectious diseases of fish and laboratory animals.

Suggested Readings

Arora BM. 1984. *Wildlife Diseases in India*. Periodical Expert Book Agency.

Fowler ME. 1978. *Zoo and Wild Animal Medicine*. WB Saunders.
 Beninchka K, Garner FM & Jones TC. 1978. *Pathology of Laboratory Animals* (Vols. I, II). Springer Verlag.
 Roberts RJ. 1979. *Fish Pathology*. Bailliere Tindall, London.

VPP 612 VETEROLEGAL PATHOLOGY 1+0

Objective

To educate the students about common veterolegal problems and legal writing of PM report.

Theory

UNIT I

General knowledge about the laws relating to veterinary practice, professional discipline and professional etiquettes.

UNIT II

Regulations dealing with diseases of animals in India regarding epidemiology, quarantine certificate, issue of soundness certificate etc.

UNIT III

Common causes of violent death, criminal assault, cruelty to animals, malicious poisoning, snake bite, electrocution, gun shot wounds, automobile accidents, doping etc.

Suggested Readings

Gahlot AK, Sharma SN & Tanwar RA. 2003. *Veterinary Jurisprudence*. 5th Ed. NBS Publishers, Bikaner.
 Jones TC & Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.
 Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.
 Rudin N & Inman K. 2002. *An Introduction to Forensic DNA Analysis*. CRC Press.

VPP 701 PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES 2+1

Objective

To teach students about nutritional and metabolic disorders of livestock.

Theory

UNIT I

Pathogenesis, gross and microscopic pathology of nutritional deficiencies viz. carbohydrate, protein, fats, vitamins and macro and microelements and their imbalances.

UNIT II

Different metabolic diseases namely milk fever, ketosis, tetany, azoturia. Downer's cow syndrome and post parturient hemoglobinuria in domestic animals.

Practical

Estimation of certain minerals in sera of natural and experimentally induced deficiencies in domestic animals. To study the haematological, gross and microscopic pathological alterations caused by nutritional and metabolic disorders.

Suggested Readings

Selected articles from journals.

- VPP 702 ADVANCES IN TOXICOPATHOLOGY 2+1**
- Objective**
To teach students about toxicity in livestock due to plants and extraneous poisons.
- Theory**
UNIT I
Introduction, mode of action, diagnosis and treatment of different poisons and their classification. Experimental animal models for toxicity studies and evaluation of parameters.
UNIT II
Pathogenesis, gross and microscopic pathology of diseases caused by toxic plants, organic and inorganic poisons commonly taken or administered maliciously to different species of domestic animals.
- Practical**
Clinico-pathological studies on natural or experimentally induced toxicity /poisoning in domestic animals. To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.
- Suggested Readings**
Selected articles from journals.
- VPP 703 ADVANCES IN DIAGNOSTIC PATHOLOGY 1+2**
- Objective**
To teach current diagnostic techniques for diagnosis of different diseases.
- Theory**
UNIT I
Study of the principles of biopsy techniques and electron microscopy.
UNIT II
Current techniques for diagnosis of diseases.
- Practical**
Principles and practice of fluorescent and phase contrast microscopy, chromatography, spectrophotometry and immunodiffusion technique, use of laboratory animals, chick embryos etc. for the diagnosis of animal diseases.
- Suggested Readings**
Selected articles from journals.
- VPP 704 ULTRASTRUCTURAL PATHOLOGY 1+1**
- Objective**
To study the significance of ultra-structural changes in organelles.
- Theory**
UNIT I
Study of cells- cell morphology, interpretation of normal and abnormal cells.
UNIT II
Study of cell organelles, degenerations, infiltrations, viral inclusions.
- Practical**
Study of EM photographs, collection and preparation of specimens for EM studies.

Suggested Readings

Selected articles from journals.

VPP 705 IMMUNOPATHOLOGY 2+1

Objective

To teach students immunologically mediated and autoimmune diseases of livestock.

Theory

UNIT I

Principles of immunopathology, hypersensitivity status, pathology of immune complex diseases.

UNIT II

Immunoproliferative disorders, autoimmune diseases and immune deficiencies in man and domestic animals.

Practical

Immune complexes, quantification and determination by various techniques, enumeration of various populations of lymphocytes by different techniques, determination of C3 levels, autoimmune reaction by demonstrating autoantibodies, hypersensitivity reactions (class IV and others).

Suggested Readings

Selected articles from journals.

VPP 706 PATHOLOGY OF IMPORTANT AND EMERGING 1+1 DISEASES OF PETS AND LIVESTOCK

Objective

To teach students important and emerging diseases of pets and livestock.

Theory

UNIT I

Introduction to emerging diseases, foot and mouth disease, vesicular stomatitis, vesicular exanthema, rinderpest/Peste des petits ruminants, para influenza -3, infectious bovine rhinotracheitis/infectious pustular vulvovaginitis, bovine spongiform encephalopathy, scrapie, blue tongue, malignant catarrhal fever, mucosal disease/bovine viral diarrhoea, bovine leucosis.

UNIT II

Tuberculosis/Johne's disease, brucellosis, listeriosis, caprine arthritis, campylobacteriosis, encephalitis, parvovirus infection, emerging diseases of pets.

Practical

Study of clinical and gross alterations and histopathology of some important emerging and enzootic diseases.

Suggested Readings

Selected articles from journals.

VPP 707 ADVANCES IN AVIAN PATHOLOGY 2+1

Objective

To teach different diagnostic techniques for diagnosis of different avian diseases.

TheoryUNIT I

Advances in pathogenesis and pathology including molecular basis of important infections (bacterial, viral, fungal and parasitic).

UNIT II

Non-infectious diseases with particular emphasis on emerging diseases of chickens, turkeys, ducks and other birds.

Practical

Necropsy examination of different species of poultry. Study of gross and microscopic lesions in natural and experimentally produced diseases in different species of birds. Diagnosis of different diseases of poultry.

Suggested Readings

Selected articles from journals.

VPP 708 PATHOLOGY OF FUNGAL DISEASES 2+1**Objective**

To teach the diseases caused by different fungi and mycotoxins in animals.

TheoryUNIT I

Pathology of diseases associated with pathogenic fungi like aspergillosis, candidiasis, epizootic lymphangitis, histoplasmosis, coccidioidomycosis, cryptococcosis, bovine abortions, dermatophytomycosis etc.

UNIT II

Diseases associated with mycotoxins like aflatoxins, rubratoxin, T₂ toxin, ochratoxin etc. Metabolism of toxins and their effect in man, domestic and laboratory animals, poultry and aquatic species.

Practical

Demonstration of pathogenic mycotoxic fungi, chemistry of toxic compounds, physical and chemical properties, methods of extraction, isolation and identification of mycotoxins.

Suggested Readings

Selected articles from journals.

VPP 709 MOLECULAR PATHOLOGY OF CELL INJURY 2+1**Objective**

To acquaint the students about the molecular basis of cell injury and inflammation.

TheoryUNIT I

Causes of cell injury - Ischemic, Hypoxic, Free radicals, virus and chemical cell injury - Chemical Mediators - Cytoskeletal and biochemical changes in cell injury.

UNIT II

Ultrastructural changes and biochemical mechanisms of reversible injury, necrosis, apoptosis. Molecular basis of disease. Cellular adaptation- hyperplasia, hypertrophy, atrophy, metaplasia and dysplasia. Intracellular accumulations.

UNIT III

Inflammation- mechanism and types. Tissue repair and healing.

Practical

Gross and histopathological studies pertaining to above conditions.

Suggested Readings

Selected articles from journals.

VPP 710 EXPERIMENTAL PATHOLOGY 1+1**Objective**

To provide expertise in designing the experiments and handling of animals.

TheoryUNIT I

Need for experimentation in research, animal experimentation techniques, preparation of experimental protocols, biochemical studies, pathological examination of clinical samples.

UNIT II

Transplantation techniques, immune regulation, tissue culture, blood cell separation protocols, electrophoresis and chromatography, study of animal model and designing of experiment.

Practical

Short research problems involving contemporary issues and research techniques.

Suggested Readings

Selected articles from journals.

VPP 790 SPECIAL PROBLEM 0+2**Objective**

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PATHOLOGY

List of Journals

- * Advances in Veterinary Sciences
- * American Journal of Veterinary Medical Association
- * Avian Diseases
- * Current Contents
- * Indian Journal of Animal Sciences
- * Indian Journal of Poultry Science
- * Indian Journal of Veterinary Pathology
- * Journal of Immunology and Immunopathology
- * Veterinary Bulletin
- * Veterinary Pathology

e-Resources

- * www.iavp.org (Indian Journal of Veterinary Pathology)
- * www.vetpathology.org (Veterinary Pathology)
- * www.tandf.co.uk (Avian Pathology)
- * www.avdi.allenpress.com (Avian Diseases)
- * www.elsevier.com/locate/vetimm (Veterinary Immunology and Immunopathology)

Suggested Broad Topics for Master's and Doctoral Research

- * Effect of probiotics on pathogenesis and pathology of bacterial diseases
- * Effect of antioxidants on pathogenesis and pathology of bacterial diseases
- * Pathology of mixed infections in domestic animals
- * Role of stress in pathogenesis and pathology of animal diseases

VETERINARY PHARMACOLOGY AND TOXICOLOGY

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VPT 601	GENERAL PHARMACOLOGY	2+0
VPT 602	AUTONOMIC AND AUTACOID PHARMACOLOGY	2+1
VPT 603	CNS PHARMACOLOGY	2+1
VPT 604	DIGESTIVE AND RESPIRATORY PHARMACOLOGY	2+0
VPT 605	CARDIOVASCULAR AND RENAL PHARMACOLOGY	2+0
VPT 606	ENDOCRINE AND REPRODUCTIVE PHARMACOLOGY	2+0
VPT 607	CHEMOTHERAPY	2+1
VPT 608	TOXICOLOGY OF XENOBIOTICS	2+1
VPT 609	TOXICOLOGY OF PLANTS AND TOXINS	2+0
VPT 610	PHARMACOLOGICAL TECHNIQUES	1+1
VPT 611	TECHNIQUES IN TOXICOLOGY	1+1
VPT 612	ETHNOPHARMACOLOGY	2+0
VPT 691	MASTER'S SEMINAR	1+0
VPT 699	MASTER'S RESEARCH	20
VPT 701	ADVANCES IN NEUROPHARMACOLOGY	2+0
VPT 702	AUTACOID PHARMACOLOGY	1+0
VPT 703	PHARMACOLOGY OF HERBAL DRUGS	2+1
VPT 704	DRUG METABOLISM	2+0
VPT 705	MOLECULAR PHARMACOLOGY	2+0
VPT 706	PHARMACOKINETICS	2+1
VPT 707	PHARMACOGENOMICS	2+0
VPT 708	IMMUNOPHARMACOLOGY	1+0
VPT 709	MOLECULAR TOXICOLOGY	2+0
VPT 710	CLINICAL PHARMACOLOGY	1+1
VPT 711	CLINICAL TOXICOLOGY	2+1
VPT 712	ECOTOXICOLOGY	2+0
VPT 713	REGULATORY TOXICOLOGY	2+1
VPT 790	SPECIAL PROBLEM	0+2
VPT 791	DOCTORAL SEMINAR I	1+0
VPT 792	DOCTORAL SEMINAR II	1+0
VPT 799	DOCTORAL RESEARCH	45

VETERINARY PHARMACOLOGY AND TOXICOLOGY

Course Contents

VPT 601	GENERAL PHARMACOLOGY	2+0
Objective	To study the scope of pharmacology and to understand the basic mechanisms of drug actions and its effects.	
Theory	<u>UNIT I</u> History and scope of pharmacology, Principles of drug absorption, distribution, metabolism and elimination. Drug bioavailability and routes of administration.	
	<u>UNIT II</u> Important pharmacokinetic parameters and their clinical significance.	
	<u>UNIT III</u> Pharmacodynamics: mechanism of action and the relationship between drug concentration and effect; signal transduction mechanism and drug receptors for physiological regulatory molecules.	
	<u>UNIT IV</u> Quantitation of drug-receptor interactions and elicited effects. Competitive and non-competitive antagonism. Factors affecting drug response. Adverse drug reactions.	
Suggested Readings	Brunton LL. (Ed). 2005. <i>Goodman and Gilman's The Pharmacological Basis of Therapeutics</i> . 11 th Ed. McGraw-Hill. Richard AH. (Ed). 2001. <i>Veterinary Pharmacology and Therapeutics</i> . 8 th Ed. Iowa State Univ. Press. Sandhu HS & Rampal S. 2006. <i>Essentials of Veterinary Pharmacology and Therapeutics</i> . 1 st Ed. Kalyani Publishers.	
VPT 602	AUTONOMIC AND AUTACOID PHARMACOLOGY	2+1
Objective	To study the pharmacodynamics of autonomic drugs.	
Theory	<u>UNIT I</u> Anatomical and physiological considerations of autonomic nervous system (ANS).	
	<u>UNIT II</u> Neurohumoral transmission in ANS.	
	<u>UNIT III</u> Pharmacology of cholinergic agonists and antagonists.	
	<u>UNIT IV</u> Pharmacology of adrenergic agonists and antagonists.	
	<u>UNIT V</u> Ganglionic stimulants and blockers.	
	<u>UNIT VI</u> Autacoids: Histamine, serotonin, kinins, eicosanoids and platelet activating factor.	

Practical

Pharmacological experiments on intact and isolated preparations for studying the effects of various prototype drugs on vascular, intestinal, respiratory, urinary and reproductive smooth muscles, autonomic ganglia, skeletal muscles; blood pressure, ECG, heart etc.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 603**CNS PHARMACOLOGY****2+1****Objective**

To study the pharmacodynamics of drugs acting on CNS.

TheoryUNIT I

Anatomical and physiological considerations of central nervous system (CNS); neurohumoral transmission in CNS.

UNIT II

Historical development, theories, principles and stages of general anaesthesia.

UNIT III

Pharmacology of anaesthetics, sedatives, hypnotics, neuroleptics, antiepileptics.

UNIT IV

CNS stimulants, analeptics, opioid agonists and antagonists; non-steroidal anti-inflammatory agents, central and peripheral muscle relaxants, local anaesthetics, therapeutic gases. euthanizing agents. Doping.

Practical

Study of pharmacodynamics of prototype drugs of each group in experimental animals.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 604**DIGESTIVE AND RESPIRATORY PHARMACOLOGY****2+0****Objective**

To study the pharmacological aspects of drugs acting on digestive and respiratory systems.

TheoryUNIT I

Pharmacology of drugs acting on gastrointestinal tract. Appetite stimulants, emetics and anti-emetics.

UNIT II

Anti-ulcer drugs, modulators of gastric and intestinal motility and secretions.

UNIT III

Gastrointestinal protectants and adsorbents, laxatives and cathartics.

UNIT IV

Agents promoting digestive functions; bile acids and pancreatic enzymes, drugs affecting liver; rumen pharmacology.

UNIT V

Pharmacology of drugs acting on respiratory system: pathogenesis of inflammatory respiratory diseases.

UNIT VI

Bronchodilators, antitussives, mucolytics, expectorants, decongestants.

UNIT VII

Drugs used in treatment of asthma.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS and Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 605 CARDIOVASCULAR AND RENAL PHARMACOLOGY 2+0

Objective

To study the pharmacological aspects of drugs acting on CVS and kidneys.

Theory

UNIT I

Pharmacology of cardiac glycosides.

UNIT II

Antiarrhythmic, antihypertensive and antihyperlipidaemic drugs.

UNIT III

Drugs affecting vasomotor and cardiorespiratory reflex mechanisms and haemopoietic system.

UNIT IV

Coagulants and anticoagulants, thrombolytic agents.

UNIT V

Pharmacology of drugs affecting renal functions and fluid-electrolyte balance.

UNIT VI

Fluid and electrolyte therapy, diuretics, antidiuretics, uricosuric drugs.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

trimethoprim and nitrofurans in biological fluids to study their kinetics and bioavailability.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 608 TOXICOLOGY OF XENOBIOTICS 2+1

Objective

To study the poisonings and their antidotal therapy in animals.

Theory

UNIT I

Principles and scope of toxicology, sources of poisoning.

UNIT II

General modes of action of poisons, detoxification, factors affecting toxicity, general principles of diagnosis and treatment of poisonings.

UNIT III

Toxicology of metals, agrochemicals, solvents and vapors, feed additives.

UNIT IV

Toxic effects of radiations and radioactive chemicals, genetic and developmental toxicology; forensic and regulatory aspects of toxicology.

Practical

Extraction, separation and detection of common poisons in toxicological specimens, study of toxicity and antidotal treatment in animals, designing of animal toxicity experiments and general toxicity tests.

Suggested Readings

Klassen CD, Amdure MO & Doull J. (Eds). 1996. *Casarett & Doull's Toxicology: The Basic Sciences of Poisons*. 5th Ed. McGraw Hill.

Sandhu HS & Brar RS. 2000. *Text Book of Veterinary Toxicology*. 1st Ed. Kalyani Publishers.

Stive KE & Brown TM. 2006. *Principles of Toxicology*. 2nd Ed. CRC Press.

VPT 609 TOXICOLOGY OF PLANTS AND TOXINS 2+0

Objective

To impart knowledge of toxicity of poisonous plants & natural toxins.

Theory

UNIT I

Classification, identification and chemical constituents of poisonous plants. Plants containing cyanide, nitrate/nitrite, oxalate, lectins and cardiotoxic glycosides.

UNIT II

Plants producing lathyrism, thiamine deficiency and photosensitization.

UNIT III

Toxicology of mycotoxins: aflatoxins, rubratoxins, ochratoxins, trichothecenes, tremorgens and ergot.

UNIT IV

Animal bites and stings: snake venom, scorpion, spider and insect stings and toad poisoning. Bacterial toxins: botulism.

Suggested Readings

- Chopra SR, Badhwar RL & Ghosh S. 1984. *Poisonous Plants of India*. 1st Ed., Academic Publishers, Jaipur.
- Klassen CD, Amdure MO & Doull J. (Eds). 1996. *Casarett & Doull's Toxicology: Basic Sciences of Poisons*. 5th Ed., McGraw Hill.
- Sandhu HS and Brar RS. 2000. *Text Book of Veterinary Toxicology*. 1st Ed., Kalyani Publishers.

VPT 610

PHARMACOLOGICAL TECHNIQUES

1+1

Objective

To impart the knowledge of various basic pharmacological techniques and screening methods of drugs.

Theory

UNIT I

Principles of drug action and bioassay. Dose response curves and their analysis.

UNIT II

Techniques for setting up isolated and intact preparations.

UNIT III

Organization of screening programme of drugs; multidimensional screening procedures and gross observational methods.

Practical

Setting up of isolated and intact preparations, recording of BP in dog/rat, recording of ECG in rat, experiments on drug potentiation, antagonism and tachyphylaxis. Construction of dose-response plots, calculation of EC₅₀, dissociation rate constants, potency ratio, pA_x, pD_x and pD'_x values.

Specific tests for evaluation of tranquillizing, hypnotic, analgesic, anti-convulsant, general and local anesthetic, muscle relaxant, anti-inflammatory, antipyretic, antiarrhythmic, antihypertensive, antihyperglycemic and anticholesterimic activities. Determination of potency ratio, median effective, toxic or lethal doses. Bioassay techniques.

Suggested Readings

- Ghosh MN. (Ed). 2005. *Fundamentals of Experimental Pharmacology*. 3rd Ed. Hilton & Co.
- Kulkarni SK (Ed). 2004. *Handbook of Experimental Pharmacology*. 3rd Ed. Vallabh Prakashan.
- Laurance DR & Bacharach AL. (Ed). 1964. *Evaluation of Drug Activities: Pharmacometrics*. Vols. I, II. Academic Press.
- Parmar NS & Shiv Prakash 2006. *Screening Methods in Pharmacology*. 1st Ed. Narosa.
- Seth UK, Dadkar NK & Usha G Kamat (Eds). 1972. *Selected Topics in Experimental Pharmacology*. 1st Ed. Kothari Book Depot.
- Tallarida RJ & Murray RB. 1987. *Manual of Pharmacologic Calculations*. 2nd Ed. Springer Verlag.

- Bisset NG. (Ed). 1994. *Herbal Drugs and Phytopharmaceuticals*. CRC Press.
- Chopra RN, Nayar SL & Chopra IC. (Eds.). 2002. *Glossary of Indian Medicinal Plants*. NISCAIR, CSIR, New Delhi.
- Pushpangadan P, Nyman U & George V. (Eds). 1995. *Glimpses of Indian Ethnopharmacology*. TBGRI Publication.
- Rastogi RP & Mehrotra BN (Eds). 1993-95. *Compendium of Indian Medicinal Plants*. Vols. I-IV. Publication and Information Directorate, New Delhi.
- Tallarida RJ & Murray RB. 1987. *Manual of Pharmacologic Calculations*. 2nd Ed. Springer Verlag.

VPT 701 ADVANCES IN NEUROPHARMACOLOGY 2+0

Objective

To understand the underlying mechanisms of drug receptor interactions and its effects.

Theory

UNIT I

Definition, classification of receptors, molecular structure of receptors.

UNIT II

G-protein coupled, ligand gated-ion channel and tyrosine kinase-linked receptors.

UNIT III

Ligand binding study of receptors. Signal transduction system: introduction to signal transduction, receptor linked to ion channels.

UNIT IV

G-proteins, second messengers: phospholipases, phosphokinases, intracellular calcium, protein kinase-C, IP₃, diacylglycerol and cyclic nucleotides.

UNIT V

Signal transduction through protein tyrosine kinases. Receptors as pharmaceutical targets.

Suggested Readings

Selected articles from journals.

VPT 702 AUTACOID PHARMACOLOGY 1+0

Objective

To study the pharmacodynamics of autacoids.

Theory

UNIT I

Pharmacodynamics of histamine and antihistamines.

UNIT II

Pharmacodynamics of serotonin and its antagonists; eicosanoids, bradykinin, angiotensin, kallikrein and other kinins.

UNIT III

Platelet-activating factors, slow reacting substances.

UNIT IV

Putative neurohumoral transmission – purine nucleotides, peptides, amino acids and nitric oxide.

Suggested Readings

Selected articles from journals.

VPT 703 PHARMACOLOGY OF HERBAL DRUGS 2+1**Objective**

To study the pharmacological, therapeutic and toxicological aspects of potential medicinal plants and herbal drugs.

TheoryUNIT I

Historical aspect, chemical constituents of medicinal plants and their classification.

UNIT II

Identification, collection, preservation, purification, isolation, standardization and clinical validation of bioactive molecules from vegetable sources.

UNIT III

Characterization of pharmacological, therapeutic and toxic effects of potential herbal drugs.

UNIT IV

Strategies for development of herbal drugs.

Practical

Extraction, detection, isolation and purifications of active chemical constituents from plant sources. Pharmacological effects of herbal drugs on intact and isolated preparations.

Suggested Readings

Selected articles from journals.

VPT 704 DRUG METABOLISM 2+0**Objective**

To study the mechanisms and processes of drug biotransformation.

TheoryUNIT I

Mechanisms and processes of drug biotransformation.

UNIT II

Synthetic and non-synthetic pathways of drug metabolism.

UNIT III

Chemical, biological, genetic and environmental factors. Species variations affecting drug biotransformation mechanisms.

UNIT IV

Hepatic microsomal and non-microsomal enzyme systems.

UNIT V

Enzyme induction and inhibition.

Suggested Readings

Selected articles from journals.

VPT 705 MOLECULAR PHARMACOLOGY 2+0**Objective**

To study the identification and characterization of receptors and drug receptors interactions.

TheoryUNIT I

Physicochemical properties of drugs, forces involved in binding of drugs to receptors.

UNIT II

Receptor conformation and configuration and structure activity relationship.

UNIT III

Theories of drug receptor interactions; analysis of dose response relationship and molecular mechanisms of drug actions.

UNIT IV

Methods of identification, isolation and characterization of receptors.

Suggested Readings

Selected articles from journals.

VPT 706 PHARMACOKINETICS 2+1**Objective**

To study the absorption, distribution, biotransformation and excretion of drugs.

TheoryUNIT I

Routes of drug administration, factors modifying drug delivery; absorption, distribution, biotransformation and elimination.

UNIT II

Kinetics following single and multiple dosage; compartmental models of drug distribution, bioavailability, volume of distribution and protein binding of drugs.

UNIT III

Rates of absorption, distribution and elimination; absorption and elimination half-lives and rate of transfer of drugs between compartments.

UNIT IV

Renal clearance, dosage regimen; non-compartmental pharmacokinetic modeling.

UNIT V

Application of pharmacokinetic principles in therapeutics.

Practical

Analysis of pharmacokinetic data and determination of different pharmacokinetic parameters and bioavailability of drugs in normal and diseased animal models.

Suggested Readings

Selected articles from journals.

VPT 707 PHARMACOGENOMICS 2+0**Objective**

To study the responses to drugs with respect to various aspects of genomics.

TheoryUNIT I

Introduction, species variations affecting drug responses, increased and decreased responsiveness to drug effects/toxicities & novel drug effects

UNIT II

Genetic polymorphism.

UNIT III

Gene therapy: gene transfer technology, viral vectors, natural delivery strategies.

UNIT IV

Drugs & gene therapy of inherited diseases, genetic repair and inactivation strategies; synthesis of therapeutic proteins and cancer gene therapy.

UNIT V

Role of bioinformatics in pharmacogenomics.

Suggested Readings

Selected articles from journals.

VPT 708

IMMUNOPHARMACOLOGY

1+0

Objective

To study the pharmacological control of immune system.

Theory

UNIT I

General aspect of immune system, chemical mediators of immune system.

UNIT II

Pharmacological control of immune responses. Immunomodulators; immunostimulants, immunosuppressant and tolerogens; immunological basis of drug allergy and drug tolerance.

UNIT III

Interaction of nervous system, endocrine system and immune system, immunotoxic effects of environmental and other pollutants.

UNIT IV

Xenobiotic-induced immune dysfunctions and immune deficiencies; autoimmune reactions to xenobiotics, immunoregulants and their therapeutic applications in asthma, arthritis, cancer, dermatology and organ transplant etc.

Suggested Readings

Selected articles from journals.

VPT 709

MOLECULAR TOXICOLOGY

2+0

Objective

To understand the mechanisms & targets of cellular/ molecular toxicity

Theory

UNIT I

Cellular, subcellular and molecular targets of toxicity; mechanisms of toxicities.

UNIT II

Factors affecting toxicity, interactions of toxicants with target molecules.

UNIT III

Cellular dysfunctions, repair and dysrepair.

UNIT IV

Target organ directed toxicological effects of xenobiotics, detoxification, risk assessment.

UNIT V

Mechanism of chemical mutagenesis, carcinogenesis, teratogenesis and radiation toxicity.

Suggested Readings

Selected articles from journals.

VPT 710 CLINICAL PHARMACOLOGY 1+1**Objective**

To study the clinical pharmacological aspects of drugs.

TheoryUNIT I

Scope of clinical pharmacology.

UNIT II

Drug discovery and clinical trials. Pharmacovigilance. Pharmacoepidemiology and pharmacoconomics.

UNIT III

PK-PD relationship and its applications. Drug interactions and adverse drug reactions.

UNIT IV

Therapeutic drug monitoring. Rationale of drug use, drug regulations and acts.

Practical

Study on drug interactions and drug levels in diseased conditions. Study on plasma drug concentration-time profile and establishment of various pharmacokinetic parameters. Dosage adjustment in diseased conditions. Clinical trials of various drugs.

Suggested Readings

Selected articles from journals.

VPT 711 CLINICAL TOXICOLOGY 2+1**Objective**

To study the scope of clinical toxicology and management of poisonings including regulatory and forensic toxicology.

TheoryUNIT I

Scope of clinical toxicology. Toxicological investigation and management of poisonings.

UNIT II

Target organ directed toxicity, Antidotal therapy.

UNIT III

Clinical aspect of poisoning due to specific toxicants viz. metals, pesticides, mycotoxins, animal and bacterial toxins, solvents and vapours, drugs and other food/feed contaminants.

UNIT IV

Forensic and analytical toxicology.

Practical

Demonstration of poisonings and their antidotal treatment; use of biomarkers in the assessment of toxicity. GLP evaluation, analysis of poisons in biological samples.

Suggested Readings

Selected articles from journals.

VPT 712	ECOTOXICOLOGY	2+0
	Objectives	
	To impart knowledge regarding ecotoxicology for conservation of healthy eco-system.	
	Theory	
	<u>UNIT I</u>	
	Basic principles of ecotoxicology. Sources of contamination and effects of pollutants on eco-health.	
	<u>UNIT II</u>	
	Chemical contamination of air, water, soil and food by major agricultural and industrial chemicals – pesticides, hydrocarbons and metals. Fate of chemicals in the environment and target species.	
	<u>UNIT III</u>	
	Marine and wildlife as monitors of environmental quality.	
	<u>UNIT IV</u>	
	Contamination control and approaches to rehabilitating damaged ecosystems.	
	Suggested Readings	
	Selected articles from journals.	
VPT 713	REGULATORY TOXICOLOGY	2+1
	Objectives	
	Introduction to general principles in toxicological risk assessment.	
	Theory	
	<u>UNIT I</u>	
	Principles of risk assessment. Test protocols for toxicity studies.	
	<u>UNIT II</u>	
	Interaction between toxicology and industry. Compounds under regulatory legislation demands. Regulatory essential dose levels in chemical risk assessment (NOEL, NOAEL, LOEL, LOAEL & AOEL).	
	<u>UNIT III</u>	
	Risk assessment in practice. Classification and marking/branding of chemicals. Monitoring/surveillance of chemicals. Exposure assessment and modeling.	
	<u>UNIT IV</u>	
	Quality control in safety research (GLP). Operation of product register.	
	Practical	
	Good laboratory practice in toxicological research. Screening procedures in regulatory toxicology. Mandatory toxicity testing protocols. Determination of ADI, NOEL, NOAEL, LOEL, LOAEL and AOEL.	
	Suggested Readings	
	Selected articles from journals.	
VPT 790	SPECIAL PROBLEM	0+2
	Objective	
	To provide expertise in handling practical research problem(s).	
	Practical	
	Short research problem(s) involving contemporary issues and research techniques.	

VETERINARY PHARMACOLOGY AND TOXICOLOGY

List of Journals

- * American Journal of Veterinary Research
- * Annual Review of Pharmacology
- * Annual Review of Pharmacology and Toxicology
- * Drugs
- * Environmental Toxicology and Pharmacology
- * European Journal of Pharmacology
- * Indian Journal of Pharmacology
- * Journal of American Medical Association
- * Journal of Ethnopharmacology
- * Journal of Pharmacology and Experimental Therapeutics
- * Journal of Veterinary Pharmacology and Therapeutics
- * Pharmacological Reviews
- * Pharmacology, Biochemistry and Behaviour
- * Toxicology
- * Toxicology and Applied Pharmacology
- * Toxicology International
- * Trends in Pharmacological Sciences
- * Veterinary and Human Toxicology

e-Resources

- * www.elsevier.com (Environmental Toxicology and Pharmacology)
- * www.blackwellpublishing.com (Journal of Vet. Pharmacology & Therapeutics)
- * www.elsevier.com (Comparative Biochem. & Physiol.-Part C: Toxicol. & Pharma.)
- * www.clinicalneuropharm.com (Clinical Neuropharmacology)
- * www.arjournals.annualreviews.org (Annual Review of Pharma. & Toxicology)
- * www.aac.aron.org (Antimicrobial agents and chemotherapy)
- * www.nature.com/big/in_dex.html (British Journal of Pharmacology)
- * www.dmd.aspetijournals.org (Drug metabolism and disposition)
- * <http://jpet.aspetijournals.org> (The Journal of Pharmacology & Experimental Therapeutics)
- * <http://modpharm> (Molecular Pharmacology)
- * <http://Pharmet.org> (Pharmacological Reviews)
- * www.nature.com/tpj/index.html (The Pharmacogenomics Journal)
- * www.informaworld.org (International Journal of Toxicology)
- * www.toxici.oxfordjournals.org (Toxicological Science)

Suggested Broad Topics for Master's and Doctoral Research

- * Neuro- and Behavioural Toxicology of Agrochemicals
- * Pharmacokinetics and Pharmacodynamics of Newer Drugs
- * Ethnopharmacology
- * Autonomic Pharmacology of Ruminants
- * Autonomic Pharmacology of Poultry
- * Clinical Pharmacology
- * Clinical Toxicology

VETERINARY PUBLIC HEALTH

Course Structure- at a Glance

CODE	COURSE TITLE	CREDITS
VPH 601	ELEMENTS OF VETERINARY PUBLIC HEALTH	1+1
VPH 602	BACTERIAL AND RICKETTSIAL AGENTS OF PUBLIC HEALTH SIGNIFICANCE	2+1
VPH 603	VIRAL, FUNGAL AND PARASITIC AGENTS OF PUBLIC HEALTH SIGNIFICANCE	2+1
VPH 604	ZOONOSES AND PUBLIC HEALTH	2+1
VPH 605	PRINCIPLES OF FOOD HYGIENE AND SAFETY	2+1
VPH 606	FOOD-BORNE INFECTIONS AND INTOXICATIONS	2+1
VPH 607	MEAT AND MILK HYGIENE	2+1
VPH 608	ENVIRONMENTAL POLLUTION AND SAFETY	3+1
VPH 609	FISH, FISH PRODUCTS AND SEAFOOD HYGIENE	1+1
VPH 610	BIOTERRORISM AND DISASTER MANAGEMENT	1+1
VPH 691	MASTER'S SEMINAR	1+0
VPH 699	MASTER'S RESEARCH	20
VPH 701	CURRENT TOPICS IN VETERINARY PUBLIC HEALTH	2+1
VPH 702	EMERGING AND REEMERGING ZOONOSES	2+1
VPH 703	QUALITY CONTROL OF ANIMAL FOOD PRODUCTS	2+1
VPH 704	OCCUPATIONAL HEALTH HAZARDS	2+1
VPH 705	DISPOSAL AND RECYCLING OF WASTE	2+1
VPH 706	BIOHAZARDS, BIOSECURITY AND DISASTER MANAGEMENT	2+0
VPH 707	FOOD PLANT SANITATION	2+1
VPH 708	ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL	2+1
VPH 790	SPECIAL PROBLEM	0+2
VPH 791	DOCTORAL SEMINAR I	1+0
VPH 792	DOCTORAL SEMINAR II	1+0
VPH 799	DOCTORAL RESEARCH	45

VETERINARY PUBLIC HEALTH

Course Contents

VPH 601 ELEMENTS OF VETERINARY PUBLIC HEALTH 1+1

Objective

To acquaint students with basics of veterinary public health.

Theory

UNIT I

The purposes and scope of veterinary public health; veterinary interests in public health, principal functions and fields of activity of public health veterinarians.

UNIT II

Definition of veterinary public health administration; organisation, administration and implementation of veterinary public health services and programmes.

UNIT III

Public health team, administration and functions; place of veterinarian in the public health team; veterinary public health agencies and institutions in India and abroad.

Practical

Collection of information about set up of veterinary public health in different countries.

Suggested Readings

Schwabe CW. 1969. *Veterinary Medicine and Human Health*. Williams & Wilkins.

Sherikar AT, Bachchil VN & Thapliyal DC. 2004. *Textbook of Elements of Veterinary Public Health*. ICAR.

VPH 602 BACTERIAL AND RICKETTSIAL AGENTS OF 2+1 **PUBLIC HEALTH SIGNIFICANCE**

Objective

To impart knowledge about importance and characteristic features of bacterial and rickettsial pathogens of public health significance.

Theory

UNIT I

Importance of microbes in relation to veterinary public health; cultural, biochemical and other identification characters; ecology, transmission and survivability of bacteria in nature.

UNIT II

Description of *Bacillus*, *Listeria*, *Mycobacterium*, *Clostridium*, *Staphylococcus*, *Enterococcus*, *Brucella* and *Leptospira*

UNIT III

Description of *Vibrio*, *Salmonella*, *Escherichia*, *Campylobacter*, *Yersinia*, *Lactobacillus*, *Pseudomonas* and *Micrococcus*.

UNIT IV

Description of *Coxiella*, *Rickettsia* and *Chlamydia*.

Practical

Isolation and identification methods for important bacterial and rickettsial agents of public health significance from host, vehicle and environment.

Suggested Readings

Holt JG, Krieg NR, Sneath PHA, Staley JT & Williams ST. 1994. *Bergey's Manual of Determinative Bacteriology*. Williams & Wilkins.

VPH 603 VIRAL, FUNGAL AND PARASITIC AGENTS OF 2+1 PUBLIC HEALTH SIGNIFICANCE

Objective

To impart knowledge about importance and characteristic features of viral, fungal and parasitic pathogens of public health significance.

Theory

UNIT I

Systematic study of viral agents of Japanese encephalitis, encephalomyelitis, rabies, influenza, KFD, Rift valley fever, and enteroviruses; their morphological and other characters, ecology, transmission and survivability in nature.

UNIT II

Description of fungal agents of public health importance belonging to genera: *Aspergillus*, *Penicillium*, *Fusarium*, *Mucor*, *Histoplasma*, *Microsporium*, *Trichophyton* and *Sporotrichum*.

UNIT III

Description of parasites of public health importance: *Taenia*, *Echinococcus*, *Trichinella*, *Toxoplasma*, *Diphyllobothrium*, *Fasciola*, and *Cryptosporidium*.

Practical

Isolation and identification methods for important fungal, viral and parasitic agents of public health significance from host, vehicle and environment.

Suggested Readings

Ananthanarayan R & Panikar J. 1997. *Textbook of Microbiology*. Orient Longman.
Pathak KML. 1991. *Fundamentals of Parasitic Zoonoses*. Kalyani.

VPH 604 ZOOSES AND PUBLIC HEALTH 2+1

Objective

To impart knowledge of epidemiology, prevention and control of important zoonotic diseases.

Theory

UNIT I

Concept and classification of zoonoses; comprehensive description of etiology, host range, epidemiology, diagnosis and management of zoonotic diseases.

UNIT II

Bacterial diseases: anthrax, brucellosis, tuberculosis, salmonellosis, yersiniosis, leptospirosis, listeriosis, plague, tularaemia, glanders, malidiosis, staphylococcosis, streptococcosis, tetanus, botulism, infections due to *Clostridium perfringens*, *E. coli*, *Aeromonas hydrophilla*, *Bacillus cereus*, *Vibrio parahaemolyticus*, cat scratch disease, chlamydiosis, Lyme disease, borreliosis (relapsing fever).

UNIT III

Detailed description of viral zoonoses: food-borne viruses viz. rota, tick-borne encephalitis, FMD, hepatitis A & E, Norwalk, entero, parvo, adeno,

cytomegalo, astro, calci and corona viruses, influenza, rabies, vector-borne viruses viz. Japanese encephalitis, Kyasanur forest disease, chickengunya, Crimean-Congo haemorrhagic fever, dengue fever, West-Nile viruses, yellow fever, rift-valley fever, equine encephalitis, louping ill, and some rare and potential zoonotic viruses such as Newcastle and pox viruses.

UNIT IV

Q fever and other rickettsiosis, fungal infections viz. dermatophytosis, blastomycosis, coccidioidomycosis, cryptococcosis, histoplasmosis, aspergillosis, candidiasis, rhinosporidiosis and sporotrichosis. Attributes and impact of parasitic zoonoses; description, etiology, host range, epidemiology, diagnosis and disease management of echinococcosis, taeniasis and cysticercosis, toxoplasmosis, trichinellosis, cryptosporidiosis, dracunculosis, fasciolopsiosis, sarcocystosis, liver fluke diseases, cutaneous and visceral larva migrans, schistosomiasis, leishmaniasis, trypanosomosis.

Practical

Isolation and identification of zoonotic agents, diagnostic procedures of zoonotic diseases.

Suggested Readings

Thapliyal DC. 1999. *Diseases of Animals Transmissible to Man*. International Book Distr. Co.

VPH 605 PRINCIPLES OF FOOD HYGIENE AND SAFETY 2+1

Objective

To acquaint the students about principles of food hygiene and quality improvement practices.

Theory

UNIT I

Relation between veterinary public health and food hygiene; concept of food hygiene, impact of environmental sanitation and other factors on food quality.

UNIT II

Food spoilage, safety and preservation methods.

UNIT III

Microbiological standards and quality control (biological and other indicators of hygienic quality and spoilage) of foods to prevent food-borne infections.

UNIT IV

General principles of prevention of food-borne illnesses, GMP, HACCP, risk analysis.

Practical

Procedures of evaluation of hygienic/microbiological quality of raw and processed foods especially of animal origin by detection of biological and other indicators.

Suggested Readings

Jay JM. 1996. *Modern Food Microbiology*. CBS.

VPH 606 FOOD-BORNE INFECTIONS AND INTOXICATIONS 2+1

Objective

To impart knowledge about major illnesses due to foods.

Theory

UNIT I

Food-borne bacterial infection and intoxications due to *Salmonella*, *Campylobacter*, *Clostridium*, *Staphylococcus*, *Listeria*, *Vibrio*, *E. coli*, *Bacillus cereus*, bacterial toxins.

UNIT II

Food-borne viral infections: infectious hepatitis, poliomyelitis, gastroenteritis etc, natural toxic substances in foods.

UNIT III

Health problems due to food additives, biocides, bacterial toxins.

UNIT IV

Heavy metals, antibiotics, hormones etc. in food.

Practical

Detection and quantitation of food-borne pathogens, toxins, antibiotics, pesticides and additives in foods.

Suggested Readings

Jay JM. 1996. *Modern Food Microbiology*. CBS.

VPH 607 MEAT AND MILK HYGIENE 2+1

Objective

To educate regarding general methods of food hygiene.

Theory

UNIT I

Principles of food hygiene with special reference to foods of animal origin, human health and economics, nature and problem of food supply in India.

UNIT II

Meat hygiene and public health, abattoir hygiene.

UNIT III

Milk hygiene and public health, in place cleaning.

UNIT IV

Egg, food legislation, meat and milk adulteration.

Practical

Milk and meat inspection, quality control tests of meat, milk and fish.

Suggested Readings

Gracey JF, Collins DS & Huey RJ. 1999. *Meat Hygiene*. WB Saunders.

WHO. 1962. *Milk Hygiene*. WHO.

Jay JM. 1996. *Modern Food Microbiology*. CBS.

VPH 608 ENVIRONMENTAL POLLUTION AND SAFETY 3+1

Objective

To impart education about pollutants in the environment and control.

Theory

UNIT I

Introduction to environmental hygiene, environment and health, microbial aspects of pollution.

UNIT II

Soil pollution, air pollution, water pollution and health.

UNIT III.

Genetic risk from environmental agents, health problems from nuclear energy and radiation pollution, environmental estrogens and pesticides-pollution.

UNIT IV

Dissemination of excreted pathogens, animal-waste and human risk, principles of safe disposal of waste.

UNIT V

Heavy metals, pesticides, veterinary drug residues and human health.

Practical

Determination of potability of drinking water, estimation and detection of pathogenic microbes in water, air, soil, animal products, sewage, and animal waste, inspection of sewage and waste disposal plants/sites.

Suggested Readings

Trieff NM. 1980. *Environment and Health*. Ann Arbor Science Publ.

VPH 609 FISH, FISH PRODUCTS AND SEAFOOD HYGIENE 1+1

Objective

To impart knowledge regarding fish hygiene and fish borne diseases

Theory

UNIT I

Fisheries and resources, fish preservation, hygienic quality control

UNIT II

Hygienic disposal and utilization of byproducts of fish, hygienic handling, transportation and marketing of fish.

UNIT III

Fish borne diseases in relation to human health.

Practical

Study of physical and biological indicators of wholesome fish to determine hygienic status of raw and processed fish. Residue analysis in fish.

Suggested Readings

Nollet Leo ML (Ed.). 2007. *Handbook of Meat, Poultry and Seafood Quality*. Blackwell publishing, Oxford.

VPH 610 BIOTERRORISM AND DISASTER MANAGEMENT 1+1

Objective

To update knowledge of disaster, biological weapons, biological hazards and remedial measures bioterrorism and biomedical hazards and their prevention

Theory

UNIT I:

Natural and man made disaster, impact analysis and classification of disaster scale, essential preparations to manage disaster, role and sequence of emergency medical services by veterinarians.

UNIT II

Effect of natural disasters like floods, prolonged draughts, forest fires, earthquakes, sunami and tidal damages, storms etc. on animal population both domestic and wild, post-disaster disease susceptibility, emergency control and remedial measures.

UNIT III

Biomedical hazards and biosafety, occupational health risk management. Major agents and their characteristics which have been used in the past and those which can be used in future as biological weapons.

UNIT IV

Biological weapons, hazard analysis and combating bioterrorism. Bio-ethics and social ethics, advisory role of veterinarians.

Practical

Detection of biohazards during disaster, detection and characterization of various organisms used as biological agents, use of disinfectants for their destruction.

Suggested Readings

Singh SK. 1998. *Disaster Management*. Mittal Publications, New Delhi.

VPH 701 CURRENT TOPICS IN VETERINARY PUBLIC HEALTH 2+1

Objective

To acquaint with contemporary issues concerning VPH.

Theory

UNIT I

Contemporary status of Veterinary Public Health administration, organisation and functions of veterinary public health agencies in India and abroad.

UNIT II

Advanced studies on principles, diagnostic methods of emerging public health problems, advances in zoonotic diseases.

UNIT III

Role of biotechnology in food hygiene, Hazard Analysis Critical Control Point System (HACCP).

Practical

Special problems related to field investigations of outbreaks of food poisoning and zoonotic diseases in a community.

Suggested Readings

Selected articles from journals.

VPH 702 EMERGING AND RE-EMERGING ZOOSES 2+1

Objective

To acquaint with emerging and re-emerging zoonotic diseases.

Theory

UNIT I

Concept of emerging and re-emerging zoonotic infections, international interests in zoonoses, measurement and economics of zoonoses, latest diagnostic and management planning for zoonoses.

UNIT II

Current challenges and strategies, euzoonoses, xenozoonoses, nosocomial zoonoses, newer zoonotic agents viz. cat-scratch disease, rat bite fever, Creutzfeld-Jacob disease, Ebola, Marburg, Lassa, Nipah, Menangle, Herpes B, SARS.

UNIT III

Simian and human immunodeficiency, bovine spongiform encephalopathy, hepatitis A & E, toro, H5N1 influenza virus; re-emerging zoonoses with

new pathology viz. neurocysticercosis, campylobacteriosis, rabies, Guillan-Barre Syndrome, tuberculosis.

Practical

Special problems related to emerging/re-emerging prevalent zoonotic diseases in India.

Suggested Readings

Selected articles from journals.

VPH 703 QUALITY CONTROL OF ANIMAL FOOD PRODUCTS 2+1

Objective

To provide expertise to student in food quality control.

Theory

UNIT I

Microorganisms influencing food quality and food safety, principles of microbiological quality control of foods.

UNIT II

Major food-borne pathogens and spoilage organisms; their significance in consumer safety.

UNIT III

Detection of microorganisms in foods of animal origin.

Practical

Special problems on microbiological quality of foods of animal origin; detection, enumeration and identification of important food-borne pathogens.

Suggested Readings

Selected articles from journals.

VPH 704 OCCUPATIONAL HEALTH HAZARDS 2+1

Objective

To acquaint with occupational health hazards

Theory

UNIT I

Health/diseases associated with various occupations

UNIT II

Transportation, spread, maintenance and control of diseases affecting various occupational groups in contact with animals and their public health significance

Practical

Diagnosis of various occupational diseases of public health significance, identification and characterization of causative agents

Suggested Readings

Selected articles from journals.

VPH 705 DISPOSAL AND RECYCLING OF WASTE 2+1

Objective

To educate about safe and economic disposal of waste.

Theory

UNIT I

Concept of 'reduce, reuse and recycle' in environmental management, role of holistic environmental biotechnology and microbial control of pollution.

UNIT II

Safe disposal of animal waste and food plant waste, utilization/recycling of livestock waste.

UNIT III

Pollutants due to sewage, sewage treatment systems, solid waste and its management.

Practical

To study the role of microorganisms and chemicals in degrading waste, to study the factors influencing biodegradation.

Suggested Readings

Selected articles from journals.

VPH 706 BIOHAZARDS, BIOSECURITY AND DISASTER 2+0
MANAGEMENT

Objective

To update knowledge on biological hazards and their prevention.

Theory

UNIT I

Biohazards and bioterrorism: case studies.

UNIT II

Innovative biosecurity approaches.

UNIT III

Regulations for safety in laboratories, hospitals, biological plants.

UNIT IV

Case studies of natural and man made disasters. Approaches for management of disasters. Formation of teams/ groups. Equipments required for managing such disasters.

Suggested Readings

Goel SL. 2007. *Disaster Administration and Management: Text and Case Studies*. Deep & Deep Publ., New Delhi.

Pinnkowski J. (Ed.). 2008. *Disaster Management Handbook*. CRC Press, Boca Raton.

VPH 707 FOOD PLANT SANITATION 2+1

Objective

To impart basic knowledge of sanitation in food plants.

Theory

UNIT I

Importance and maintenance of abattoir and meat plant sanitation.

UNIT II

Dairy plant sanitation.

UNIT III

Food plant waste disposal.

Practical

Evaluation of sanitation and disinfection procedures in food plants, evaluation of efficacy of disinfectants.

Suggested Readings

Selected articles from journals.

VPH 708 **ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL** **2+1**

Objective

To update knowledge on modern environmental pollution problem and control.

Theory

UNIT I

Advanced studies on problems pertaining to environmental hygiene, air, soil and water pollution, disinfection procedures, impact of global environmental problems on human/animal health; ecophilosophy, environmental ethics and environmental economics, environmental conflicts and cooperation.

UNIT II

Environmental risks and management, environmental risk assessment and reporting, modern global information, surveillance and monitoring systems, decision making and public awareness.

UNIT III

International environmental management efforts, participatory international organizations and their selected programmes and selected legislations.

Practical

Detection and estimation of air, soil and water pollution; detection of pathogens in environmental sources.

Suggested Readings

Selected articles from journals.

VPH 790 **SPECIAL PROBLEM** **0+2**

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PUBLIC HEALTH

List of Journals

- * Abstracts on Hygiene and Communicable Diseases
- * Applied and Environmental Microbiology
- * Emerging Infectious Diseases
- * Food Science and Technology Abstracts
- * Journal of Food Protection
- * Journal of Food Science and Technology
- * Journal of Veterinary Public Health
- * Letters in Applied Microbiology

e-Resources

- * www.who.int/zoonoses/vph/en (W.H.O. website related to Zoonotic diseases)
- * www.fao.org (Website of Food and Agriculture Organization)
- * www.cdc.gov (website of CDC publications)

Suggested Broad Topics for Master's and Doctoral Research

- * Prevention and control of emerging and re-emerging food-borne infections and intoxications
- * Prevention and control of major zoonotic diseases of local importance
- * Environmental pollution and health problems
- * Food safety, risk analysis
- * Shelf life
- * Food adulteration and food safety

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
 Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
 Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
 James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
 Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
 Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
 Richard WS. 1969. *Technical Writing*. Barnes & Noble.
 Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
 Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
 Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503
(e-Course)

**INTELLECTUAL PROPERTY AND ITS
MANAGEMENT**

1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of animal varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
 Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer. Vol. V. Technology Generation and IPR Issues.* Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics.* CABI.

Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies.* Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 506
(e-Course)

DISASTER MANAGEMENT

1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management.* Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management.* Routledge.

Sharma VK. 2001. *Disaster Management.* National Centre for Disaster Management, India.

BSMA Committee on Veterinary Paraclinical Sciences

(Vety. Micro, Pathology, Pharma. & Toxicology, Parasitology, Immunology, Virology)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR
dated January 14, 2008)

Name	Address	Specialization
Dr. S. K. Jand Dean, PGS <i>Convener</i>	GADVASU, Ludhiana	Microbiology
Dr. G. Krishnan Nair Prof. & Head	Dept. of Vety. Microbiology, College of Vety. & Animal Sciences, Mannuthy, Trichur	Microbiology
Dr. D. Kumar Prof. & Head	Dept. of Vety. Parasitology, RGCovas, Pondicherry	Parasitology
Dr. R. Somvanshi Principal Sci. & Head	Division of Pathology, IVRI, Izatnagar	Pathology
Dr. M. L. Satyanarayana Prof. & Head	Dept. of Vety. Pathology, Vety. College, Hebbal, Bangalore	Pathology
Dr. A. K. Srivastava Dean	SKUAST, Jammu	Pharmacology
Dr. Satish Garg Prof. & Head	Dept. of Pharmacology, Mathura Vety. College, Mathura	Pharmacology
Dr. P. K. Kapur Professor	I/C, DFSAH, CCS HAU, Hisar	Public Health
Dr. S.K. Gupta Prof. & Head <i>Member Secretary</i>	Dept. of Parasitology, COVS, CCS HAU Hisar	Parasitology

**NEW AND RESTRUCTURED
POST-GRADUATE CURRICULA & SYLLABI**

Veterinary Clinical Subjects

Animal Reproduction, Gynecology & Obstetrics
Veterinary Clinical Medicine, Ethics & Jurisprudence
Veterinary Epidemiology & Preventive Medicine
Veterinary Surgery & Radiology



**Education Division
Indian Council of Agricultural Research
New Delhi**

January 2009

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PREAMBLE

Veterinary sciences have helped in reducing animal sufferings, minimizing risk of zoonotic diseases threatening human health and ensuring food security. There have been unprecedented advancements in all the branches of veterinary sciences. The futuristic requirements of the society such as integrated casualty management, public health, food security and safety, healthy eco-system, containing bio-terrorism, productivity, profitability and stability of livestock farming systems etc., have posed greater challenges for veterinary academics and scientific community. Veterinarians with higher qualifications are increasingly being involved in devising means and methods of developing diagnostics against prevalent and emerging pathogens, prevention and control of animal diseases and zoonoses, eco-health stewardship, monitoring and surveillance of diseases of livestock and poultry, combating bio-terrorism, genetic engineering to optimize production and develop disease resistant breeds of animals. Bio-medical research, being heavily dependent upon animal experimentation, demands deeper scientific knowledge of veterinary sciences. Temporal aspirations of knowledge seekers ought to be addressed through building knowledge and skill portfolio suiting the job market and thus enhancing the marketability of the veterinary post graduates

In this perspective, it is important that the veterinary profession responds to the futuristic societal needs to remain relevant and purposeful. Recent advances in veterinary medical sciences have led to wide spread use of animal disease surveillance and prediction system, 3-D holographic animal models, robotic tele-surgery, globe-wide virtual class rooms and demonstration centers, sensor diagnostic facilities etc. The dominant forces shaping the Veterinary-Business and Veterinary-education are global and virtual with a large number of specialists offering tele-veterinary services from off-shore locations like India. The ever changing and demanding public service sector has necessitated re-look into the veterinary higher education.

At undergraduate level, veterinary students acquire comprehensive knowledge and skills in basic, para-clinical and clinical subjects required for performing multi-tasking role of a veterinarian. However, at post graduate level, in-depth knowledge of theory, practical aspects and research methodology in each subject is of paramount importance. Detailed study of the course curricula and syllabi, being implemented by veterinary colleges in India, revealed that there was enormous heterogeneity in the course structure, nomenclature and contents. Informal discussions amongst veterinary academicians, over

the years, referred to the need to train good teachers and researchers with comprehensive subject knowledge rather than narrow sub-specialization of a discipline at Master's level. In view of the above, the task of formulating need based contemporary post graduate courses and syllabi for implementation of post graduate education uniformly at national level was initiated.

Three BSMA committees, constituted by ICAR for restructuring of masters and doctorate course curricula and syllabi, worked in unison to formulate common basic format. The BSMA committees consisted of ¹Basic Veterinary Sciences (Anatomy and Histology; Veterinary & Animal Husbandry Extension; Biochemistry and Physiology); ²Veterinary Para-clinical Sciences (Microbiology, Parasitology, Pathology, Pharmacology & Toxicology, Public Health) and ³Veterinary Clinical Sciences (Animal Reproduction, Gynaecology & Obstetrics; Clinical Medicine, Ethics & Jurisprudence; Epidemiology & Preventive Medicine and Surgery & Radiology).

The Master's program in basic veterinary subjects aims at providing cutting edge concepts as well as practical applications of these exciting fields. The new and restructured Post-Graduate curricula and syllabi in respect of basic, paraclinical and clinical veterinary sciences documents contain several innovative and practically applicable courses and extensively revamped course contents viz. inclusion of imaging techniques, ultra-structural studies and clinical applications in the curricula of veterinary anatomy; emphasis on cell membrane dynamics, receptor biology and proteomics in relation to various animal diseases, in veterinary biochemistry; focus on rumen microbiology and metabolism, immuno-physiology and physiology of stress in veterinary physiology; framing of courses on social psychology, group dynamics, gender and livestock development, planning and monitoring, organizational management and information and communication technology in the veterinary and animal husbandry extension.

Para-clinical veterinary subjects, which provide essential support by employing disease diagnostics technologies for prevention and control of animal diseases, directing efforts for Green Earth, maintenance of biodiversity etc., have been redesigned in the light of general recommendations of the BSMA committees on veterinary sciences. Courses have been re-designed in such a manner that an MVSc student in Microbiology studies all aspects of bacteriology, virology, mycology and immunology. The contents of 17 courses of microbiology and 14 courses of immunology have been reshaped and encapsulated into 9 mandatory courses of 600 series and 18 optional courses of 700 series have been carved

in veterinary microbiology. In veterinary parasitology, new courses on malacology, remote sensing and GIS have been introduced. In veterinary pathology, courses on veterolegal pathology and toxico-pathology have been introduced. A new course on ethno-pharmacology has been introduced in veterinary pharmacology while courses on fish, fish products and seafood hygiene; disaster management and bioterrorism; emerging and reemerging zoonoses; occupational health hazards; disposal and recycling of waste; biohazards and bio-security have been introduced in veterinary public health.

The new approach encompassed the latest knowledge for development of advanced diagnostics, clinical management, clinical epidemiology, bio-security, prevention and control of diseases of livestock and poultry including zoonoses like Bird Flu, Rabies, Tuberculosis, Brucellosis etc. New courses on 'Herd Health management', 'Ecology', 'Forensic Medicine', 'Emergency Medicine', 'Diagnostic Imaging Techniques,' 'Survey and Surveillance', 'Diseases of Zoo, Wild and Laboratory Animals' etc. have been framed and contents of other courses were heavily revised to include the latest developments. To encourage clinical practice in the veterinary clinics, courses of Clinical Practice each at MVSc and PhD level have been made mandatory. To focus on learning of research methodology, scientific thinking, planning and experimentation, a course for special problems has been introduced in all the subjects.

Teaching Veterinary Clinical Service Complex, along with clinical departments and diagnostic laboratories, provides yeoman's service to stake holders in the field of animal health. The up-gradation of the clinical services will go a long way in meeting the expectations and demands for advanced diagnosis, therapeutics and prophylaxis. The state of infra-structure, manpower (both technical and support staff) and contingencies attached to clinical service units in veterinary colleges in India, requires immediate attention of policy planners to support and supplement in terms of liberal financial grants.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stakeholders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

Simrat Sagar Singh, Convener, BSMAC (Veterinary Clinical Sciences)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in veterinary science disciplines have been prepared in the light of PG programs in vogue at different veterinary colleges in India and contemporary developments in veterinary sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each MVSc student should register for all the courses offered by the major department, e.g. an MVSc student in microbiology should study all basic courses of bacteriology, virology and immunology instead of opting for courses of 1 or 2 sub-disciplines only. However, flexibility has been retained at Ph.D. level.

II. Credit Requirements

- Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the veterinary students as given below.
- The total course work of 40 credit hours has been proposed at M.V.Sc. level instead of minimum requirement 35 credit hours (Table 2), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together-11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and course (s) with a minimum of 3 credit hours from supporting subject (s) should be taken. Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- It is proposed that clinical practice of 0+3 credit hours should be made compulsory in the two semesters for all MVSc students in departments of Clinical Medicine, Ethics & Jurisprudence, Surgery & Radiology, and Animal Reproduction, Gynaecology & Obstetrics.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.
- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary

Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for MVSc and 700 for Ph. D. programme.

III. Major additions and alterations in the existing PG courses

Animal Reproduction, Gynaecology and Obstetrics

- VOG 607 and VOG-608 [Clinical practice – I & II] courses made mandatory in all clinical subjects to encourage ‘On site work based learning’.
- VOG 606 and VOG 704 [Reproductive biotechnology and Advances in reproductive biotechnology] contents of ‘embryo biotechnology course’ improved to include other aspects like stem cell biotechnology, immuno-modulation and immuno-neutralization

Veterinary Clinical Medicine, Ethics and Jurisprudence

- To facilitate comprehensive understanding and learning, all the courses of 600 series are designed so that diseases of group of animals (e.g. equines, canines etc.) are discussed together rather than the diseases of body systems.
- VCM 607 [Clinical diseases of animal species of regional importance e.g. Camel in Haryana, Yak in eastern & elephant in south India] has been introduced.
- VCM 610 [Veterinary forensic medicine]; VCM 611 [Clinical diagnostic techniques] and VCM 612 [Veterinary emergency medicine] are designed to meet current day demands.
- Newly framed courses (VCM 701 to 708) deal with advances in gastroenterology, cardiopulmonary medicine, neurological and urological disorders; endocrine and dermatological disorders; production diseases; pediatrics and geriatrics; veterinary diagnostics and veterinary therapeutics

Veterinary Epidemiology and Preventive Medicine

- To facilitate comprehensive understanding and learning the courses of preventive Medicine of 600 and 700 series are newly designed so that diseases of group of animals (e.g. ruminants, equines, canines etc.) are discussed together rather than the diseases of body systems.
- Two courses of epidemiology viz. VEP 604 [Veterinary clinical epidemiology] and VEP 605, [Bio-security practices in disease prevention] are new courses.
- Advanced courses (of 700 series) of preventive Medicine are new and courses enlist diseases of a group of animals.
- Advanced courses of epidemiology viz. VEP 701 [Recent concepts in epidemiology and disease forecasting]; VEP 702 [Herd health management]; VEP 703 [Data collection, management and presentation]; VEP 704 [Survey and surveillance]; VEP 705 [Emerging and re-emerging animal diseases] and VEP 706 [Ecology of diseases] are all newly designed courses keeping in mind the latest developments.

Veterinary Surgery and Radiology

- VSR 606 [Diagnostic imaging techniques] and VSR 707 [Advances in diagnostic imaging techniques] are redesigned courses from courses of radiology, ultrasound and alternate imaging. These also include latest techniques like MRI, CT Scan, nuclear medicine, positron emission tomography.
- VSR 701 [Veterinary dentistry]; VSR 705 [Anesthesia of wild and laboratory animals] and VSR 709 [Experimental surgical techniques in animals] are new courses.

ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	60	75
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given in Table 1.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Table 1. Suggested list of specified minor subjects (departments)

Major Subject	Minor Subjects*
Animal Reproduction Gynecology and Obstetrics	Veterinary Surgery & Radiology, Veterinary Physiology, Veterinary Biochemistry, Veterinary Clinical Medicine, Ethics & Jurisprudence, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Animal Nutrition
Veterinary Clinical Medicine, Ethics & Jurisprudence	Veterinary Surgery and Radiology, Veterinary Epidemiology and Preventive Medicine, Veterinary Pharmacology & Toxicology, Veterinary Physiology, Veterinary Biochemistry, Animal Reproduction Gynaecology and Obstetrics
Veterinary Epidemiology and Preventive Medicine	Veterinary Microbiology, Animal Biotechnology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Public Health, Veterinary Pathology
Veterinary Public Health	Veterinary Epidemiology and Preventive Medicine, Veterinary Microbiology, Veterinary Pathology, Animal Biotechnology, Veterinary Pharmacology & Toxicology, Veterinary Parasitology, Livestock Product Technology
Veterinary Surgery and Radiology	Veterinary Anatomy and Histology, Veterinary Clinical Medicine, Ethics & Jurisprudence, Veterinary Pharmacology & Toxicology, Veterinary Physiology, Veterinary Pathology, Animal Reproduction Gynaecology and Obstetrics

*The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean post graduate studies.

ANIMAL REPRODUCTION, GYNAECOLOGY & OBSTETRICS
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VOG 601	GENERAL GYNAECOLOGY	3+1
VOG 602	FEMALE INFERTILITY	3+1
VOG 603	VETERINARY OBSTETRICS	2+2
VOG 604	ANDROLOGY & MALE INFERTILITY	3+1
VOG 605	SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION	2+1
VOG 606	REPRODUCTIVE BIOTECHNOLOGY	2+1
VOG 607	CLINICAL PRACTICE I	0+3
VOG 608	CLINICAL PRACTICE II	0+3
VOG 691	MASTER'S SEMINAR	1+0
VOG 699	MASTER'S RESEARCH	20
VOG 701	ADVANCES IN GYNAECOLOGY	2+1
VOG 702	ADVANCES IN OBSTETRICS	2+1
VOG 703	ADVANCES IN ANDROLOGY	2+1
VOG 704	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	1+1
VOG 705	ADVANCES IN SEMEN PRESERVATION	1+1
VOG 706	CLINICAL PRACTICE I	0+3
VOG 707	CLINICAL PRACTICE II	0+3
VOG 790	SPECIAL PROBLEM	0+2
VOG 791	DOCTORAL SEMINAR I	1+0
VOG 792	DOCTORAL SEMINAR II	1+0
VOG 799	DOCTORAL RESEARCH	45

ANIMAL REPRODUCTION, GYNAECOLOGY & OBSTETRICS

Course Contents

VOG 601	GENERAL GYNAECOLOGY	3+1
Objective	To understand hormonal regulation of female reproduction and therapeutic management of infertility.	
Theory	<u>UNIT I</u> Puberty and sexual maturity, role of hypothalamic-pituitary-gonadal axis in attainment of puberty and sexual maturity, onset of postpartum ovarian activity, Endocrine regulation of estrous cycle.	
	<u>UNIT II</u> Folliculogenesis, oogenesis and ovulation and associated endocrine pattern, manipulation of follicular waves, synchronization of estrus and ovulation and induction of ovarian activity.	
	<u>UNIT III</u> Gamete transport, fertilization, implantation and maternal recognition of pregnancy.	
	<u>UNIT IV</u> Embryonic and fetal development, placentation, fetal circulation and gestation, position of fetus in the uterus, age characteristics of fetus.	
	<u>UNIT V</u> Pregnancy diagnosis: clinical, ultrasonographic, endocrinological and other diagnostic laboratory tests. Pseudo-pregnancy and its treatment.	
	<u>UNIT VI</u> Factors affecting reproduction – seasonality, nutrition, stress, environment, management, suckling and diseases.	
	<u>UNIT VII</u> Lactation and artificial induction of lactation.	
Practical	Clinical examination of female genitalia. Biometry of female genital organs. Rectal and vaginal examination to diagnose cyclic phases of estrous cycle. Fern pattern of cervical mucus and exfoliated vaginal cytology. Pregnancy diagnosis in large and small animals by various methods. Estimation of age of the fetus. Use of ultrasound / RIA / ELISA in gynaecology. Synchronization of estrus and ovulation in farm animals.	
Suggested Readings	Cupps PT. 1991. <i>Reproduction in Domestic Animals</i> . Academic Press. Hafez ESE. 2000. <i>Reproduction in Farm Animals</i> . Lippincott, Williams & Wilkins. Pubedam MH & Pubedam MH. 2003. <i>McDonald's Veterinary Endocrinology and Reproduction</i> . Iowa State Press. Noakes DE, Parkinson DJ & England GCW. 2001. <i>Arthurs Veterinary Reproduction and Obstetrics</i> . Saunders Harcourt India. Roberts SJ. 1976. <i>Veterinary Obstetrics and Genital Diseases</i> . Scientific Book Agency.	

VOG 602

FEMALE INFERTILITY

3+1

Objective

To impart knowledge and training in diagnosis and treatment of infertility in female domestic animals.

Theory

UNIT I

Introduction to infertility, classification, economic impact. Anatomical causes of infertility, congenital and hereditary causes and acquired defects.

UNIT II

Nutritional causes of infertility. Importance of body condition score.

UNIT III

Managemental and environmental causes of infertility. Out of season breeding.

UNIT IV

Infectious causes of female infertility, specific and non-specific infections.

UNIT V

Ovarian dysfunction: anoestrus, cystic ovarian degeneration, anovulation, delayed ovulation and luteal insufficiency.

UNIT VI

Repeat breeding: its causes, diagnosis and treatment.

UNIT VII

Early embryonic death (EED): causes, diagnosis and therapeutic management.

UNIT VIII

Abortion: infectious and non-infectious causes, diagnosis and prevention of abortion.

UNIT IX

Interactions in Immunological mechanisms and infertility.

Practical

Record keeping, herd fertility assessment and management, diagnosis and treatment of infertility in female animals, use of uterine swabs for bacterial and fungal culture, histo-pathological evaluation of uterine biopsy, exfoliated vaginal cytology and hormone assay. Use of ultrasonography in diagnosis of infertility. Immuno diagnostic techniques.

Suggested Readings

- Laing JA. 1979. *Fertility and Infertility in Domestic Animals*. English Language Book Soc. & Bailliere Tindall.
- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Noakes DE, Parkinson DJ & England GCW. 2001. *Arthurs Veterinary Reproduction and Obstetrics*. Saunders Harcourt India.
- Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.

VOG 603

VETERINARY OBSTETRICS

2+2

Objective

To impart knowledge and training on problems of pregnancy and parturition and their management in domestic animals.

Theory

UNIT I

Parturition: stages of parturition, mechanism of initiation of parturition, hormonal profiles associated with parturition.

UNIT II

Principles of handling of dystocia, obstetrical procedures: mutations, fetotomy, caesarean section. Obstetrical anesthesia and analgesia, epidural anesthesia.

UNIT III

Fetal and maternal dystocia: causes, diagnosis and management.

UNIT IV

Uterine torsion: causes, diagnosis and its correction.

UNIT V

Diseases and accidents during gestation and around parturition.

UNIT VI

Etiology, diagnosis and treatment of ante-partum and post-partum uterine and vaginal prolapse.

UNIT VII

Induction of parturition and elective termination of pregnancy.

UNIT VIII

Involution of uterus following normal and abnormal parturition.

UNIT IX

Care of dam and the newborn.

Practical

Pelvimetry of different species of farm animals. Diagnosis and correction of abnormal fetal presentation, position and posture in phantom box. Epidural anesthesia, ovariohysterectomy and caesarean operation. Fetotomy exercises. Detorsion of uterus. Management of prolapse. Handling of clinical cases of dystocia.

Suggested Readings

- Arthur GH, Pearson H & Noakes DE. 2000. *Veterinary Reproduction and Obstetrics*. English Language Book Society & Bailliere Tindall.
- Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.
- Sloss V & Dufty JH. 1980. *Handbook of Bovine Obstetrics*. Williams & Wilkins.

VOG 604

ANDROLOGY AND MALE INFERTILITY

3+1

Objective

To impart knowledge and training about male reproduction and treatment of male infertility in domestic animals.

Theory

UNIT I

Structure and function of reproductive tract of male.

UNIT II

Sexual behavior and examination of bulls for breeding soundness.

UNIT III

Spermatogenesis, (formation, migration, maturation and ejaculation of semen), fine structure of spermatozoa, semen and its composition.

UNIT IV

Diseases transmitted through semen.

UNIT V

Factors affecting semen quality, semen culture, tests for assessment of sperm motility, sperm survival and fertilizing capacity of spermatozoa.

UNIT VI

Causes of infertility: hereditary, congenital, infectious, nutritional and hormonal. Pathological and functional disturbances of epididymis, vas deferens and accessory sex glands.

UNIT VII

Impotentia cocundi and impotentia generandi. Testicular hypoplasia and degeneration: causes and affect on semen and fertility.

UNIT VIII

Coital injuries and vices of male animals.

Practical

General and rectal examination for biometrics of male genitalia and accessory sex glands. Breeding soundness evaluation of male animals. Semen evaluation for sperm abnormalities, fertility and determination of other biochemical constituents of seminal plasma. Computer assisted semen analysis (CASA), Microbiological load of semen. Examination, diagnosis and treatment of infertile male animals.

Suggested Readings

- Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.
- Mann T & Lutwak-Mann C. 1981. *Male Reproductive Function and Semen*. Springer-Verlag.
- Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency
- Salisbury GW, VanDemark NL & Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman & Co.

VOG 605

SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION

2+1

Objective

To impart knowledge and training about collection, evaluation and preservation of semen and artificial insemination (AI) in domestic animals.

Theory

UNIT I

History of artificial insemination.

UNIT II

Methods of semen collection.

UNIT III

Semen evaluation: macroscopic, microscopic, biochemical and microbiological tests, Computer assisted semen analysis (CASA).

UNIT IV

Semen preservation. Extenders for preservation of semen at different temperatures. Semen additives for enhancement of motility and fertilizing capacity of spermatozoa.

UNIT V

Cryopreservation of semen. Effects of cryopreservation on spermatozoa, semen quality and fertility.

UNIT VI

Thawing protocols of frozen semen. Factors affecting post-thaw semen quality.

UNIT VII

Ideal protocol for AI in different species of animals. Factors affecting success of AI.

Practical

Computer assisted semen analysis (CASA), Collection and evaluation of semen. Preparation of extenders. Preservation of semen: room temperature, refrigeration and cryopreservation. Handling and evaluation of processed semen. Practice of AI techniques.

Suggested Readings

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.

Perry J. 1970. *Artificial Insemination of Farm Animals*. Oxford & IBH.

Salisbury GW, VanDemark NL & Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman.

VOG 606

REPRODUCTIVE BIOTECHNOLOGY

2+1

Objective

To impart knowledge and training on biotechniques in animal reproduction.

Theory

UNIT I

Embryo transfer technology: selection of donors and recipients.

UNIT II

Synchronization, super-ovulation, surgical and non-surgical collection of embryos and evaluation of embryos.

UNIT III

Cryopreservation of embryos, transfer of embryos to donors.

UNIT IV

In vitro fertilization, *in vitro* maturation, micromanipulation of embryos.

UNIT V

Sexing of sperm and embryos.

UNIT VI

Transgenic animals. Chimeras.

UNIT VII

Stem cell biotechnology

UNIT VIII

Immuno-neutralization of hormones. Immunomodulation of fertility.

Practical

Synchronization of estrus in donors and recipients, superovulation, surgical and non-surgical collection and transfer of embryos. Collection of oocytes from slaughter house genitalia. *In vitro* fertilization, *in vitro* maturation and cryopreservation of embryos. Sexing of embryos.

Suggested Readings

Gordon I. 2004. *Reproductive Technologies in Farm Animals*. CABI.

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.

- VOG 607** **CLINICAL PRACTICE - I** **0+3**
- Objective**
Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCSC.
- Practical**
Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Maintenance of case records. Presentation on selected /assigned cases.
- Suggested Readings**
Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- VOG 608** **CLINICAL PRACTICE – II** **0+3**
- Objective**
Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCSC.
- Practical**
Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Maintenance of case records. Presentation on selected /assigned cases.
- Suggested Readings**
Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.
- VOG 701** **ADVANCES IN GYNAECOLOGY** **2+1**
- Objective**
To learn about advances in endocrine, ovarian and uterine functions and effect of nutrition, season and immunological factors on female fertility.
- Theory**
- UNIT I
Neuro-endocrine control of reproduction, follicular development, ovulation fertilization and implantation. Embryonic and fetal development.
- UNIT II
Maternal recognition of pregnancy, Advances in early diagnosis of pregnancy.
- UNIT III
Embryonic losses, abortion and their prevention.
- UNIT IV
Seasonal breeders, synchronization and induction of estrus and ovulation in seasonal breeders, Assisted reproductive technology (ART) to increase reproductive efficiency in farm animals..
- UNIT V
Effect of stress, nutrition and immunological factors on fertility.
- UNIT VI
Onset of postpartum ovarian activity and factors affecting it.
- UNIT VI
Diagnostic & therapeutic approaches in infertility: Principles of hormone therapy in reproductive disorders, Laproscopy, ultrasonographic diagnosis of ovarian/uterine dysfunction, RIA/ELISA techniques for hormones assay in reproductive disorders, vaginal and uterine cytology

Practical

Clinical examination of female animals. Use of ultrasonography in ovarian function (follicular image pattern, follicular dynamics) and in early pregnancy diagnosis and infertility. Utility of uterine culture, uterine cytology and uterine biopsy (histopathological examination) in infertility investigation. Laparoscopy in diagnosis of ovarian and uterine dysfunction. ELISA/RIA of hormones and interpretation of results. Use of Assisted reproductive technology (ART) to enhance reproductive efficiency in farm animals.

Suggested Readings

Selected articles from journals.

VOG 702

ADVANCES IN OBSTETRICS

2+1

Objective

To learn current developments in diagnosis and management of dystocia, accidents of gestation and peri-parturient disorders in domestic animals.

TheoryUNIT I

Conceptus and its development. Factors influencing gestation period and birth weight.

UNIT II

Anomalies of conceptus, teratogens and effect of stress on conceptus development.

UNIT III

Mechanism of initiation of parturition. Use of tocolytic drugs in management of uterine inertia.

UNIT IV

Induction of parturition and termination of abnormal pregnancies. Obstetrical analgesia and anaesthesia.

UNIT V

Pre-treatment evaluation of the dam suffering from dystocia. Management of maternal and fetal dystocia, hydrallantois, hydramnion, fetal mummification, fetal maceration, uterine inertia and uterine torsion.

UNIT VI

Fetotomy, caesarean section and ovario-hysterectomy.

UNIT VII

Neo-natal physiology and post-natal adaptations.

UNIT VIII

Involution of uterus, post-partum ovarian dysfunction and their manipulation.

Practical

Obstetrical operations in fetal dystocia: Mutations, fetotomy, caesarean section, ovario-hysterectomy; induction of parturition, use of tocolytic drugs in dystocia, obstetrical analgesia and anaesthesia.

Suggested Readings

Selected articles from journals.

VOG 703

ADVANCES IN ANDROLOGY

2+1

Objective

To learn advances in male reproduction and treatment of male infertility in domestic animals

Theory

UNIT I

Spermatogenesis, spermatogenic waves, sperm passage in male genitalia, biochemical milieu of male genitalia. Correlation between motility and fertilizing capacity of spermatozoa.

UNIT II

Separation of motile and immotile spermatozoa. Sexing and separation of male and female determining spermatozoa.

UNIT III

Sperm plasma membrane and its permeability and binding properties: acrosome and lysosomal enzymes, sperm nucleus and nuclear proteins. Mitochondria and their role in sperm metabolism. Flagellum and the mechanochemical basis of motility and cyclic nucleotides.

UNIT IV

Biochemistry of seminal plasma and accessory sex gland secretions. Electrolytes, proteins, enzymes and amino acids in seminal plasma. Fructose and other sugars, lipids, cholesterol, steroid hormones and prostaglandins in seminal plasma.

UNIT V

Fructolysis index. Aerobic and anaerobic metabolism of spermatozoa.

UNIT VI

Biochemical markers of fertility in males, sperm chromatin structure assay, Anti-sperm antibodies.

Practical

Breeding soundness evaluation of bulls, biochemical tests of semen for evaluation of fertility, semen culture for diagnosis of venereal diseases, diagnosis and treatment of genital pathological condition. Computer assisted semen analysis (CASA), Semen evaluation for assessment of fertilizing capacity of spermatozoa: cervical mucus penetration test, sperm capacitation test, hypo osmotic swelling test and zona free hamster egg penetration test. Anti-sperm antibody assay.

Suggested Readings

Selected articles from journals.

VOG 704

ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY 1+1

Objective

To learn advances in recent developments in biotechnology in reproduction for the production of desired elite animals.

Theory

UNIT I

Embryo transfer technology and its application in farm animals.

UNIT II

Selection and management of donor and recipient animals. Superovulation, surgical and non-surgical collection, evaluation of embryos and transfer of embryos.

UNIT III

In vitro fertilization and maturation of oocytes.

UNIT IV

Micromanipulation, sexing and cryopreservation of embryos.

UNIT V

Sexing of sperm and embryos.

UNIT VI

Transgenic animals. Chimeras.

UNIT VII

Stem cell biotechnology

UNIT VIII

Immuno-neutralization of hormones. Immunomodulation of fertility.

Practical

Evaluation of superovulatory hormonal regimens in donors and synchronization of estrus in recipients. Surgical and non-surgical collection and transfer of embryos. Collection of oocytes from slaughter house genitalia. *In vitro* fertilization, *in vitro* maturation and cryopreservation of embryos. Sexing of embryos.

Suggested Readings

Selected articles from journals.

VOG 705

ADVANCES IN SEMEN PRESERVATION

1+1

Objective

To learn advances in processing and cryopreservation of semen and insemination techniques to obtain high fertility.

Theory

UNIT I

Transmission of venereal diseases through semen and their prevention.

UNIT II

Factors affecting motility and fertilizing capacity of spermatozoa. Semen collection, extension and cryopreservation of semen, damages to spermatozoa caused by cryopreservation.

UNIT III

Use of semen additives for promotion of sperm motility and fertilizing capacity.

UNIT IV

Thawing protocols for frozen semen. Post-thaw evaluation of motility and fertilizing capacity of spermatozoa.

Practical

Collection of preputial washings and semen for bacterial load and venereal pathogens. Preparation of semen extenders with different additives. Use of different freezing protocols for preservation of semen. Evaluation of fertility with frozen semen. Enzymatic changes in semen following cryopreservation.

Suggested Readings

Selected articles from journals.

- VOG 706 CLINICAL PRACTICE - I 0+3**
- Objective**
Hands-on training on diagnosis and treatment of reproductive disorders in animals.
- Practical**
Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy, maintenance of case records, presentation on selected/ assigned cases
- Suggested Readings**
Selected articles from journals.
- VOG 707 CLINICAL PRACTICE - II 0+3**
- Objective**
Hands-on training on diagnosis and treatment of reproductive disorders in animals
- Practical**
Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy.
- Suggested Readings**
Selected articles from journals.
- VOG 790 SPECIAL PROBLEM 0+2**
- Objective**
To expose students to research techniques related to sub discipline of the subject and submission of written project with references.
- Practical**
Student will carry out research on allotted project and submit the project along with research papers for publication in scientific journals.

ANIMAL REPRODUCTION, GYNAECOLOGY & OBSTETRICS

List of Journals

- * American Journal of Obstetrics and Gynaecology
- * Animal Reproduction
- * Animal Reproduction Science
- * Animal Science Journal
- * Bibliography of Reproduction
- * Biology of Reproduction
- * Equine practice
- * Equine Veterinary Journal
- * Fertility and Sterility
- * Indian Journal of Animal Reproduction
- * Indian Journal of Animal Sciences
- * Indian Journal of Experimental Biology
- * Indian Veterinary Journal
- * Journal of American Veterinary Medical Association
- * Journal of Animal Science
- * Journal of Dairy Science
- * Journal of Endocrinology
- * Journal of Reproduction and Development
- * Journal of Reproduction and fertility
- * Reproduction in Domestic Animals
- * Research in Veterinary Science
- * Theriogenology
- * Veterinary Record

e-Resources

- * www.anirgyep.elsevier.com (Animal Reproduction Science)
- * www.blackwellpublilshing.com (International Journal of Andrology)
- * www.bioreprod.org (Biology of reproduction)
- * www.domesticanimalendo.com (Domestic Animal Andocrinology)
- * www.reproduction-online.org (Journal of Andrology)
- * www.reproduction-online.org (Reproduction)
- * www.interscience.wiley.com (Reproduction in domestic animals)
- * www.theriojournal.com (Theriogenology)
- * www.buffaloresearch.com (Buffalo Journal)
- * www.eje-online.org (European journal of Endocrinology)
- * www.sciencedirect.com (The Veterinary Journal)
- * www.blackwellpublishing.com (Asian journal of Andrology)
- * editorijar@yahoo.co.in (Indian Journal of Animal Reproduction)

Suggested Broad Topics for Master's and Doctoral Research

- * Anoestrus: Endocrinological investigations
- * Reproductive biotechnology
- * Investigations into andrological problems
- * Management of obstetrical problems

VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VCM 601	RUMINANT CLINICAL MEDICINE -I	2+0
VCM 602	RUMINANT CLINICAL MEDICINE -II	2+0
VCM 603	EQUINE CLINICAL MEDICINE	2+0
VCM 604	CANINE AND FELINE CLINICAL MEDICINE	2+0
VCM 605	SWINE CLINICAL MEDICINE	1+0
VCM 606	AVIAN MEDICINE	1+0
VCM 607	ZOO, WILD & LABORATORY ANIMAL MEDICINE	2+0
VCM 608	CLINICAL DISEASES OF ANIMAL SPECIES*OF REGIONAL IMPORTANCE	1+0
VCM 609	PRODUCTION DISEASES	2+0
VCM 610	DISEASES OF ANIMALS CAUSED BY TOXICANTS	1+0
VCM 611	VETERINARY FORENSIC MEDICINE	1+1
VCM 612	CLINICAL DIAGNOSTIC TECHNIQUES	0+2
VCM 613	VETERINARY EMERGENCY MEDICINE	0+2
VCM 614	CLINICAL PRACTICE I	0+3
VCM 615	CLINICAL PRACTICE II	0+3
VCM 691	MASTER'S SEMINAR	1+0
VCM 699	MASTER'S RESEARCH	20
VCM 701	ADVANCES IN GASTROENTROLOGY	2+0
VCM 702	ADVANCES IN CARDIOPULMONARY MEDICINE	2+0
VCM 703	ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS	2+0
VCM 704	ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS	2+0
VCM 705	ADVANCES IN PRODUCTION DISEASES	2+0
VCM 706	ADVANCES IN PAEDIATRICS AND GERIATRICS	1+0
VCM 707	ADVANCES IN VETERINARY DIAGNOSTICS	1+2
VCM 708	ADVANCES IN VETERINARY THERAPEUTICS	1+2
VCM 709	ADVANCED CLINICAL PRACTICE I	0+2
VCM 710	ADVANCED CLINICAL PRACTICE II	0+2
VCM 711	ADVANCED CLINICAL PRACTICE III	0+2
VCM 790	SPECIAL PROBLEM	0+2
VCM 791	DOCTORAL SEMINAR I	1+0
VCM 792	DOCTORAL SEMINAR II	1+0
VCM 799	DOCTORAL RESEARCH	45

*Domestic animals of regional importance e.g. Camel in Haryana, Yak in Eastern India, Elephant in South India

VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

Course Contents

VCM 601 RUMINANT CLINICAL MEDICINE - I 2+0

Objective

Study of diseases of various body systems of bovine, sheep and goats.

Theory

UNIT I

General systemic states.

UNIT II

Diseases of alimentary system, liver and urinary system.

UNIT III

Diseases of respiratory and nervous system.

Suggested Readings

Chakrabarti A. 1998. *Text Book of Clinical Veterinary Medicine*. Kalyani.
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders.

VCM 602 RUMINANT CLINICAL MEDICINE - II 2+0

Objective

Study of diseases of various body systems of bovine, sheep and goats.

Theory

UNIT I

Diseases of cardiovascular system, blood and blood forming organs.

UNIT II

Diseases of musculoskeletal system and skin

UNIT III

Diseases of eyes, ears, nose

Suggested Readings

Chakrabarti A. 1998. *Text Book of Clinical Veterinary Medicine*. Kalyani.
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders.

VCM 603 EQUINE CLINICAL MEDICINE 2+0

Objective

Study of diseases of various body systems of horses, donkeys and mules.

Theory

UNIT I

General systemic states and diseases of alimentary system and liver.

UNIT II

Diseases of respiratory, cardiovascular system, blood and blood forming organs

UNIT III

Diseases of urinary and nervous systems

UNIT IV

Diseases of musculoskeletal system and skin.

Suggested Books

Wintzer H. 1986. *Equine diseases*. Verlaug Paul Parey.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders.

VCM 604 **CANINE AND FELINE CLINICAL MEDICINE** **2+0**

Objective

Study of diseases of various body systems of dogs and cats.

Theory

UNIT I

Specific needs of canine and felines, Pet psychology; pet behavior and adaptation needs; General systemic states. and

UNIT II

Diseases of digestive system, liver and pancreas, cardiovascular system, blood and blood-forming organs,.

UNIT III

Diseases of respiratory system, urogenital and nervous systems.

UNIT IV

Diseases of musculoskeletal system and skin.

UNIT V

Diseases of endocrine system, diseases of new borne animals.

Suggested Books

Dunn JK. 1999. *Text Book of Small Animal Medicine*. WB Saunders.

Ettinger SJ & Feldman EC. 2000. *Text Book of Veterinary Internal Medicine*. Vols. I, II. Saunders.

Gorman NT. 1998. *Canine Medicine and Therapeutics*. Blackwell.

VCM 605 **SWINE CLINICAL MEDICINE** **1+0**

Objective

Study of diseases of various body systems in swine.

Theory

UNIT I

General systemic states and diseases of digestive system

UNIT II

Diseases of cardiovascular and respiratory system.

UNIT III

Diseases of urogenital and nervous system and skin.

UNIT IV

Diseases of endocrine system and of newborn animals.

Suggested Readings

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders.

Straw BF. (Eds.). 1999. *Diseases of Swine*. 8th Ed. Iowa State Univ. Press.

VCM 606 **AVIAN MEDICINE** **1+0**

Objective

Study of non-infectious diseases of avian species.

Theory

UNIT I

Diseases due to deficiency of vitamins (vitamins A, B complex, C, D, K); minerals (calcium, phosphorus, manganese, zinc) and sodium chloride.

UNIT II

Miscellaneous diseases/conditions/ vices (cage layer fatigue, blue comb disease, beak necrosis, round heart disease, kerato- conjunctivitis, ascites, urolithiasis, fatty liver, kidney hemorrhagic syndrome, heat stroke, cannibalism, vent picking).

Suggested Readings

Gordon RF & Jordan ETW. 1982. *Poultry Diseases*. ELBS.
Leeson S, Diaz G & Summers JD. 2001. *Poultry Metabolic Disorders and Mycotoxins*. IBDC Publ.

VCM 607 ZOO, WILD AND LABORATORY ANIMAL MEDICINE 2+0

Objective

Study of diseases and health management of zoo, wild and laboratory animals

Theory

UNIT I

Etiology, symptoms, diagnosis and management of various diseases of zoo, wild and laboratory animals.

Diseases of urinary system.

UNIT II

Diseases, restraint, feeding and health management of exotic animals kept as pets

Suggested Readings

Baker HJ. 1978. *Pathology of Laboratory Animals*. Springer, New York.
Fowler ME. 1986. *Zoo and Wild Animal Medicine*. 2nd Ed. W. B. Saunders.
Fox JG, Anderson LC, Loew FM & Quimby FW. (Eds.). 2004. *Laboratory Animal Medicine*. 2nd Ed.
Hafez ESE. (Ed.). *Reproduction and Breeding Techniques for Laboratory Animals*. Lea & Fabiger.
Hrapkiewicz K. 2007. *Clinical Laboratory Animal Medicine- An Introduction*. 3rd Ed. Blackwell Publ.
Joshi BP. 1991. *Wild Animal Medicine*. Kalyani.
Sirois M. 2005. *Laboratory Animal Medicine: Principles and Procedures*. 2nd Ed. Elsevier.

VCM 608 CLINICAL DISEASES OF ANIMAL SPECIES 1+0 OF REGIONAL IMPORTANCE

Objective

Study of non-infectious diseases of important regional animal species.

Theory

The animal species, to be studied/ taught is to be decided by the individual institution. For Veterinary College at CCS HAU Hisar, camel diseases will be covered.

UNIT I

Non-infectious/miscellaneous diseases of camels (satyriasis, kumri, allotriophagia, diseases of various body systems, nutritional deficiency disorders).

UNIT II

Diagnostic tests related to various non-infectious diseases of camels.

Suggested Readings

Gahlot TK. 2000. *Selected Topics on Camelids*. The Camelid Publishing House, Bikaner.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders.

VCM 609 PRODUCTION DISEASES 2+0**Objective**

Study of metabolic, production and deficiency diseases of domestic animals.

TheoryUNIT I

General aspects, production diseases (parturient paresis, downer cow syndrome, ketosis, post-parturient haemoglobinuria, hypomagnesemic tetany, pregnancy toxaemia).

UNIT II

Lactation tetany of mares, eclampsia of bitches, osteodystrophia fibrosa, azoturia of equines, rheumatism-like syndrome in buffaloes, hypothyroidism, diabetes mellitus and diabetes insipidus in dogs.

UNIT III

Deficiency diseases (calcium, phosphorus, vitamin-D₃, vit-A, vit B-complex, vit-C and vit-K).

UNIT IV

Deficiency diseases (iron, copper, cobalt, zinc, manganese, iodine, vitamin E and selenium).

Suggested Readings

Dunn JK. 1999. *Text Book of Small Animal Medicine*. WB Saunders.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders

VCM 610 DISEASES OF ANIMALS CAUSED BY TOXICANTS 1+0**Objective**

Study of diseases caused by various toxicants in domestic animals.

TheoryUNIT I

Diseases caused by physical agents and poisoning of organic and inorganic compounds.

UNIT II

Diseases caused by farm chemicals and phytotoxins

UNIT III

Diseases caused by mycotoxins and zootoxins

UNIT IV

Diseases caused by poisonous plants, snake and insect bites.

Suggested Readings

Kahn CM. (Ed.). 2005. *The Merck Veterinary Manual*. Merck & Co.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2000. *Veterinary Medicine*. WB Saunders.

VCM 611	VETERINARY FORENSIC MEDICINE	1+1
Objective		
To familiarize students with various aspects of veterinary forensic medicine.		
Theory		
<u>UNIT I</u>		
Veterolegal aspects of ante mortem and post mortem examination.		
<u>UNIT II</u>		
Examination of wounds, blood, offenses, frauds in animals and their products, animal cruelty and welfare. DNA analysis of clinical samples		
<u>UNIT III</u>		
Study of common laws related to veterolegal aspects.		
Practical		
Ante mortem and post mortem examination, examination of wounds, blood, offenses, frauds in animals and their products, collection, dispatch and examination of veterolegal samples.		
Suggested Readings		
Sharma SN, Gahlot AK & Tanwer RK. 2003. <i>Veterinary Jurisprudence</i> . 5 th Ed. Camel Publ. House.		
VCM 612	CLINICAL DIAGNOSTIC TECHNIQUES	0+2
Objective		
Study the diagnostic protocols and procedures for various diseases of farm and companion animals.		
Practical		
<u>UNIT I</u>		
Clinical tests and their interpretation related to diseases of alimentary tract, liver, cardio vascular system, blood and blood-forming organs of various species of animals.		
<u>UNIT II</u>		
Clinical tests and their interpretation related to respiratory, urinary, nervous, endocrine, musculoskeletal and integumentary systems of various species of animals.		
Suggested Readings		
Kaneko JJ. 2008. <i>Clinical Biochemistry of Domestic Animals</i> . 6 th Ed. Elsevier.		
Kelly WR. 1984. <i>Veterinary Clinical Diagnosis</i> . 3 rd Ed. Eastbourne Balliere-Tindall.		
VCM 613	VETERINARY EMERGENCY MEDICINE	0+2
Objective		
Diagnosis and therapeutic management of various medical emergencies in farm and companion animals.		
Practical		
<u>UNIT I</u>		
Diagnosis and therapeutic management of various emergencies of cardiovascular, respiratory, gastrointestinal, urinary and nervous systems,		
<u>UNIT II</u>		
Diagnosis and therapeutic management of various emergencies of toxicities, sting bites and burns of farm and companion animals.		

UNIT III

Monitoring critical ill patient, application of emergency care procedures for resuscitation of critically ill patient

Suggested Reading

Kirk RW.1995. *Handbook of Veterinary Procedures and Emergency Treatment*. 6th Ed. WB Saunders.

Sattler FP & Knowles W. 2001. *Veterinary Critical Care*. Lea & Febiger.

VCM 614 CLINICAL PRACTICE - I 0+3

Objective

Application of the theoretical concepts in practice

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.

Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

VCM 615 CLINICAL PRACTICE - II 0+3

Objective

Application of the theoretical concepts in practice

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.

Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

VCM 701 ADVANCES IN GASTROENTEROLOGY 2+1

Objective

Study of contemporary advancements in gastro-enterology

Theory

UNIT I

Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of farm animals.

UNIT II

Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of companion animals.

Practical

Advanced clinical procedures for the diagnosis of diseases of gastrointestinal system and associated organs of farm and companion animals

Suggested Readings

Selected articles from journals.

VCM 702 ADVANCES IN CARDIOPULMONARY MEDICINE 2+0

Objective

Study of recent advances in the field of cardiopulmonary medicine

Theory

UNIT I

Advances in diagnosis and therapeutic management of diseases of circulatory system

UNIT II

Advances in diagnosis and therapeutic management of diseases of respiratory system

UNIT III

Advances in diagnosis and therapeutic management of diseases of blood and blood forming organs in animals

Suggested Readings

Selected articles from journals.

VCM 703 ADVANCES IN NEUROLOGICAL AND 2+0
UROLOGICAL DISORDERS

Objective

Study of recent advances in the field of neurological and urological disorders.

Theory

UNIT I

Advances in diagnosis, therapy and control of diseases of nervous system

UNIT II

Advances in diagnosis, therapy and control of diseases of urogenital system

UNIT III

Advances in diagnosis, therapy and control of diseases of locomotor system

Suggested Readings

Selected articles from journals.

VCM 704 ADVANCES IN ENDOCRINE AND 2+0
DERMATOLOGICAL DISORDERS

Objective

Study of recent advances in endocrine and dermatological disorders.

Theory

UNIT I

Advances in diagnosis, therapy and control of diseases of skin and integumentary system

UNIT II

Advances in diagnosis, therapy and control of diseases of endocrine system.

Suggested Readings

Selected articles from journals.

VCM 705 ADVANCES IN PRODUCTION DISEASES 2+0

Objective

Study of recent advances in production diseases.

Theory

UNIT I

Latest advances in diagnosis, therapy and prophylaxis of metabolic diseases of farm and companion animals.

UNIT II

Latest advances in diagnosis, therapy and prophylaxis of nutritional diseases of farm and companion animals.

UNIT III

Latest advances in diagnosis and treatment of various poisonings and toxicities

Suggested Readings

Selected articles from journals.

VCM 706 ADVANCES IN PAEDIATRICS AND GERIATRICS 1+0

Objective

Study of recent advances in paediatrics and geriatrics

Theory

UNIT I

Recent advances in diagnosis, therapy and control of diseases and management of emergencies of neonates

UNIT II

Recent advances in diagnosis, therapy and control of diseases and management of emergencies of geriatric animals

Suggested Readings

Selected articles from journals.

VCM 707 ADVANCES IN VETERINARY DIAGNOSTICS 1+2

Objective

Study of recent advances in diagnostics

Theory

UNIT I

Blood and serum biochemical and hematological analyses.

UNIT II

Imaging techniques for the diagnosis of animal diseases (x-ray, contrast radiography, CT, MRI, Scintigraphy, Echocardiogram etc).

UNIT III

Electrocardiography, ophthalmoscopy, ultrasonography, EEG, CVP, GFR assessment, pulse-oxymetry etc.

Practical

Assignments on advanced diagnostic techniques for various diseases of domestic animals. Use of above mentioned advanced diagnostic techniques where ever possible. Collection of CSF, Gastric / rumen /intestinal fluid, absorption and digestion tests, water withheld, low and high dose dexamithasone test, ACTH stimulation, Hormone prolile, enzyme profile.

Suggested Readings

Selected articles from journals.

VCM 708 ADVANCES IN VETERINARY THERAPEUTICS 1+2

Objective

Study of recent advances in Veterinary Therapeutics.

Theory

UNIT I

Fluid and electrolyte imbalance and therapy.

UNIT II

Antimicrobial, antineoplastic and hormonal therapy.

UNIT III

Blood transfusion and Emergency critical care, Peritoneal dialysis / hemodialysis, Gastric lavage, fluid therapy, parenteral total nutrition, nebulization, oxygen therapy, paracentesis, thoracocentesis.

Practical

Assignments on advanced therapeutic approaches in various diseases of domestic animals.

Suggested Readings

Selected articles from journals.

VCM 709 ADVANCED CLINICAL PRACTICE - I 0+2

Objective

Application of the theoretical concepts in practice

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.

Note: This course shall be conducted in TVCSC where students shall participate in diagnosis and treatment of diseased animals).

VCM 710 ADVANCED CLINICAL PRACTICE - II 0+2

Objective

Application of the theoretical concepts in practice

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.

Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

VCM 711 ADVANCED CLINICAL PRACTICE - III 0+2

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.

Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals).

VCM 790 SPECIAL PROBLEM 0+2

Objective

A short-term project work on some aspect of etio-pathogenesis, diagnosis and therapy of diseases of domestic animals.

VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

List of Journals

- * Indian Journal of Poultry Science
- * Indian Journal of Veterinary Medicine
- * Indian Journal of Veterinary Research
- * Indian Veterinary Journal
- * Journal of American Veterinary Medical Association
- * Research in Veterinary Science
- * Veterinary Medicine
- * Veterinary Medicine and Small Animal Clinician
- * Veterinary Record
- * Veterinary Research Communications

e-Resources

- * www.uni-sz.bg/bjvm/bjvm.htm (Bulgarian Journal of Veterinary Medicine)
- * www.jarm.com (International Journal of Applied Research in Vety. Medicine)
- * www.ispub.com/ostia/index..php?xmlFilePath=journals/ijvm/front.xml (Internet Journal of Veterinary Medicine)
- * Isrvma.org/journal.htm. (Israel Journal of Veterinary Medicine)
- * www.medwellonline.net/java/fp.html (Journal of Animal & Veterinary Advances)
- * www.jstage.jst.go.jp/browse/jes/-char/en (Journal of Equine Science)
- * www.stage.jst.go.jp/browse/jpsa (Journal of Poultry science)
- * www.vesci.org (Journal of Veterinary Science)
- * www.sasas.co.za (South African Journal of Animal Science)
- * journals.tubitak.gov.tr/veterinary/index.php (Turkish Journal of Veterinary and Animal Sciences)
- * vetmed.vri.cz (Veterinary Medicine)

Suggested Broad Topics for Master's and Doctoral Research

- * Clinico-therapeutic aspects of bovine mastitis
- * Hepatic, respiratory and skin disorders in animals
- * Metabolic/nutritional deficiency disorders in animals with emphasis on hypophosphatemia, hypocupremia and hypomagnesemia

VETERINARY EPIDEMIOLOGY AND PREVENTIVE MEDICINE

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VEP 601	PRINCIPLES OF EPIDEMIOLOGY	2+0
VEP 602	APPLIED EPIDEMIOLOGY	1+1
VEP 603	LIVESTOCK AND POULTRY DISEASE INVESTIGATION	0+2
VEP 604	VETERINARY CLINICAL EPIDEMIOLOGY	1+1
VEP 605	BIOSECURITY PRACTICES IN DISEASE PREVENTION	1+1
VEP 606	INFECTIOUS DISEASES OF RUMINANTS -I	2+1
VEP 607	INFECTIOUS DISEASES OF RUMINANTS -II	2+1
VEP 608	INFECTIOUS DISEASES OF EQUINES	1+1
VEP 609	INFECTIOUS DISEASES OF CANINES AND FELINES	2+1
VEP 610	INFECTIOUS DISEASES OF POULTRY	2+1
VEP 611	INFECTIOUS DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE	2+1
VEP 612	INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS	1+0
VEP 691	MASTER'S SEMINAR	1+0
VEP 699	MASTER'S RESEARCH	20
VEP 701	RECENT CONCEPTS IN EPIDEMIOLOGY AND DISEASE FORECASTING	2+1
VEP 702	HERD HEALTH MANAGEMENT	2+1
VEP 703	DATA COLLECTION , MANAGEMENT AND PRESENTATION	2+1
VEP 704	SURVEY AND SURVEILLANCE	2+1
VEP 705	EMERGING AND RE-EMERGING ANIMAL DISEASES	2+0
VEP 706	ECOLOGY OF DISEASES	2+0
VEP 707	MOLECULAR APPROACHES IN EPIDEMIOLOGY	2+1
VEP 708	ADVANCES IN PREVENTION & CONTROL OF INFECTIOUS DISEASES OF RUMINANTS	2+1
VEP 709	ADVANCES IN PREVENTION AND CONTROL OF INFECTIOUS DISEASES OF EQUINES	2+1
VEP 710	ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN PET ANIMALS	2+1
VEP 711	ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN POULTRY	2+1
VEP 712	ADVANCES IN INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS	1+0
VEP 713	ADVANCES IN DIAGNOSIS AND MANAGEMENT OF TOXICOLOGICAL CONDITIONS	1+1
VEP 790	SPECIAL PROBLEM	0+2
VEP 791	DOCTORAL SEMINAR I	1+0
VEP 792	DOCTORAL SEMINAR II	1+0
VEP 799	DOCTORAL RESEARCH	45

VETERINARY EPIDEMIOLOGY AND PREVENTIVE MEDICINE

Course Contents

VEP 601	PRINCIPLES OF EPIDEMIOLOGY	2+0
Objective	To familiarize students with epidemiological concepts.	
Theory	<u>UNIT I</u> Definitions, scope, concepts, types, application and common terms used in epidemiology. <u>UNIT II</u> Host-Agent-Environmental factors in causation of diseases and disease patterns. <u>UNIT III</u> Epidemiological data: its nature, sources, collection, storage, retrieval and presentation. <u>UNIT IV</u> Epidemiological studies: Experimental and observational, international organizations and laws regulating animal diseases.	
Suggested Readings	Martin SW, Meek AH & Willeberg P. 1993. <i>Veterinary Epidemiology: Principles and Methods</i> . IBH. Narayan KG. 2004. <i>Epidemiology, Diagnosis and Management of Zoonoses</i> . ICAR. Schwabe CW, Riemann HP & Franti CE. 1984. <i>Epidemiology in Veterinary Practice</i> . 3 rd Ed. Lea & Fabiger. Thrusfield M. 2004. <i>Veterinary Epidemiology</i> . 8 th Ed. Blackwell.	
VEP 602	APPLIED EPIDEMIOLOGY	1+1
Objective	To acquaint students with the application of epidemiology in disease diagnosis, prevention and control.	
Theory	<u>UNIT I</u> Surveys, sampling and collection of information, design questionnaires, disease monitoring and surveillance. <u>UNIT II</u> Epidemiological investigations of disease outbreak, modeling, disease forecasting, serological and molecular epidemiology. <u>UNIT III</u> Economics of diseases and different strategies for prevention and control of diseases and syndromes. Disease free zones and zero disease concept. <u>UNIT IV</u> Molecular basis of a disease, application of nucleic acid based assays for genomic characterization of field isolates vis-à-vis vaccine strains.	
Practical	Design proforma questionnaires for collection of information on health and diseases in populations, sero-surveys for important diseases of livestock and poultry, investigation of outbreaks, use of computer software in epidemiology.	

Suggested Readings

- Martin SW, Meek AH & Willeberg P. 1993. *Veterinary Epidemiology: Principles and Methods*. IBH.
Thrusfield M. 2004. *Veterinary Epidemiology*. 8th Ed. Blackwell.
Thomas B. (Ed.). *Applied Veterinary Epidemiology*. Elsevier.

VEP 603 LIVESTOCK AND POULTRY DISEASE INVESTIGATION 0+2**Objective**

To expose students to actual field based investigations of diseases in livestock and poultry.

Practical

To attend outbreaks of infectious diseases and toxicological conditions in livestock and poultry in the field and at farms. Recording and analysis of data. Investigation and diagnosis on dead and live diseased animal(s) and poultry. Collection, preservation and transport of material in the face of disease outbreak, and processing of material in the laboratory for diagnosis; screening of animal herds and poultry flocks for certain important diseases. Formulating and advising treatment and control measures. Extraction and isolation of nucleic acid of field isolates and vaccine strains, and their characterization by PCR and other techniques.

Suggested Readings

- Vihan VS. 2002. *Modern Veterinary Laboratory Techniques in Clinical Diagnosis*. CBS.

VEP 604 VETERINARY CLINICAL EPIDEMIOLOGY 1+1**Objective**

To familiarize students with various epidemiological approaches for solving field problems.

TheoryUNIT I

Definitions and epidemiological approaches, measuring frequency of clinical events, incidence, prevalence, occurrence etc., principles of accuracy, precision, linearity, diagnostic sensitivity and specificity.

UNIT II

Uses of diagnostic tests, evaluation of diagnostic tests, cohort and case control studies.

UNIT III

Design and evaluation of clinical trials, cost of disease, cost benefit analysis.

Practical

Diseases of multiple etiology: mastitis, diarrhea, abortions and their diagnosis and prevention. Sampling, isolations and antibiotic/ culture sensitivity etc. statistical evaluation of diagnostic assays.

Suggested Readings

- Smith RD. 2005. *Veterinary Clinical Epidemiology - a Problem Oriented Approach*. 3rd Ed. Taylor & Francis, CRC.

VEP 605 **BIOSECURITY PRACTICES IN DISEASE PREVENTION** **1+1**

Objective

To facilitate learning concepts of disinfection, sterilization and vaccination for disease prevention.

Theory

UNIT I

Definition and principles of biosecurity, shedding of pathogens by infected animals, their survival in the environment, routes of entry and transmission of pathogens.

UNIT II

Protection of susceptible animals, interruption of pathways of transmission, role of disinfection to break cycle of infection.

UNIT III

Chemical disinfectants, microbial resistance to disinfectants, physical methods of disinfection and sterilization.

UNIT IV

Biosecurity measures for collection of specimen from wild animals. Vaccines- success stories of disease eradication through vaccination.

Practical

Practical use of disinfectants in destruction of microbes in laboratory and under field conditions. Determination of efficacy/phenol coefficient of commonly used disinfectants. Measurement of vaccine titres.

Suggested Readings

Linton AH, Hugo WB & Russell AD. 1987. *Disinfection in Veterinary and Farm Animals Practice*. Blackwell.

VEP 606 **INFECTIOUS DISEASES OF RUMINANTS - I** **2+1**

Objective

To supplement cognitive learning with regard to recent progress made in the areas of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of bacterial and fungal diseases of bovine, sheep and goats.

Theory

UNIT I

Mastitis, joint ill, ulcerative lymphangitis, anthrax, clostridial infections, black quarter, tetanus, bacillary haemoglobinuria, botulism, colibacillosis.

UNIT II

Pasteurellosis, listeriosis, compylobacteriosis, tuberculosis, Johne's disease, braxy, entero-toxaemia, brucellosis, salmonellosis, leptospirosis.

UNIT III

Actinomycosis, actinobacillosis, ringworm, cutaneous streptothricosis, sporotrichosis, aspergillosis, coccidiomycosis, rhinosporidiosis, mucormycosis, histoplasmosis, candidiasis, blastomycosis etc.

Practical

Application of latest diagnostic/serological tests and adoption of preventive measures for the control of various bacterial and fungal diseases of bovine, sheep and goats.

Suggested Readings

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. *Veterinary Medicine, a Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses*. Book Power.

VEP 607 INFECTIOUS DISEASES OF RUMINANTS - II 2+1

Objective

To supplement cognitive learning with regard to recent progress made in the areas of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of viral, rickettsial and parasitic diseases of bovine, sheep and goats.

Theory

UNIT I

Foot and mouth disease, vesicular stomatitis, vesicular exanthema, rinderpest, PPR, bovine viral diarrhea, mucosal disease, ephemeral fever, bovine herpes virus-1 induced syndromes, leucosis, viral pneumonia, pox diseases, infectious gastro-enteritis of viral etiology.

UNIT II

Bovine malignant head catarrh, rabies, scrapie, blue tongue, louping ill, papillomatosis.

UNIT III

Bovine tropical theileriosis, babesiosis, anaplasmosis, trypanosomiasis, toxoplasmosis, coccidiosis.

UNIT IV

Sarcocystosis, fascioliasis, amphistomiasis, gastro-intestinal nematodiasis, schistosomiasis, verminous bronchitis, echino-coccosis, coenurosis, tape worm infestations.

Practical

Application of latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by viruses, rickettsiae, helminth parasites and blood protozoa.

Suggested Readings

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. *Veterinary Medicine, a Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses*. Book Power.

VEP 608 INFECTIOUS DISEASES OF EQUINES 1+1

Objective

Learning of important infectious diseases of equines; their diagnosis, prevention and control.

Theory

UNIT I

Anthrax, tetanus, botulism, strangles, glanders, malignant edema, actinomycosis, clostridial infections, *Rhodococcus equi* pneumonia (Zoonotic), tuberculosis.

UNIT II

African horse sickness, infectious equine anaemia, equine influenza, equine encephalomyelitis, rabies, equine viral rhinopneumonitis, equine viral arteritis vesicular stomatitis, ulcerative lymphangitis.

UNIT III

Trypanosomiasis/ dourine, babesiosis, parasitic pneumonia.

UNIT IV

Cutaneous eczema, cutaneous acne, cutaneous pustular dermatitis, candidiasis, histoplasmosis, coccidiomycosis, dermatophytosis.

Practical

Diagnostic tests and serological tests for study of epidemiology of infectious diseases of equines.

Suggested Readings

Robison NE. 1997. *Current Therapy in Equine Medicine*. WB Saunders.

Wintzer HJ. 1986. *Equine Diseases, a Text Book for Students and Practitioners*. Verlaug Paul Parcey.

VEP 609 INFECTIOUS DISEASES OF CANINES AND FELINES 2+1

Objective

Learning of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of infectious diseases of dogs and cat.

Theory

UNIT I

Bacterial diseases: salmonellosis, campylobacteriosis, mycobacteriosis, actinomycosis, nocardiosis, streptococcosis, leptospirosis, borreliosis, tetanus, botulism. Viral diseases: canine-distemper, infectious canine hepatitis, parvovirus infection, rabies, infectious tracheo-bronchitis, corona virus infection.

UNIT II

Feline diseases: feline pan-leucopaenia, feline infectious peritonitis, feline herpesvirus, feline spongiform encephalopathy, feline calci virus, feline immuno-deficiency virus (FIV).

UNIT III

Toxoplasmosis, neosporosis, sarcoptic mange, demodectic mange, hookworm and toxocara canis infections, leishmaniasis, canine babesiosis, ehrlichiosis, hepatozoonosis.

Practical

Assignments, recent diagnostic/ serological tests for the diagnosis of important diseases of dogs and cats. Vaccination schedule for various diseases. Collection of material from clinical cases.

Suggested Readings

Dunn JK. 1999. *Text Book of Small Animal Medicine*. WB Saunders.

Ettinger SJ & Feldman EC. 2000. *Text book of Veterinary Internal Medicine*. 5th Ed. WB Saunders.

Gormann NT. 1998. *Canine Medicine and Therapeutics*. Blackwell.

Tilley LP & Smith FWK Jr. 2004. *The 5-minute Veterinary Consult (Canine and Feline)*. 3rd Ed. Lippincot, Williams & Wilkins.

VEP 610 INFECTIOUS DISEASES OF POULTRY 2+1

Objective

Learning of etio-pathology, diagnosis, prevention and control of important infectious diseases of poultry.

Theory

UNIT I

Impact of diseases on poultry industry, mechanism of disease transmission. Bacterial diseases: *Escherichia coli* and Salmonella infections, coryza, fowl cholera, gangrenous dermatitis, mycoplasmosis, CRD.

UNIT II

Viral diseases: Newcastle disease, infectious bursal disease, Marek's disease, infectious bronchitis, inclusion body hepatitis, hydro-pericardium syndrome, avian pox, infectious laryngo-tracheitis, avian influenza, lymphoid leucosis, avian encephalomyelitis, infectious bronchitis.

UNIT III

Fungal and parasitic diseases: aspergillosis, candidiosis, favus, mycotoxicosis, coccidiosis, roundworm and tape worm infestations, vaccination schedule etc.

Practical

Postmortem examination of poultry birds, collection of material for isolation, antibiotic sensitivity assay, histopathology and demonstration of other routine diagnostic tests. Seromonitoring for important diseases and pullorum testing.

Suggested Readings

Calnek BW, Barnes HA, Beard CW, Reid WM & Yoder HW Jr. 1994. *Diseases of Poultry*. 10th Ed. Iowa State Univ. Press.

Jordan FTW & Pattison M. 1996. *Poultry Diseases*. WB Saunders.

VEP 611

INFECTIOUS DISEASES OF ANIMAL SPECIES OF 2+1 REGIONAL IMPORTANCE (CAMEL AND SWINE)

Objective

Learning of diseases of animals which are important to the particular region i.e. swine, camel, yak, mithun, elephant etc. e.g., in Haryana, swine and camel diseases will be taught to the students.

Theory

UNIT I

Specific diseases of camel e.g. kapali, malli, jhooling, pica, satyriasis, specific peritonitis, kumree, chronic peritonitis.

UNIT II

General infectious diseases: anthrax, actinomycosis, black quarter, bronchitis, coccidiosis, contagious echthyma, haemorrhagic septicaemia, hydatidosis, mange, mastitis, camel pox, rabies, surra, tuberculosis etc.

UNIT III

Swine diseases: Swine influenza, hog cholera, African swine fever, swine pox, vesicular exanthema, vesicular stomatitis, rabies.

UNIT IV

Porcine enteroviruses, pseudorabies, listeriosis, leptospirosis, brucellosis, anthrax, salmonellosis, swine erysipelas, pasteurellosis, tuberculosis mange etc.

Practical

Recent diagnostic tests and preventive measures for the control of infectious diseases of swine and camel. Investigations of outbreaks. Visits to organized farms.

Suggested Readings

- Dunne HW & Leman AD. (Eds.). 1978. *Diseases of Swine*. Iowa State Univ. Press.
- Gahlot TK & Singh J. 2002. *Selected Topics on Camelids*. Camel Publishing House.
- Kohler I, Rollfeson E & Evelyn M. 2001. *Field Manual of Camel Diseases: Traditional and Modern Health Care of Dromedary*.
- Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. *Veterinary Medicine: A Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses*. Book Power.
- Wernery U & Kaden M. 2002. *Infectious Diseases of Camelids*. Blackwell.

VEP 612 INFECTIOUS DISEASES OF LABORATORY 1+0 AND ZOO ANIMALS

Objective

Learning of specific diseases of laboratory and zoo animals which will help in understanding, and managing them in good health and employing good sanitation and bio-security measures.

UNIT I

Specific diseases of laboratory animals caused by bacteria, viruses, fungi and parasites..

UNIT II

Specific diseases of zoo (captive) animals caused by bacteria, viruses, fungi and parasites.

Suggested Readings

- Joshi BP. 1991. *Wild Animal Medicine*. Kalyani.
- Fowler ME. 1986. *Zoo and Wild Animal Medicine*. 2nd Ed. WB Saunders.
- Fox JG, Anderson LC, Loew FM & Quimby FW. (Eds.). 2004. *Laboratory Animal Medicine*. 2ndEd.
- Baker HJ. 1978. *Pathology of Laboratory Animals*. Springer, New York
- Hafez ESE. (Ed.). *Reproduction and Breeding Techniques for Laboratory Animals*. Lea and Fabiger, Philadelphia.
- Sirois M. 2005. *Laboratory Animal Medicine: Principles and Procedures*. 2nd Ed. Elsevier.
- Hrapkiewicz K. 2007. *Clinical Laboratory Animal Medicine – An Introduction*. 3rd Ed. Blackwell Publ.
- Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. *Veterinary Medicine: A Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses*. Book Power.

VEP 701 RECENT CONCEPTS IN EPIDEMIOLOGY AND 2+1 DISEASE FORECASTING

Objective

To learn about different epidemiological aspects of major diseases and to develop suitable disease forecasting system.

Theory

UNIT I

Review of epidemiological concepts and applications, recent concepts.

UNIT II

Epidemiology of economically important diseases in the region (haemorrhagic septicemia, foot and mouth disease, surra, brucellosis, PPR, swine fever, IBD and fowl typhoid).

UNIT III

Geographical Information System and its applications in epidemiology, various expert systems and their role in epidemiology.

UNIT IV

Modeling and application of various models in disease forecasting. Epidemiological software.

Practical

Epidemiology exercises of economically important diseases in the region, use of Geographical Information System in epidemiology, various expert systems, modeling and various models used in disease forecasting, use of various epidemiological softwares.

Suggested Readings

Noordhuizen JPTM, Franklin K, Thrusfield MV & Graat EAM. 2003. *Application of Quantitative Methods in Veterinary Epidemiology*. IBD.

VEP 702 HERD HEALTH MANAGEMENT 2+1

Objective

Adoption of holistic approach to address issues of herd health without affecting production.

Theory

UNIT I

General principles, interactions between health and production.

UNIT II

Dairy cattle: mastitis control and health management of dairy cows and calves.

UNIT III

Health and production in swine, sheep, goats and poultry.

Practical

Visit to farms, assessment of their problems, systematic programme or control of a specific disease and its impact.

Suggested Readings

Radostits & Blood DC. 1996. *Herd Health*. Book Power.

VEP 703 DATA COLLECTION, MANAGEMENT AND 2+1
PRESENTATION

Objective

To apprise the students of importance of data collection, analysis and interpretation for effective disease control.

Theory

UNIT I

Classification of data, sources of data, data collection, questionnaires.

UNIT II

Data storage, computerized and non-computerized recording techniques.

UNIT III

Application of computing and internet based records. Veterinary recording schemes, veterinary information systems and databases.

UNIT IV

Presenting numerical data: some basic definitions. Displaying numerical data.

Practical

Collection, storage and analysis of data of Disease Investigation Laboratories of department, Veterinary hospitals, livestock and poultry farms etc. Development of suitable software for the same. Pie charts, graphs and maps for presentation of data.

Suggested Readings

Noordhuizen JPTM, Frankena K, Thrusfield MV & Gruat EAM. 2003. *Application of Quantitative Methods in Veterinary Epidemiology*. International Book Distr. Co.

VEP 704 SURVEY AND SURVEILLANCE 2+1

Objective

To demonstrate different methodologies and procedures involved in conducting survey and surveillance.

Theory

UNIT I

Over-view of concepts of survey and surveillance, purpose and method of sampling, size of sample, questionnaires.

UNIT II

Goals and types of surveillance, difference from monitoring, mechanism of surveillance and surveillance network.

UNIT III

Disease/data recording and reporting.

Practical

Develop questionnaires on selective topics, Survey among livestock and poultry farmers to find out usefulness/effectiveness of vaccination/ artificial insemination/ other practices, surveillance of important diseases in different parts of state.

Suggested Readings

Selected articles from journals.

VEP 705 EMERGING AND RE-EMERGING ANIMAL DISEASES 2+0

Objective

To create awareness about emerging and reemerging diseases and surveillance methods.

Theory

UNIT I

General concepts for emergence of new diseases and re-emergence of old diseases.

UNIT II

Epidemiology of globally and nationally important emerging/re-emerging diseases and designing of strategies for their prevention and control.

Suggested Readings

Selected articles from journals.

VEP 706	ECOLOGY OF DISEASES	2+0
	Objective	
	To make the students aware about ecology, ecological systems and impact of global warming.	
	Theory	
	<u>UNIT I</u>	
	Basic ecological concepts, distribution and regulation of population size, the niche with examples.	
	<u>UNIT II</u>	
	Ecosystems, biotope, landscape epidemiology, nidality.	
	<u>UNIT III</u>	
	Patterns of disease, epidemic curves (Reed-Frost-model, Kendall's waves), trends in temporal and spatial distribution of disease.	
	<u>UNIT IV</u>	
	Global warming, its impact on animal health, pathogens/vectors and changing disease patterns.	
	Suggested Readings	
	Selected articles from journals.	
VEP 707	MOLECULAR APPROACHES IN EPIDEMIOLOGY	2+1
	Objective	
	Learning of recent advanced molecular techniques for establishing disease diagnosis.	
	Theory	
	<u>UNIT I</u>	
	The concept of molecular basis of a disease, molecular determinants of pathogenicity of infectious agents and their transmissibility to susceptible populations of livestock and poultry.	
	<u>UNIT II</u>	
	Laboratory biosafety, antigenic, genetic and biological characterization of field isolates of pathogens incriminated in field outbreaks, differentiation of field and vaccine strains, the concept of marker vaccines, and correlation of pathotypes and genotypes of a pathogen.	
	<u>UNIT III</u>	
	Immunological tests, immunoblotting techniques and use of monoclonal antibodies in different ELISAs for antigenic analysis. Application of nucleic acid based assays viz. polymerase chain reaction (PCR) assays, nucleotide sequencing, restriction endonuclease analysis and RFLP analysis for genomic characterization using the field material directly or after extraction of nucleic acid from small scale cultures, use of radio-actively labeled or non radioactive oligo-nucleotide probes in dot-blot and Southern hybridizations.	
	Practical	
	Extraction and isolation of nucleic acid from field isolates of the causative pathogens, digestion with restriction endonucleases and electrophoresis in agarose gel in order to obtain fingerprints and their comparative analysis. SDS-PAGE for protein profiling. Western blotting, ELISA for screening of field samples.	

Suggested Readings

Selected articles from journals.

VEP 708 ADVANCES IN PREVENTION AND CONTROL OF 2+1 INFECTIOUS DISEASES OF RUMINANTS

Objective

To understand advancements made in the field of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of diseases of ruminants.

Theory

UNIT I

Bacterial diseases of economic importance in bovines, sheep and goats.

UNIT II

Viral diseases of economic importance in bovines, sheep and goats.

UNIT III

Fungal diseases of economic importance in bovines, sheep and goats.

UNIT IV

Blood protozoan and rickettsial diseases of economic importance in bovines, sheep and goats.

UNIT V

Parasitic diseases of economic importance in bovines, ovines and caprines.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures for major diseases of veterinary importance caused by bacteria, viruses, fungi, rickettsiae, parasites and protozoa.

Suggested Readings

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. *Veterinary Medicine: A Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses*. Book Power.

VEP 709 ADVANCES IN PREVENTION AND CONTROL OF 2+1 INFECTIOUS DISEASES OF EQUINES

Objective

To train students in learning and practicing advancements made in the field of prevention and control of important infectious diseases of equines.

Theory

UNIT I

Bacterial diseases of economic importance in equines.

UNIT II

Viral diseases of economic importance in equines.

UNIT III

Fungal diseases of economic importance in equines.

UNIT IV

Blood protozoan and rickettsial diseases of economic importance in equines.

UNIT V

Parasitic diseases of economic importance in equines.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by viruses, rickettsiae and protozoa.

Suggested Readings

Selected articles from journals.

**VEP 710 ADVANCES IN PREVENTION AND CONTROL OF 2+1
DISEASE IN PET ANIMALS****Objective**

To get students acquainted with advancements made in the field of prevention and control of important infectious diseases of pet animals.

TheoryUNIT I

Bacterial diseases of economic importance in pet animals.

UNIT II

Viral diseases of economic importance in pet animals.

UNIT III

Fungal diseases of economic importance in pet animals.

UNIT IV

Blood protozoan and rickettsial diseases of economic importance in pet animals.

UNIT V

Parasitic diseases of economic importance in pet animals.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of pet animals caused by bacteria, viruses, fungi, rickettsiae, parasites and protozoa.

Suggested Readings

Selected articles from journals.

**VEP 711 ADVANCES IN PREVENTION AND CONTROL OF 2+1
DISEASES IN POULTRY****Objective**

To impart knowledge about latest advancements made in the field of prevention and control of important infectious diseases of poultry.

TheoryUNIT I

Bacterial diseases of economic importance in poultry.

UNIT II

Viral diseases of economic importance in poultry.

UNIT III

Fungal diseases of economic importance in poultry.

UNIT IV

Parasitic diseases of economic importance in poultry.

Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by bacteria, viruses, fungi and other parasites.

Suggested Readings

Selected articles from journals.

VEP 790

SPECIAL PROBLEM

0+2

Objective

To provide expertise in handling practical research problems.

Practical

Short research problems involving contemporary issues and research techniques.

VETERINARY EPIDEMIOLOGY AND PREVENTIVE MEDICINE

List of Journals

- * Avian Diseases
- * Avian pathology
- * British Poultry Science
- * British Veterinary Journal
- * Epidemiology and Infection
- * Indian Journal of comparative Microbiology, Immunology and Infectious diseases
- * Infection and Immunity
- * Infection and Immunity
- * Journal of General Virology
- * Journal of Poultry Science
- * Quarterly Bulletin of O.I.E.
- * Tropical Animal Health and Production
- * Veterinary Medicine
- * Veterinary Microbiology
- * Veterinary Record
- * World Animal Health
- * World Poultry Science Journal

e-Resources

- * <http://www.jarvm.com/> (International Journal of Applied Research in Veterinary Medicine)
- * <http://calvados.c3sl.ufpr.br/ojs2/index.php/veterinary/> (Archives of Veterinary Science)
- * <http://www.pjbs.org/ijps/ijps.htm> (International Journal of Poultry Science)
- * <http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijvm/front.xml> (Internet Journal of Veterinary Medicine)
- * <http://www.medwellonline.net/java/fp.html> (Journal of Animal and Veterinary Advances)
- * <http://www.jstage.jst.go.jp/browse/jpsa> (Journal of Poultry Science)
- * <http://www.jstage.jst.go.jp/browse/jvms/-char/en> (Journal of Veterinary Medical Science)
- * <http://www.cipav.org.co/lrrd/> (Livestock Research for Rural Development)
- * <http://vetmed.vri.cz/> (Veterinarni Medicina)
- * <http://isrvma.org/journal.htm> (Israel Journal of Veterinary Medicine)
- * <http://www.jstage.jst.go.jp/browse/jpestics> (Journal of Pesticide Science)
- * <http://www.vetsci.org> (Journal of Veterinary Science)
- * <http://journals.tubitak.gov.tr/veterinary/index.php> (Turkish Journal of Veterinary and Animal Sciences)
- * <http://www.uni-sz.bg/bjvm/bjvm.htm> (Bulgarian Journal of Veterinary Medicine)
- * <http://www.ecology.kee.hu/> (Applied Ecology and Environmental Research)

Suggested Broad Topics for Master's and Doctoral Research

- * Molecular epidemiological studies on infectious diseases of livestock
- * Molecular epidemiological studies on infectious diseases of poultry
- * Surveillance of economically important diseases of farm animals
- * Surveillance of economically important diseases of poultry
- * Development of immunodiagnostic/ sero-diagnostic tests for field application
- * Monitoring of protective immunity induced by vaccines under different schedules
- * Diagnostic assay for milk adulterants
- * Diagnostic assays and epidemiological studies in respect of toxicants in livestock and poultry feeds.

VETERINARY SURGERY AND RADIOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
VSR 601	PRINCIPLES OF SURGERY	2+0
VSR 602	CLINICAL PRACTICE – I	0+3
VSR 603	CLINICAL PRACTICE – II	0+3
VSR 604	SMALL ANIMAL ANAESTHESIA	2+1
VSR 605	LARGE ANIMAL ANAESTHESIA	2+1
VSR 606	DIAGNOSTIC IMAGING TECHNIQUES	2+1
VSR 607	VETERINARY OPHTHALMOLOGY AND DENTISTRY	1+1
VSR 608	SMALL ANIMAL SOFT TISSUE SURGERY	2+1
VSR 609	LARGE ANIMAL SOFT TISSUE SURGERY	2+1
VSR 610	ORTHOPAEDIC AND LIMB SURGERY	2+1
VSR 691	MASTER'S SEMINAR	1+0
VSR 699	MASTER'S RESEARCH	20
VSR 701	CLINICAL SURGICAL PRACTICE – I	0+2
VSR 702	CLINICAL SURGICAL PRACTICE – II	0+2
VSR 703	CLINICAL SURGICAL PRACTICE – III	0+2
VSR 704	ANAESTHESIA OF WILD AND LABORATORY ANIMALS	1+1
VSR 705	ADVANCES IN ANAESTHESIOLOGY	2+1
VSR 706	ADVANCES IN DIAGNOSTIC IMAGING TECHNIQUES	2+1
VSR 707	NEUROSURGERY	2+1
VSR 708	EXPERIMENTAL SURGICAL TECHNIQUES IN ANIMALS	1+1
VSR 789	SPECIAL PROBLEMS IN ANAESTHESIA	0+2
VSR 790	SPECIAL PROBLEMS IN SURGERY	0+2
VSR 791	DOCTORAL SEMINAR I	1+0
VSR 792	DOCTORAL SEMINAR II	1+0
VSR 799	DOCTORAL RESEARCH	45

VETERINARY SURGERY AND RADIOLOGY

Course Contents

VSR 601	PRINCIPLES OF SURGERY	2+0
Objective		
To impart the basic knowledge of principles of surgery.		
Theory		
<u>UNIT I</u>		
Wound healing, current concepts of inflammation and management, wound infections, antimicrobial therapy, principles of surgical asepsis, sterilization and disinfection.		
<u>UNIT II</u>		
Systemic effects of surgical stress, haemorrhage and haemostasis, metabolism of the surgical patient, fluid therapy in surgical patients, acid-base balance, shock. Hyperalimentation. Blood transfusion. Host defense mechanism.		
<u>UNIT III</u>		
Biomaterials, surgical immunity, pre-operative assessment of the surgical patient, post-operative care of the surgical patient. Chemotherapy of tumors.		
<u>UNIT IV</u>		
Operating room emergencies, cardio-pulmonary embarrassment and resuscitation, monitoring of surgical patient.		
<u>UNIT V</u>		
Principles of laser surgery, cryosurgery, electrosurgery, lithotripsy and endoscopy, physiotherapy, stem cell therapy etc.		
Suggested Readings		
Fossum TW. (Ed.). 2002. <i>Small Animal Surgery</i> . Mosby.		
Slatter DH. (Ed.). 2002. <i>Textbook of Small Animal Surgery</i> . WB Saunders.		
VSR 602	CLINICAL PRACTICE - I	0+3
Objective		
To impart practical training in anaesthesia, diagnostic imaging techniques and surgery.		
Practical		
Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments, disaster management.		
Suggested Readings		
Auer JA. (Ed.). 2006. <i>Equine Surgery</i> . WB Saunders.		
Fossum TW. (Ed.). 2002. <i>Small Animal Surgery</i> . Mosby.		
Fubini SL & Ducharme NG. (Ed.). 2004. <i>Farm Animal Surgery</i> . WB Saunders.		
Slatter DH. (Ed.). 2002. <i>Textbook of Small Animal Surgery</i> . WB Saunders.		
VSR 603	CLINICAL PRACTICE - II	0+3
Objective		
To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.		

Practical

Client management, animal welfare and rehabilitation, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel, disaster management.

Suggested Readings

Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders.
Fossum TW. (Ed.). 2002. *Small Animal Surgery*. Mosby.
Fubini SL & Ducharme NG. (Ed.). 2004. *Farm Animal Surgery*. WB Saunders.
Slatter DH. (Ed.). 2002. *Textbook of Small Animal Surgery*. WB Saunders.

VSR 604 SMALL ANIMAL ANAESTHESIA 2+1

Objective

To impart the basic and practical knowledge of principles of companion animal anaesthesia.

Theory

UNIT I

General considerations for anaesthesia, peri-operative and post-operative pain and its management.

UNIT II

Sedation: analgesia and pre-medication, anaesthetic agents (injectable anaesthetics, dissociative anaesthetics, inhalation anaesthetics), muscle relaxants, neuromuscular blocking agents and local analgesia.

UNIT III

Anaesthetic techniques, anaesthetic equipments, artificial ventilation.

UNIT IV

Anaesthesia of small animals, pediatric and geriatric patients, birds.

UNIT V

Monitoring of anaesthesia, anaesthetic emergencies, complications and their management, euthanasia.

Practical

Anaesthetic equipments and instrumentation, artificial ventilation, use of various preanaesthetic and anaesthetic agents in small animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia.

Suggested Readings

Hall LW & Clarke KW. (Eds.). 1991. *Veterinary Anaesthesia*. Bailliere Tindall.
Paddleford RR. (Ed.). 1999. *Manual of Small Animal Anesthesia*. 2nd Ed. WB Saunders.
Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. *Lumb and Jone's Veterinary Anaesthesia*. Williams & Wilkins.
Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1999. *Essentials of Small Animal Anesthesia and Analgesia*. Lippincott Williams & Wilkins.

VSR 605 LARGE ANIMAL ANAESTHESIA 2+1

Objective

To impart the basic and practical knowledge of principles of farm animal anaesthesia and mechanism of pain.

Theory

UNIT I

General considerations for anaesthesia, peri-operative pain, and post-operative pain and its management.

UNIT II

Pre-anaesthetic and anaesthetic adjuncts, injectable anaesthetics, dissociative anaesthetics, inhalation anaesthetics.

UNIT III

Local anaesthetics, neuromuscular blocking agents.

UNIT IV

Anaesthetic techniques, anaesthetic machines, breathing systems, artificial ventilation.

UNIT V

Monitoring of anaesthesia, anaesthetic emergencies and complications, anaesthesia of pediatric and geriatric patients, euthanasia.

Practical

Anaesthetic equipments and instrumentation, artificial ventilation, use of various preanaesthetic and anaesthetic agents in large animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia.

Suggested Readings

Hall LW & Clarke KW. (Eds.). 1991. *Veterinary Anaesthesia*. Bailliere Tindall.

Muir WW & John AE. (Eds.). 1991. *Equine Anesthesia*. Mosby.

Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. *Lumb and Jone's Veterinary Anaesthesia*. Williams & Wilkins.

VSR 606

DIAGNOSTIC IMAGING TECHNIQUES

2+1

Objective

To impart the basic and practical knowledge of principles of diagnostic imaging techniques and interpretation of radiographs, ultrasonograph/CT/MRI and other imaging techniques.

Theory

UNIT I

Conventional and digital X-ray machine, quality of radiation, formation of radiograph technique chart, artifacts and their prevention, special diagnostic radiographic procedures, radiographic quality, radiographic accessories, differentiation of radiographic densities in relation to clinical diagnosis.

UNIT II

Principles of radiographic interpretation, plain and contrast radiographic techniques of small and large animals, image intensification.

UNIT III

Principles of radiation therapy, medical radioisotope curves, radiation laws and regulations.

UNIT IV

Principles of ultrasound, basic physics, transducers, equipment controls, display models, terminology of echotexture and artifacts, application of ultrasound in small and large animals.

UNIT V

Doppler techniques echocardiography and its application, introduction to MRI, CT scan, nuclear medicine, xeroradiography, positron emission tomography technique and other imaging techniques.

UNIT VI

Electromagnetic radiations, hazards of electromagnetic radiations and protection and bio-safety.

Practical

Acquaintance with imaging equipments, dark room processing techniques and X-ray film handling, formulation of technique chart with fixed kVp and variable mAs, basics of radiographic interpretation of diseases, computer aided image acquisition and retrieval, radiographic positioning of different regions in domestic animals, angiography, cardiac catheterization and other contrast radiographic techniques of different types, interpretation of ultrasonographs, MRI, CT scans etc.

Suggested Readings

Bargai U, Bharr, JW & Morgan JP. (Eds.). 1989. *Bovine Radiology*. Iowa State University Press, Ames.

Bushong SC. (Ed.). 1975. *Radiologic Science for Technologists*. CV Mosby.

Gillette EL, Thrall DE & Lebel JL. (Eds.). 1977. *Carlson's Veterinary Radiology*. Lea & Febiger.

Goddard PJ. (Ed.). 1995. *Veterinary Ultrasonography*. CABI.

Kealy JK. (Ed.). 1987. *Diagnostic Radiology and Ultrasonography in Dogs and Cats*. 2nd Ed. Saunders, Philadelphia.

Morgan JP. (Ed.). 1972. *Radiology in Veterinary Orthopaedics*. Lea & Febiger.

Singh AP & Singh J. (Eds.). 1994. *Veterinary Radiology*. CBS.

Thrall DE. (Ed.). 2007. *Textbook of Veterinary Diagnostic Radiology*. 5th Ed. Saunders, Philadelphia.

VSR 607

VETERINARY OPHTHALMOLOGY AND DENTISTRY

1+1

Objective

To impart the basic and practical knowledge of diagnosis and treatment of diseases of eye and teeth in domestic animals.

Theory

UNIT I

General Anatomical and physiological considerations for ophthalmic surgery.

UNIT II

Ophthalmic examination and diagnosis, local anaesthesia of eye, ocular therapeutics, diagnostic instruments.

UNIT III

General consideration for eye surgery, diseases and surgery of eye lids, lacrimal apparatus, naso-lacrimal duct.

UNIT IV

Diseases of conjunctiva, cornea, sclera, iris, orbit, lens, vitreous and aqueous humor, retina and optic nerve.

UNIT V

Ocular manifestation of systemic diseases.

UNIT VI

Anatomy of teeth, examination of teeth. Diseases of teeth- congenital anomalies (retained deciduous teeth, impacted teeth, abnormalities in the shape of teeth). Diseases of teeth- acquired diseases (dental caries, fracture of teeth, endodontic disease, dental materials and dental radiography). Restorative dentistry, periodontal disease, tooth extraction, gum diseases. Current techniques in dentistry.

Practical

Ophthalmic instrumentation, examination of the eye and its adnexa, preparation of patient for eye anaesthesia and surgery, canthotomy, tarsorrhaphy, transplantation of cornea, keratoplasty, anterior chamber paracentesis, flushing of naso-lacrimal duct, iridectomy, lens extraction/implantation. Dentistry instrumentation, dental radiography, teeth cleaning, tooth extraction.

Suggested Readings

- Gelatt KN. (Ed.). 1981. *Veterinary Ophthalmology*. Lea & Febiger.
Gelatt KN. (Ed.). 2007. *Atlas of Veterinary Ophthalmology*. 4th Ed. Blackwell Publ.
Gelatt KN. (Ed.). 2000. *Essentials of Veterinary Ophthalmology*. Blackwell.
Lavach JD. (Ed.). 1990. *Large Animal Ophthalmology*. CV Mosby.
Oehme FW & Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams & Wilkins.
Slatter DH. (Ed.). 1981. *Fundamentals of Veterinary Ophthalmology*. WB Saunders.
Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 608

SMALL ANIMAL SOFT TISSUE SURGERY

2+1

Objective

To familiarize with various surgical affections of different body systems and their treatment in small animals.

Theory

UNIT I

Skin and adnexa- the integument, management of skin wounds, principles of plastic and reconstructive surgery, pedicle grafts, skin grafts, burns, electrical chemical and cold injuries.

UNIT II

Surgical approaches/ affections of ear, oral cavity and pharynx, abdomen, thorax, the salivary glands, oesophagus, stomach, intestines, rectum and anus, liver and biliary system, pancreas.

UNIT III

Hernias- abdominal hernia, diaphragmatic hernia, perineal hernia, inguinal, scrotal, and umbilical hernia etc. Surgical approaches to thoracic wall, Pleura.

UNIT IV

Respiratory system- functional anatomy, diseases of upper respiratory system and lower respiratory system.

UNIT V

Surgical anatomy of the cardiovascular system, cardiovascular physiology, diagnostic methods, cardiac disorders, principles of vascular surgery, basic cardiac procedures, hypothermia, basic peripheral vascular procedures, peripheral vascular disorders, portacaval shunts and anomalies. Haemolymphatic system, bone marrow, spleen, tonsils, lymph nodes and lymphatics, thymus.

UNIT VI

Male reproductive system- anatomy of the male genital organs, diagnostic and biopsy techniques, surgical affections of male genital organs; female reproductive system- anatomy, diagnostic techniques, surgical affections of female genital organs.

UNIT VII

Urinary system- anatomy of the urinary tract, principles of urinary tract surgery, kidneys, ureters, surgery of the bladder, surgical diseases of the urethra, medical dissolution and prevention of canine uroliths, feline urologic syndrome.

UNIT VIII

Endocrine system- pituitary, adrenals, thyroid, parathyroid, surgical affections of mammary glands and tail. Surgical affections of nervous system, special sense organs.

Practical

Practice of various surgical techniques of skin and adnexa, alimentary system, hernias, respiratory system, cardiovascular system, male and female reproductive systems, urinary system, mammary glands and tail.

Suggested Readings

Fossum TW. (Ed.). 2002. *Small Animal Surgery*. Mosby.

Slatter DH. (Ed.). 2002. *Textbook of Small Animal Surgery*. WB Saunders.

VSR 609

LARGE ANIMAL SOFT TISSUE SURGERY

2+1

Objective

To familiarize with various surgical affections of different body systems and their treatment in large animals.

Theory

UNIT I

Abdominal wall, integumentary system - skin and appendages; mammary gland, tail, affections of oral cavity.

UNIT II

Surgical affections of respiratory system, cardiovascular and lymphatic system.

UNIT III

Surgical affections of digestive system, urinary and genital system.

UNIT IV

Surgical affections of nervous system, special sense organs.

Practical

Practice of various surgical techniques of skin, alimentary system, hernias, respiratory system, cardiovascular system, male and female reproductive system, urinary system, mammary glands and tail. Surgical affections of nervous system, special sense organs.

Suggested Readings

- Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders.
Fubini SL & Ducharme NG. (Eds.). 2004. *Farm Animal Surgery*. WB Saunders.
Oehme FW & Prier JE. (Ed.). 1994. *Textbook of Large Animal Surgery*. Williams & Wilkins.
Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 610 ORTHOPAEDICS AND LIMB SURGERY 2+1

Objective

To familiarize with various affections of bones, joints, tendons, ligaments and foot as well as their treatment in animals.

Theory

UNIT I

Fractures and dislocations, fracture healing, ligaments and tendons - repair techniques.

UNIT II

Treatment of fractures of different bones in domestic animals, bone diseases.

UNIT III

Various affections of the joints, their diagnosis and treatment.

UNIT IV

Conformation of the limb, anatomy of hoof.

UNIT V

Lameness and allied surgical conditions of fore limbs/hind limbs, rehabilitation of orthopaedic patient.

Practical

Internal and external fixation of fractures and dislocation, arthrotomy, tenotomy, examination of limbs for lameness, nerve blocks, injections in joints, operations for arthritis, hoof surgery and corrective shoeing, physiotherapy. Instrumentation, neurological examination, imaging the spine; skull and brain, surgical approach to the cervical spine; thoracolumbar spine and brain.

Suggested Readings

- Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders.
Fubini SL & Ducharme NG. (Eds.). 2004. *Farm Animal Surgery*. WB Saunders.
Newton CD & Nunamaber DM. (Eds.). 1985. *Textbook of Small Animal Orthopaedics*. JB Lippincott.
Oehme FW & Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams & Wilkins.
Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 701 CLINICAL SURGICAL PRACTICE - I 0+3

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management,

database management, attending surgical cases, surgical facilities, equipments and personnel.

VSR 702 CLINICAL SURGICAL PRACTICE - II 0+3

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel..

VSR 703 CLINICAL SURGICAL PRACTICE - III 0+3

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel..

VSR 704 ANAESTHESIA OF WILD AND LABORATORY ANIMALS 1+1

Objective

To impart the basic and practical knowledge of chemical immobilization, sedation and anaesthesia of laboratory animals, captive and free ranging wild animals.

Theory

UNIT I

General considerations in chemical restraint of captive and free ranging wild animals.

UNIT II

Methods of administration of anaesthesia in captive, free ranging animals and laboratory animals.

UNIT III

Local and general anaesthesia in exotic species, wild animals, zoo animals and laboratory animals.

UNIT IV

Anaesthetic emergencies and complications.

Practical

Familiarization with capture equipments, local anaesthetic techniques, use of various preanaesthetic and anaesthetic agents in laboratory animals, monitoring of patient during general anaesthesia.

Suggested Readings

Selected articles from journals.

VSR 705 ADVANCES IN ANAESTHESIOLOGY 2+1

Objective

To impart the advanced knowledge of animal anaesthesia.

Theory

UNIT I

Considerations for general anaesthesia, drug interactions in anaesthesia, perioperative pain and distress, effects of anaesthetics on CNS function.

UNIT II

Pharmacology of preanaesthetics and anaesthetic adjuncts; injectable anaesthetics; dissociative anaesthetics; inhalation anaesthetics; local anaesthetics; muscle relaxants and neuromuscular blocking agents.

UNIT III

Anaesthetic machines and breathing system, airway management and ventilation, acid-base physiology and fluid therapy during anaesthesia, monitoring of anaesthetized patients, anaesthetic emergencies and accidents.

UNIT IV

Anaesthesia for selected diseases (cardiovascular dysfunction, pulmonary dysfunction, neurologic diseases, renal diseases, hepatic diseases, gastrointestinal diseases, endocrine diseases, airway diseases).

UNIT V

Anaesthesia for special patients (ocular patients, heart patients, caesarian section patients, trauma patients, neonatal and geriatric patients), euthanasia.

Practical

Various procedures for catheterization of heart and great vessels, haemodynamic changes and pulmonary function tests during trials of anaesthetics, electrocardiographic, encephalographic evaluation of central nervous system activity, cybernetics, data acquisition and retrieval.

Suggested Readings

Selected articles from journals.

VSR 706 ADVANCES IN DIAGNOSTIC IMAGING TECHNIQUES 2+1

Objective

To impart the advanced theoretical and practical knowledge of diagnostic imaging techniques and their interpretations.

Theory

UNIT I

Biological effects of radiations (alpha, beta, X-ray and gamma rays) *in vivo* and *in vitro* cellular response following radiation as an immunosuppressive agent.

UNIT II

Isotopes (natural and man-made); cyclotron reactor, half-life, decay pattern, storage and handling of radioactive material, fluoroscopy, magnetic resonance imaging and computerised axial tomography, xeroradiography, doppler techniques, indications for ultrasound diagnosis.

UNIT III

Methods in the detection of isotopes, Geiger-Muller tubes, photo-multiplier tube, medical use of isotope, dosimetry, nuclear medicine and its use in diagnosis of thyroid, kidney, bone and liver function studies.

UNIT IV

Labelling of isotope and biological uses, detonation and fission products.

UNIT V

Radiation therapy in cancer patients, biological effects of radiation physics, physics of radiation.

UNIT VI

Doppler techniques echocardiography and its application, MRI, CT scan, nuclear medicine, xeroradiography, positron emission tomography technique etc.

UNIT VII

Electromagnetic radiations, hazards of electromagnetic radiations and protection and bio-safety.

Practical

Radiation safety measures, handling radioactive material, measurement of thyroid function and cardiac output, demonstration of advanced radiological techniques.

Suggested Readings

Selected articles from journals.

VSR 707 NEUROSURGERY 2+1

Objective

To impart theoretical and practical knowledge of treatment of surgical affections of nervous system in animals.

Theory

UNIT I

Nervous system- anatomy and physiology.

UNIT II

Clinical neurology, pathogenesis of disease of the central nervous system.

UNIT III

Diagnostic methods- electrodiagnostic methods, neuroradiology.

UNIT IV

Fundamentals of neurosurgery, surgical approaches to brain, surgical diseases of peripheral nerves, surgical approaches to the spine, diseases of the spinal column, intervertebral disc diseases.

UNIT V

Intracranial surgery.

Practical

Instrumentation, neurological examination, imaging the spine; skull and brain, surgical approach to the cervical spine; thoracolumbar spine and brain.

Suggested Readings

Selected articles from journals.

VSR 708 EXPERIMENTAL SURGICAL TECHNIQUES IN 1+1
ANIMALS

Objective

To familiarize with designing of experiments and various surgical models for research.

Theory

UNIT I

General considerations and protocols for designing experiments.

UNIT II

Surgical models of various systems. Care and feeding of genobiotic experimental animals.

UNIT III

Rumen and intestinal fistulae, production of experimental peritonitis and ascitis, nephrectomy, adrenalectomy.

UNIT IV

Cannulation of various blood vessels and lymphatics, portacaval shunt.

UNIT V

Principles of transplantation of organs and use of prosthetic material.

UNIT VI

Tissue engineering-*in vitro*, *in vivo*, *ex vivo* techniques, regenerative therapy.

Practical

Various experimental surgical techniques and special problems related to veterinary surgery, radiology and anaesthesiology, transplantation of skin, fascia, tendon and blood vessels.

Suggested Readings

Selected articles from journals.

VSR 789 SPECIAL PROBLEMS IN ANAESTHESIA 0+2

Objective

To impart practical exposure to experimental models related to anaesthesia for research.

Practical

Investigative anaesthetic problems in clinical or experimental models. Didactic and interpersonnel learning-teaching, problem solving self-learning strategies in problems related to anaesthesia.

VSR 790 SPECIAL PROBLEMS IN SURGERY 0+2

Objective

To impart practical exposure to experimental models related to surgery for research.

Practical

Investigative surgical problems in clinical or experimental models. Didactic and interpersonnel learning-teaching, problem solving self-learning strategies in problems related to surgery.

VETERINARY SURGERY AND RADIOLOGY

List of Journals

- * American Journal of Veterinary Research
- * Canadian Veterinary Journal
- * Compendium of continuing Education for the practicing Veterinarian
- * Cornell Veterinarian
- * Equine Practice
- * Indian Journal of Veterinary Surgery
- * Journal of American Veterinary Medical Association
- * Journal of American Animal Hospital Association
- * Journal of Bone and Joint Surgery –A & B
- * Journal of Camel Practice and Research
- * Journal of Veterinary Emergency and Critical Care
- * Journal of Small Animal Practice
- * Journal of Veterinary Dentistry
- * Journal of Veterinary Medicine – Series A
- * Veterinary Anaesthesia and Analgesia
- * Veterinary clinics of North America – Small animal practice
- * Veterinary clinics of North America – Equine practice
- * Veterinary clinics of North America – Exotic animal practice
- * Veterinary clinics of North America – Large animal practice
- * Veterinary clinics of North America – Food animal practice
- * Veterinary Ophthalmology
- * Veterinary Radiology and Ultrasound
- * Veterinary Record
- * Veterinary Research Communication
- * Veterinary Surgery

e-Resources

- * www.blackwellpublishing.com/journal.asp (Veterinary Surgery)
- * www.blackwellpublishing.com/summit.asp (Veterinary anesthesia and Analgesia)
- * www.blackwellpublishing.com/journal.asp (Veterinary Radiology and Ultrasound)
- * www.blackwellpublishing.com/journal.asp (Veterinary Ophthalmology)
- * www.indianjournal.com/ijor.aspx (Indian Journal of Veterinary Surgery)

Suggested Broad Topics for Master's and Doctoral Research

- * Evaluation of preanaesthetics and anaesthetics in domestic animals
- * Management of pain in animals
- * Surgical Management of gastrointestinal tract disorders in bovines
- * Management of fractures in animals
- * Ultrasonography of soft organs of large and small animals

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
 Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
 Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
 James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
 Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
 Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
 Richard WS. 1969. *Technical Writing*. Barnes & Noble.
 Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
 Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
 Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503
(e-Course)

INTELLECTUAL PROPERTY AND ITS
MANAGEMENT

1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of animal varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.

Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.

Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 506
(e-Course)

DISASTER MANAGEMENT

1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

BSMA Committee on Veterinary Clinical Subjects

(Vety. Epidemiology, Clinical Medicine, Obst. & Gynae, Surgery & Radiology)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR
dated January 14, 2008)

Name	Address	Specialization
Dr. Simrat Sagar Singh Dean <i>Convener</i>	GADVASU, Ludhiana	Surgery
Dr. A.C. Varshney Dean	COVS, CSK HPAU, Palampur	Surgery
Dr. A.S. Nanda Director of Research	GADVASU, Ludhiana	ARGO
Dr. A.K. Sinha Dean	COVS, Ranchi Vety. College, Ranchi	ARGO
Dr. V. S. Rajora Professor	Dept. of Vety. Clinical Medicine, COVS, GBPUAT, Pantnagar	Clinical Medicine
Dr. A.K. Gehlot Dean	COVS, RAU, Jobner Campus, Bikaner	Medicine
Dr. S.K. Kotwal Assoc. Prof. & Head	Bombay Vety. College, Mumbai	Public Health
Dr. N.K. Rakha Prof. & Head	Dept of VEPM, COVS, CCS HAU, Hisar	VEPM
Dr A. M. Paturkar Professor	Bombay Vety. College, Parel, Bombay	Public Health
Dr. Jit Singh ADR <i>Member Secretary</i>	CCS HAU Hisar	Surgery

**NEW AND RESTRUCTURED
POST-GRADUATE CURRICULA & SYLLABI**

**Livestock Production Technology
&
Products Management**

Animal Genetics & Breeding

Animal Nutrition

Livestock Production and Management

Livestock Products Technology

Poultry Science



**Education Division
Indian Council of Agricultural Research
New Delhi**

January 2009

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PREAMBLE

Livestock sector has gained prominence during the past three decades owing to its impressive growth and increasing GDP contribution within the agricultural sector. Livestock rearing practices have dramatically changed in recent years from subsistence to commercial, subsidiary to main-occupational and unorganized to intensively organized systems. These achievements have taken place in spite of the limited priority and monetary allocations to this sector and the poor resources of the majority of the farmers who have contributed to this phenomenal transition. The high quality man power generated through the educational institutions dealing with veterinary and animal sciences has been mainly instrumental in fulfilling the technological backstopping needed at the field level, through scientific research and technology development. The farming community and the industry adopted latest innovations in production, processing, health and management, resulting in production and productivity enhancement and increased per capita availability of livestock products.

Today, India leads the world in milk production with around 100 million tonnes per annum. Over seventy per cent of the milk produced in India is contributed by semi-medium, small, marginal and landless farmers. Another significant feature of milk production is that over 56 per cent of it is derived from the buffalo, which is an animal species of pride to this country. Poultry sector has set the trend for other sub-sectors of livestock rearing by its intensive commercialization, high productivity level and technology adoption of a high order. Concerns of food and nutritional security are being adequately addressed through inclusion of food products of animal origin in the human diet, particularly the vulnerable sections of the society such as growing children, adolescents, pregnant and nursing mothers, senior citizens and convalescing patients.

Livestock sector is not only a sustainable livelihood option, but also an appropriate medium of socio-economic growth through educational empowerment, employment and entrepreneurship development and gender equity for millions of people in the country. Value addition at the farm level brings additional income to the producer and saves food products of animal origin from deterioration and wastage. Environmental protection through proper shelters, drainage, waste disposal and recycling has become all the more important when our country enters into the era of commercial and intensive production. There are several areas of untapped resources with large scope for development. In the meat sector, the sheep, goats and

swine need to be paid more attention. Buffalo meat production is gaining popularity with increased prospects of export. Emerging dimensions relating to phyto-sanitary monitoring and quality assurance are becoming immensely relevant at national and global levels.

It is imperative that, in tune with the change of times and modern needs, the large scale developments in science and technology in the field of livestock production and processing are appropriately incorporated into the proposed revised course curricula in respect of postgraduate and doctoral programmes. This task has been undertaken by the Broad Subject Matter Area (BSMA) Committee. The subject matter area has been identified as “Livestock Production Technology and Products Management”. This exercise has been the outcome of the initiative provided by the Education Division of Indian Council of Agricultural Research, which has constituted the 18 BSMA Committees to cover the entire area of agricultural sciences. The BSMA Committee on Livestock Production Technology and Products Management seriously deliberated upon the issues concerning animal science education in general, and livestock production technology and products management in particular. The curricula and syllabi of all the seven disciplines, viz., Animal Breeding, Animal Nutrition, Animal Physiology, Animal Products Technology, Livestock Production and Management, Meat Science and Poultry Science were discussed at length in the meetings and workshop convened by the BSMA Committee.

The key issues, which need to be specially addressed while contemplating on the revision of course curricula at PG and doctoral levels are: supply of high quality germplasm to farming community, compounded feed supply to intensive livestock production units, adoption of concepts such as total mixed rations, complete feeds, strategic bio-available micro-nutrient supplements, land use for intensive green fodder production, shelter designs for in-house livestock rearing amenable to automation and mechanization, clean milk production to be taken up as a national mission, phyto-sanitary measures for traceability and quality assurance of products of animal origin, onward linkages for processing and marketing of meat, particularly from small ruminants, swine and buffalo, cold chain infrastructure for meat, milk and eggs, entrepreneurship building and economic analysis of livestock production including pricing, insurance, credit, technological backstopping and assessment of economic losses associated with inadequate prioritization of the livestock enterprise.

The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/ dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

The BSMA Committee wishes to place on record the help rendered by Dr. Lalitha John, Dean, Madras Veterinary College, Faculty and Staff Members of TANUVAS especially Dr. T. Sivakumar and Dr. J. John Kirubaharan for coordinating the various BSMA committee meetings and for their active participation, unstinted cooperation and assistance. The help rendered by National Core Group under the Chairmanship of Dr. J.C. Katyal, Vice-Chancellor, CCS Haryana Agricultural University, Hisar for providing guidance and regulations and format is greatly acknowledged. The committee is also indebted to Dr. S.P. Tiwari, DDG (Education) and Dr. R.K. Mittal, ADG (EQR), ICAR for providing all administrative assistance. The critical inputs provided by Dr. Dharmeshwar Das (Member, NCG), Dr. B.K. Joshi, Dr. Arjava Sharma, Dr. N. Balaraman, Dr. V. Balakrishnan, Dr. B.T. Deshmukh, Dr. R.S. Yadav, Dr. T. Shivkumar, Dr. F.R. Sheriff, Dr. J.J. Robinson Abraham were helpful in designing this document. The basic document (1st draft) prepared by the faculty of Animal Sciences, CCS Haryana Agricultural University, Hisar, the efforts put in by the HAU faculty is highly appreciated.

Dr. N. Balaraman

Convener, BSMAC (Livestock Production Technology & Products Management)

EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in animal science disciplines have been prepared in the light of PG programs in vogue at different veterinary colleges in India and contemporary developments in animal sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master's level. It is proposed that each M.Sc./MVSc student should register for all the courses offered by the major department, instead of opting for courses of 1 or 2 sub-disciplines only.

II. Credit Requirements

- Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the animal science students as given below.
- The total course work of 40 credit hours has been proposed at M.Sc./M.V.Sc. level instead of minimum requirement 35 credit hours (Table 1), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together -11 credits.
- At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together-11 credits.
- Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and course(s) with a minimum of 3 credit hours from supporting subject(s) should be taken. Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject.
- The credit hours for minor and supporting subjects both at Master's and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.
- Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master's level, and at Doctoral level, if not studied already.
- The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for M.Sc./MVSc and 700 for Ph.D. programme.

Based upon the key issues that are assuming priority day by day, the areas which need to be strengthened in various disciplines, are outlined hereunder.

Animal Genetics and Breeding

Molecular techniques in animal breeding, biometrical techniques in animal breeding, conservation of animal genetic resources and bio-informatics in animal genetics and breeding.

Animal Nutrition

New concepts in feed technology, feed analysis and quality control, clinical animal nutrition, nutrition of companion and laboratory animals, nutrition of wild and captive animals, toxic constituents in animal feed stuffs, modern concepts in feeding of ruminants, monogastrics, rumen fermentation, micronutrients and nutrient-drug interaction.

Livestock Products Technology

Abattoir and slaughter technology, fresh and processed meat technology, animal by products processing, poultry other than chickens and broilers such as turkeys, ducks, geese, quails, emu and ostriches.

Livestock Production and Management

Shelter designs and engineering, climatology in relation to animal production, poultry farm and hatchery management, integrated livestock production systems, acts and regulations relating to animal welfare, livestock business management, management of rabbits and intensive rearing of goats, sheep, swine and buffaloes for meat and milk.

Poultry Science

Commercial layer and broiler production, breeder flock and hatchery management, bio-security of flock management, poultry economics, micro-nutrients and amino acids in poultry nutrition, commercial aspects of marketing and integration.

Regarding certain specific suggestions made during the presentation of the draft report of this BSMA Committee, the following response by way of clarification may be worthwhile mentioning:

Animal Physiology is distinct from Veterinary Physiology deals with physiological aspects relating to production, such as body maintenance, growth, lactation and various other productive and reproductive traits. While the governing basic features of Physiology remain

the same in both the streams, in Animal Physiology, the relationship with nutrition, breeding, management, climate and environment are given special emphasis.

Regarding the admission of B.Sc Agriculture and dairy science graduates to PG programmes in LPM, it can be considered by prescribing supplementary/pre-requisite courses, if need be, as per admission relations and concerned Advisory Committee Recommendations.

ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 600-series courses pertain to Master's level, and 700-series to Doctoral level. A Ph. D. student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
- Similarly, 699 and 799 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	28	17
Minor + Supporting (minimum 6 for minor & 3 for supporting)	11	11
Seminar	01	02
Research	20	45
Total Credits	60	75
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject. A suggested list of specified minor subjects is given below.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

Suggested list of specified minor subjects (departments)

Major Subjects	Minor Subjects
Animal Genetics and Breeding	Genetics, Animal Biotechnology, Statistics, Livestock Production and Management, Vety. Gynecology & Obstetrics, Animal Reproduction, Vety. Physiology, Vety. Biochemistry, Poultry Science, Animal Nutrition.
Animal Nutrition	Bio-chemistry, Veterinary Physiology, Livestock Production and Management, Animal Biotechnology, Livestock Product Technology, Poultry Science.
Livestock Production and Management	Animal Nutrition, Animal Genetics & Breeding, Livestock Products Technology and Veterinary and Animal Husbandry Extension
Livestock Products and Technology	Food Science and technology, Biochemistry, Microbiology, veterinary public health, Poultry science, Livestock Production and Management
Poultry Science	Animal Genetics & Breeding, Animal Nutrition, Livestock Product Technology, Livestock Production and Management.

Note: The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean post graduate studies.

ANIMAL GENETICS AND BREEDING
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
AGB 601	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1
AGB 603	POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING	2+1
AGB 604	SELECTION METHODS AND BREEDING SYSTEMS	3+1
AGB 605	BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING	3+1
AGB 606	CONSERVATION OF ANIMAL GENETIC RESOURCES	2+0
AGB 607	CATTLE AND BUFFALO BREEDING	2+1
AGB 608	SMALL FARM ANIMAL BREEDING (SHEEP, GOAT, SWINE AND RABBIT)	2+0
AGB 609	POULTRY BREEDING	2+1
AGB 610	LABORATORY ANIMAL BREEDING	1+0
AGB 691	MASTER'S SEMINAR	1+0
AGB 699	MASTER'S RESEARCH	20
AGB 701	RECENT ADVANCES IN ANIMAL GENETICS	2+0
AGB 702	RECENT TRENDS IN ANIMAL BREEDING	2+0
AGB 703	ADVANCES IN BIOMETRICAL GENETICS	2+1
AGB 704	ADVANCES IN SELECTION METHODOLOGY	2+1
AGB 705	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0
AGB 706	ADVANCES IN MOLECULAR CYTOGENETICS	2+0
AGB 707	UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1
AGB 791	DOCTORAL SEMINAR I	1+0
AGB 792	DOCTORAL SEMINAR II	1+0
AGB 799	DOCTORAL RESEARCH	45

ANIMAL GENETICS AND BREEDING

Course Contents

AGB 601 ANIMAL CYTOGENETICS AND IMMUNOGENETICS 2+1

Objective

To educate about basic principles of cytogenetics and immunogenetics and their applications in improving farm animals.

Theory

UNIT I

Development in animal cytogenetics and immunogenetics of farm animals. Immunoglobulins and their types: antigen-antibody interactions, Immune response, ELISA.

UNIT II

Major histocompatibility complex; genetics of biochemical variants and their applications; Ir-genes and concepts of disease resistance including major genes; hybridoma and its significance; concept of immuno-fertility, BoLA, BuLA, TLRs, Interleukins.

UNIT III

Chromatin structure of eukaryotes; chromosome number and morphology in farm animals banding and karyotyping; chromosomal and genetic syndromes, DNA packing in chromosomes, Z+B DNA, FISH chromosome painting and PRINS. RH Panel Mapping.

UNIT IV

Mutation and assays of mutagenesis; sister chromatid exchanges; recombinant DNA technique and its application in animal improvement programme.

Practical

Polymorphism of haemoglobulins, transferrins, enzymes/proteins; preparation of monovalent blood reagent-isoimmunization, titre testing and absorption of polyvalent serum; identification of bar bodies; in vitro and in vivo preparation of somatic metaphase chromosomes; screening of chromosomal abnormalities; microphotography and karyotyping; banding procedures for comparing the chromosomal complement, FISH and PRINS.

Suggested Readings

Hare WCD & Elizabeth L Singh 1999. *Cytogenetics in Animal Reproduction*. CABI.

Roitt I. 1997. *Essential Immunology*. Blackwell.

Stine GJ. 1989. *The New Human Genetics*. Wm C Brown Publ.

Summer AT & Chandley AC. 1993. *Chromosome Today*. Chapman & Hall.

AGB 602 MOLECULAR GENETICS IN ANIMAL BREEDING 2+1

Objective

To educate about molecular techniques to identify molecular markers as an aid to selection.

Theory

UNIT I

Basic concept: Genesis and importance of molecular techniques; Genome organization – physical and genetic map, current status of genome maps of livestock

UNIT II

Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting

UNIT III

DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer

UNIT IV

Statistical techniques for analyzing molecular genetic data, Quantitative Trait Loci (QTL) mapping and its application in animal breeding, Genome scan, Candidate gene approach, Genomic selection, Marker Assisted Selection- basic concept

Practical

Extraction and purification of genomic DNA, Gel electrophoresis, Restriction enzyme digestion of DNA and analysis, PCR, PCR-RFLP, PCR-SSCP, Bioinformatics tool for DNA sequence analysis, Design of primer, Isolation of RNA, cDNA synthesis, Statistical methods for analyzing molecular genetic data.

Suggested Readings

Akano IE 1992. *DNA Technology*. IAP Academic Press.

Micklos DA, Fryer GA & Crotty DA. 2003. *DNA Science*. Cold Spring Harbour.

Setlow JK. 2006. *Genetic Engineering – Principles and Methods*. Springer.

AGB 603

POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING

2+1

Objective

To study genetic structure of animal population and importance of genetic variation and covariation among traits.

Theory

UNIT I

Individual versus population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal populations. Approach to equilibrium under different situations: Viz: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci;

UNIT II

Small population: random genetic drift, effective population size, pedigreed populations, regular and irregular inbreeding systems.

UNIT III

Quantitative genetics-gene effects, population mean and variance and its partitioning, biometric relations between relatives.

UNIT IV

Genetic and phenotypic parameters-their methods of estimation, uses, possible biases and precision. Scale effects and threshold traits.

Practical

Problems relating to gene and genotypic frequencies under different conditions. Estimation of inbreeding in regular and irregular systems. Estimation of effective population size. Computation of quantitative genetic effects. Estimation of variance components. Computation of heritability, repeatability, genetic, environmental and phenotypic correlations and their standard errors.

Suggested Readings

- Bulmer MG. 1980. *The Mathematical Theory of Quantitative Genetics*. Clarendon Press.
- Crow JF & Kimura M. 1970. *An Introduction to Population Genetics. Theory*. Harper & Row.
- Falconer DS & Mackay TFC 1996. *An Introduction to Quantitative Genetics*. Longman.
- Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
- Pirchner F. 1981. *Population Genetics in Animal Breeding*. S. Chand.

AGB 604 SELECTION METHODS AND BREEDING SYSTEMS 3+1

Objective

To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.

Theory

UNIT I

Type of selection and their genetic consequences. Response to selection and its prediction and improvement of response to selection.

UNIT II

Theoretical aspects of accuracy and efficiency of different base of selection. Prediction of breeding value using different criteria. Combined Selection. Correlated response to selection and efficiency of indirect selection.

UNIT III

Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateau and limit.

UNIT IV

Genetic aspects and consequences of various mating systems. Effects of mating systems on mean and variance. Application of various mating system in animal improvement. Selection for general and specific combining ability. Genetic polymorphism and its application in genetic improvement.

Practical

Estimation of breeding values from different sources of information. Prediction of direct and correlated response to different bases of selection. Computation of breeding values using different sources of information for female and male

selection. Computation of realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits. Estimation of heterosis for different types of crosses. Estimation of GCA and SCA

Suggested Readings

- Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
- Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
- Tomar SS 1996. *Text Book of Population Genetics*. Vol. I. *Qualitative Inheritance*; Vol. II. *Quantitative Inheritance*. Universal Publ.

AGB 605 BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING 3+1

Objective

To educate about the various biometrical techniques for data analysis and their applications in animal breeding research.

Theory

UNIT I

Review of basic concepts in statistical inference and balanced experimental designs. Nature of structure of animal breeding data and sources of variation.

UNIT II

Introduction to matrix algebra, types of matrices and matrix operations. Determinants and their properties, methods of finding inverse of a matrix and their application

UNIT III

ANOVA, Regression and Correlations, Henderson's methods for estimation of variance components, Basic concepts of linear models, Least-squares analysis, maximum likelihood; Method of estimation; Generalized LS and weighted LS. Fisher's discriminant function and its application, D2 - Statistics in divergent analysis.

UNIT IV

Linear models in animal breeding, Methods of analysis of unbalanced animal breeding data. Adjustment of data. Data base management and use of software packages in animal breeding.

Practical

Matrix applications, determinant and inverse of matrices; Building of models for various types of data; Estimation of variance components; Least squares method for analysis of research data; Collection, compilation, coding, transformation and analysis of animal breeding data by using above biometrical techniques with computer application.

Suggested Readings

- Henderson CR. 1984. *Application of Linear Models in Animal Breeding*. Univ. of Guelph.
- Kaps M & Lamberson WR. 2004. *Biostatistics for Animal Science*. CABI.
- Mather K & Jinks JI. 1977. *Introduction to Biometrical Genetics*. Chapman & Hall.

Searle Sr. 1971. *Linear Models*. John Wiley & Sons.
Singh RK & Choudhary BD. 1977. *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani.

AGB 606 CONSERVATION OF ANIMAL GENETIC RESOURCES 2+0

Objective

To educate about the concept of conservation of Animal Genetic Resources and their sustainable utilization.

Theory

UNIT I

Domestic Animal Diversity in India, its origin, history and utilization. Present status and flow of Animal Genetic Resources and its contribution to livelihood security. Methodology for genotypic characterization of livestock and poultry breeds through systematic surveys. Fodder availability; management of breed; physical, biochemical and performance traits and uniqueness of animals of a breed; social, cultural and economic aspects of their owners/communities rearing the breed.

UNIT II

Methodology for molecular genetic characterization, diversity analysis and relationship among the breeds. Concept of conservation, *In-situ* and *ex-situ* (*in-vivo* and *in-vitro*); models of conservation; prioritization of breeds for conservation. National and international strategies for conservation of Animal Genetic Resources.

UNIT III

Status, opportunities and challenges in conservation of AnGR. IPR issues pertaining to animal genetic resources/animal products or by-products. Registration of livestock breeds and protection of livestock owner's rights in India.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH.
Nicholas FW. 1987. *Veterinary Genetics*. Claredon Press.
Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 607 CATTLE AND BUFFALO BREEDING 2+1

Objective

To educate about the concept of cattle and buffalo breeding.

Theory

UNIT I

History of dairy cattle and buffalo breeding. Breeds of cattle and buffalo and their Characterisation. Inheritance of important economic traits. Recording and handling of breeding data. Standardization of records. Computation of correction factors for the adjustment of the data. Estimation of breeding values of the cows and bulls.

UNIT II

Sire evaluation methods using single trait and multiple traits: construction of Sire indices, Sire evaluation under animal model, sire mode; and maternal grand sire model. Open nucleus breeding systems with MOET.

UNIT III

Methods of cross breeding. Breeding of type, milk quality and production efficiency. Plans for developing new breeds of dairy cattle. History of development of important breeds of dairy cattle.

UNIT IV

Considerations in the import of exotic germplasm for breeding cattle in the tropics. Appraisal of buffalo and cattle breeding programme. Role of breed associations in dairy improvement.

Practical

Performance recording – milk recording - Estimation of economic traits – Standardization of records – Index cards – Sire evaluation – Comparison of latest methods - Computation of genetic parameters – Genetic gain – Estimation of heterosis – Culling and replacement.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH.

Nicholas FW. 1987. *Veterinary Genetics*. Clarendon Press.

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.

Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 608

SMALL FARM ANIMAL BREEDING (Sheep, Goat, Swine and Rabbit)

2+0

Objective

To educate about the small farm animal breeding concepts.

Theory

UNIT I

Breeds–Economic traits–Prolificacy–Breeding records and standardization.

UNIT II

Genetic parameters – Selection of males and females – Breeding systems. Development of new breeds.

UNIT III

Breeding policy – Breeding research – Conservation of breeds.

UNIT IV

Culling and replacement – EADR.

Suggested Readings

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.

Turner HN & Young SSY. 1969. *Quantitative Genetics in Sheep Breeding*. MacMillan.

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 609

POULTRY BREEDING

2+1

Objective

To educate about the advances in poultry breeding practices.

Theory

UNIT I

Origin and history of poultry species: Chicken, turkey, duck and quail – Important qualitative traits in poultry including lethals – Economic traits of egg-type chicken and their standardization – Selection criteria – Aids to selection: Index selection and Osborne index – Restricted selection index – Economic traits of meat – type chicken and their standardization.

UNIT II

Selection criteria and selection indices – Response to selection – Genetic controls – Genotype and environment interaction – Inbreeding, and its effects on production traits in egg and meat-type chickens – Inbred lines – Strain development – Crossing : strain and line crosses – Introduction to diallel cross – Utilisation of heterosis and reciprocal effect – Reciprocal recurrent selection and recurrent selection.

UNIT III

Industrial breeding – Artificial insemination in chicken – Autosexing – Random Sample Test.

UNIT IV

Biochemical variants and immunogenetics of poultry – Use of molecular genetics in poultry breeding – Quantitative trait loci and marker-assisted selection – Conservation of poultry genetic resources

Practical

Inheritance of qualitative traits – Economic traits of egg-type and meat-type chicken – Procedures of standardization – Estimations of heritability, correlation between various production traits, inbreeding co-efficient and heterosis – Selection of sires and dams – Osborne index – Restricted selection index – Collection and evaluation of semen and insemination – Diallel cross.

Suggested Readings

Crawford RD.1990. *Poultry Breeding and Genetics*. Elsevier.

Hutt FB. 2003. *Genetics of Fowl*. Norton Greek Press.

Singh RP & KumarJ. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani.

AGB 610

LABORATORY ANIMAL BREEDING

1+0

Objective

To educate about the laboratory animal breeding principles.

Theory

UNIT I

Introduction to laboratory animal genetics – Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits.

UNIT II

Selection and Mating methods/systems – monogamous, polygamous and others.

UNIT III

Development of genetically controlled laboratory animals – Rules for nomenclature, inbred strains, outbred stocks, mutant stocks, recombinant inbred strains, transgenic strains, gene targeting and production of ‘gene knock-out’ animals.

UNIT IV

Genetic control and monitoring – Record keeping – Ethics of laboratory animal use.

Suggested Readings

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 701 RECENT ADVANCES IN ANIMAL GENETICS 2+0

Objective

To impart knowledge about the latest tools and techniques of animal genetics and their uses in animal sciences.

Theory

UNIT I

Eukaryotic genome: Gene families, Pseudogenes SnRNPs, Gene conversion, tandemly repeated genes, Nuclear Organiser region, mRNA splicing, Minisatellites, Microsatellites and its usage.

UNIT II

Transposons, RNA processing Transcription regulation of gene expression, selective gene amplification, post transcriptional regulation. The proteasome and longevity of proteins.

UNIT III

Transgenic animals their benefits in livestock production, somatic cell nuclear transfer, transgenic animals in biomedical research, ethical consideration of transgenic animals; gene therapy and transgenic animal production. Pharming of Pharmaceutical.

UNIT IV

Radiation hybrid panels and their usage in livestock, microdissection of chromosomes, *In-situ* hybridization, chromosome painting, meiotic crossing over, genome selection; Structure and functions of major histocompatibility complex, T Cell receptor, CD4, Toll Like Receptors and their functions.

Suggested Readings

Selected articles from journals

AGB 702 RECENT TRENDS IN ANIMAL BREEDING 2+0

Objective

To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

Theory

UNIT I

Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding.

UNIT II

Formulation of detailed breeding plans ongoing breed improvement programmes and their impact analysis in various species of livestock under different situations.

UNIT III

Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

Suggested Readings

Selected articles from journals.

AGB 703 ADVANCES IN BIOMETRICAL GENETICS 2+1

Objective

To impart knowledge about recent advances in population genetic theory and application in animal breeding.

Theory

UNIT I

Mating designs; genetic basis of tripple test cross analysis (TTC); triallel analysis, partial diallel crosses and mating design for studying reciprocal and maternal differences.

UNIT II

Models for studying the inheritance of endosperm characters; classificatory problems; discriminant function, D2 analysis; principal component analysis.

UNIT III

Use of genetic parameters for prediction of recombinant inbred lines; advances in studies of genotype environment interaction and selection indices.

UNIT IV

Generation matrix and its use in population genetics; gene mapping of QTL (quantitative trait loci).

Practical

Estimation of genetic parameters – Diallel analysis – Triallel analysis – D2 analysis – Problems in Matrix.

Suggested Readings

Selected articles from journals.

AGB 704 ADVANCES IN SELECTION METHODOLOGY 2+1

Objective

To educate about the latest advances in selection theory and their application in animal breeding.

Theory

UNIT I

Fundamental theorem of natural selection; Selection in finite populations-effect on genetic structure and variance. Optimum designs for the estimation of genetic parameters. Design of selection experiments for testing selection theory.

UNIT II

Methods of measurement of genetic and environmental trends. Advances in selection indices Multistage, Restricted and retrospective selection indices.

UNIT III

Multi-information, Empirical evaluation of selection theory: genetic slippage, limits to selection, asymmetry of response, selection experiments, effect of selection on variance.

UNIT IV

Selection for threshold traits; single and multiple trait best linear unbiased estimation (BLUE) and prediction (BLUP); selection under single and multiple trait animal models; direct and correlated response through various selection indices, relationship between BLUP and selection index; fundamentals of marker assisted selections.

Practical

Estimation of relative economic values; determination of culling levels and selection intensity; construction of various indices; estimation of direct and correlated response; QTL analysis using LDMAS & LEMAS.

Suggested Readings

Selected articles from journals

AGB 705 BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING 2+0

Objective

To educate about basic concepts of bioinformatics and their applications in Animal Genetics and Breeding.

Theory

UNIT I

Overview of bioinformatics, Database concepts, Algorithms, Information resources for protein and genome databases: Gene Bank, EMBL, SWISS-PROT, PROSITE.

UNIT II

Nucleotide and protein sequence analysis, Pair-wise and multiple sequence alignments, Phylogeny, Micro-array processing, Clustering, Analysis software, Secondary database search.

UNIT III

Genetic characterisation, Use of bioinformatics tools for identifying QTL and selection of elite germplasm.

Suggested Readings

Selected articles from journals.

AGB 706 ADVANCES IN MOLECULAR CYTOGENETICS 2+0

Objective

To educate about the advances in cytogenetics and their application in animal genetic and breeding

Theory

UNIT I

Structure of eukaryotic chromosomes – Evolution of karyotype – Various in vitro cell culture techniques – Cell lines and utility – Genotoxicity.

UNIT II

Somatic cell genetics – Stem cell genetics – Molecular cytogenetics and gene mapping – ISH, FISH, Radiation hybrid mapping, Fibre-FISH, PRINS.

UNIT III

Positional cloning – Spectral karyotyping.

UNIT IV

Image analysis – Chromosome walking – Chromosome painting.

Suggested Readings

Selected articles from journals.

AGB 707

**UTILISATION OF NON-ADDITIVE GENETIC VARIANCE 2+1
IN FARM ANIMALS**

Objective

To educate about the recent advances in estimation of non-additive genetic variation and possible use in developing synthetic population of livestock and poultry.

Theory

UNIT I

Heterosis – forms and genetic basis; detection and estimation of non-additive genetic variance – average dominance, overdominance.

UNIT II

Partitioning of between cross variance – general combining ability, specific combining ability and reciprocal effects; methods of analyzing diallel crosses; utilization of non-additive genetic variance.

UNIT III

Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

UNIT IV

Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.

Practical

Computation of degree of dominance using NC Plans; analysis of partial and complete diallel cross data; estimation of crossbreeding effects; estimation of genetic correlation among paternal purebred and crossbred half sibs; computation of response through RS and RRS.

Suggested Readings

Selected articles from journals.

ANIMAL GENETICS AND BREEDING
List of Journals

- ❖ Animal Biotechnology
- ❖ Animal Production
- ❖ Animal Reproduction Science
- ❖ Animal Genetics
- ❖ Animal Science
- ❖ Animal Genetic Resource Information
- ❖ Asian-Australian Journal of Animal Sciences
- ❖ Biochemical Genetics
- ❖ Biometrical Journal
- ❖ Biometrics
- ❖ Biodiversity and Conservation
- ❖ British Veterinary Journal
- ❖ Canadian Journal of Animal Sciences
- ❖ Canadian Journal of Genetics and Cytology
- ❖ Chromosoma
- ❖ Chromosome Research
- ❖ Current Genetics
- ❖ Current Genomics
- ❖ Current Opinion in Genetics and Development
- ❖ Cytogenetics and Cell Genetics
- ❖ Developmental Genetics
- ❖ DNA Sequence
- ❖ DNA and Cell Biology
- ❖ Evolution
- ❖ Gene
- ❖ Gene Expression
- ❖ Gene Therapy
- ❖ Genetica
- ❖ Genetics
- ❖ Genetics and Molecular Biology
- ❖ Genetical Research
- ❖ Genome Research
- ❖ Genomics
- ❖ Heredity
- ❖ Immunogenetics
- ❖ Indian Journal of Animal Science
- ❖ Indian Journal of Experimental Biology
- ❖ Indian Journal of Heredity
- ❖ Indian Journal of Animal Reproduction
- ❖ Japanese Journal of Breeding
- ❖ Journal of Animal Genetics & Breeding
- ❖ Journal of Dairy Research
- ❖ Journal of Dairy Sciences

- ❖ Journal of Heredity
- ❖ Journal of Animal Science
- ❖ Journal of Genetics & Breeding
- ❖ Journal of Research, HAU
- ❖ Journal of Research, PAU
- ❖ Journal of Rural Development
- ❖ Journal of Genetics
- ❖ Molecular Biology
- ❖ Theoretical and Applied Genetics
- ❖ World Animal Review
- ❖ World Review of Animal Production

e-Resources

- ❖ <http://www.ncbi.nlm.nih.gov/>
- ❖ <http://www.genome.gov>
- ❖ <http://www.hgsc.bcm.tmc.edu/projects/bovine>
- ❖ <http://www.animalgenome.org>
- ❖ <http://www.blackwell-synergy.com>
- ❖ <http://www.genomics.liv.ac.uk>
- ❖ <http://www.biomedcentral.com>
- ❖ <http://www.genomealliance.org.au>
- ❖ <http://www.csiro.au>
- ❖ <http://www.isag.org.uk>
- ❖ <http://www.ebi.ac.uk/imgt/>
- ❖ <http://www.csrees.usda.gov>

Suggested Broad Topics for Masters and Doctoral Research

- ❖ Animal Genetic Resources characterization and evaluation using field survey and molecular markers
- ❖ Animal Genetic Resource enhancement through selection/crossbreeding/reproductive biotechnology/molecular biology
- ❖ Identification of molecular markers for economic traits
- ❖ Genetic basis for improvement in quantitative traits
- ❖ Breeding tools for Sire evaluation
- ❖ Appropriate models for evaluating animal breeding values
- ❖ Transgenesis and gene transfer
- ❖ Genetics of Disease Resistance

ANIMAL NUTRITION
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
ANN 601	ANIMAL NUTRITION – ENERGY AND PROTEIN	3+0
ANN 602	ANIMAL NUTRITION – MINERALS, VITAMINS AND FEED ADDITIVES	3+1
ANN 603	FEED TECHNOLOGY	1+1
ANN 604	FEED CONSERVATION ,STORAGE AND QUALITY CONTROL	2+2
ANN 605	RUMINANT NUTRITION	2+1
ANN 606	NON-RUMINANT NUTRITION	1+1
ANN 607	NUTRITION OF COMPANION/LABORATORY, WILD AND ZOO ANIMALS	2+1
ANN 608	RESEARCH TECHNIQUES IN ANIMAL NUTRITION	1+3
ANN 609	NON CONVENTIONAL FEED STUFF AND TOXIC CONSTITUENTS/ANTIMETABOLITES IN ANIMAL FEEDSTUFF	2+1
ANN 691	MASTER’S SEMINAR	1+0
ANN 699	MASTER’S RESEARCH	20
ANN 701	MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION	3+0
ANN 702	MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS	2+0
ANN 703	NUTRITION AND RUMEN FERMENTATION	1+1
ANN 704	ADVANCES IN MICRONUTRIENTS	1+0
ANN 705	ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH	1+2
ANN 706	ADVANCES IN FEED TECHNOLOGY	1+1
ANN 707	CLINICAL NUTRITION	1+1
ANN 708	NUTRIENT AND DRUG INTERACTION	2+0
ANN 709	NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING	2+0
ANN 791	DOCTORAL SEMINAR I	1+0
ANN 792	DOCTORAL SEMINAR II	1+0
ANN 799	DOCTORAL RESEARCH	45

ANIMAL NUTRITION

Course Contents

ANN 601 ANIMAL NUTRITION – ENERGY AND PROTEIN 3+0

Objective

Familiarization with fundamental concepts of energy and proteins, metabolism of carbohydrate, fat and protein and their efficiency of utilization. Requirement of carbohydrates, fat and proteins for various physiological functions.

Theory

UNIT I

Basic terminology and classification of carbohydrates, fats and proteins. Fundamental concepts of Digestion and metabolism of Carbohydrate Fat and Protein in different species of animals. Gluconeogenesis, Recent advances in glucogenic precursors on acetate utilization. NPN metabolism, urea fermentation potential and metabolizable protein. Amino acids imbalance, antagonism and toxicity.

UNIT II

Measures of feed energy. Partitioning of feed energy. Efficiency of energy and Protein utilization. Feeding standards- comparative appraisal and limitations.

UNIT III

Rumen degradable Protein (RDP), and rumen undegradable protein (UDN) and Kinetics. Energetics of protein synthesis and turn over. Quantification of microbial protein synthesis. Protein quality determination in monogastrics and utility.

UNIT IV

Energy balance, Fasting catabolism. Direct and indirect calorimetry. Determination of energy and protein requirements. Energy and protein requirement for maintenance, growth, pregnancy and lactation in ruminants, companion animals and poultry.

Suggested Readings

- Blaxter K. 1989. *Energy Metabolism in Animal and Man*. Cambridge Univ. Press.
- Bondi A. 1987. *Animal Nutrition*. Wiley InterScience.
- Crampton EW & Harris LE. 1969. *Applied Animal Nutrition*. WH Freeman.
- Maynard LA, Loosli JK, Hintz HF & Warner RG. 1987. *Animal Nutrition*. McGraw-Hill.
- McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.
- Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.
- Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.

Objective

Role, requirement, functions, deficiency and toxic effects of vitamins, essential, probably essential and toxic minerals. Understanding soil-plant-animal-human relationship for utilization of minerals. Recent trends in the use of feed additives, probiotics, prebiotic and enzymes in animal feeding.

TheoryUNIT I

Essential minerals, general role of minerals, soil-plant-animal-human relationship, requirement of minerals, factors affecting requirements. Macro elements and micro elements, their distribution, metabolism, physiological functions, deficiencies and excesses, requirements and sources. Probable essential minerals. Toxic minerals.

Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water soluble and fat-soluble vitamins.

UNIT II

Critical minerals for ruminants and non-ruminants, chelates and chelated minerals. Inter-relationship of minerals with other nutrients. Impact of minerals arising from industrial affluent on animal health and production. Critical limits of minerals in edible herbage. Bioavailability studies in minerals. Impact of minerals on reproduction. Area specific minerals.

UNIT III

Relationship of vitamins with other nutrients. Critical vitamins for ruminants and non-ruminants. Feed additives including probiotics Prebiotics, Symbiotics and feed enzymes. Research techniques in nutrition.

Practical

General principles of mineral estimation, Sampling and processing techniques, Estimation of macro- and micro-minerals. Determination of bioavailability of minerals. Formulation of mineral mixture for various species. Identification of adulterants and quality control. Atomic absorption spectrometry in mineral estimation. Preparation of diets for mineral studies. Principles of vitamin estimation. Estimation of some important vitamins (vitamin A,E,C). Formulation of vitamin mixture for various species.

Suggested Readings

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.
- Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques*. Kalyani.
- McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.
- McDowell LR. 2003. *Minerals in Animal and Human Nutrition*. Reed Elsvier India.
- Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.
- Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

Underwood EJ & Shuttle 1999. *The Mineral Nutrition of Livestock*. 3rd Ed. CABI.

ANN 603

FEED TECHNOLOGY

1+1

Objective

Introduction to the subject, formula feed manufacturing and different operations involved. Layout, designing, operation and management of feed mill.

Theory

UNIT I

Importance of feed technology in relation to animal productivity. The integrated biological, chemical and physical basis for evaluating the inherent nutritional quality of feed ingredients and feeds.

Familiarization of various feed mill equipments, layout and operations. Problems of feed manufacturing units and control measures. Quarantine measures.

UNIT II

Introduction to the formula feed manufacturing including principles of material handling, grinding, mixing, pelleting and other major processing operations. Crumbling, Flaking, Popping, Extrusion.

Principles of instrumentation and analysis, with emphasis on application to quality control and research in the feed industry.

UNIT III

The formulation of concentrate mixtures, premixes and rations using computer. Automated feed mill. Personal management in feed plants, laws and regulation of feed manufacturing industry. Codex alimentarius, HACCP.

Organizational charts for small, medium and large feed plants, labour standard, planning and production programme, handling of plant equipment. Merits and demerits of automated feed plant

Practical

Identification of feed ingredients and their specifications, as well as compound feed for different categories of livestock and poultry. Feed microscopy. Formulating premixes. Introduction to Pulverisers, pelletisers, complete feed blocks equipments Plant layout and design of different capacity of feed mills, problems related to feasibility, records keeping in different sections of feed mill. Experiential learning at the feed plant for preparing feed, urea molasses mineral blocks, mineral mixture.

Suggested Readings

Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.

Givens DI. 2000. *Forage Evaluation in ruminant Nutrition*. Great Britain Publ.

Gohl BO. 1985. *Tropical Feeds*. FAO.

Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.

- McEllihner, Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.
- Perry TW. 2004. *Feeds and Feeding*. Prentice Hall.
- Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.
- Zaworski F. 1997. *Feed Industry Red Book*. ZMAG Publ.

ANN 604 FEED CONSERVATION, STORAGE AND QUALITY CONTROL 2+2

Objective

To acquaint with inherent nutritional quality of feed ingredients and feeds. Evaluation of feeds and fodders and feed preservation techniques. Procurement and storage of feed ingredients. Losses during storage and its control.

Theory

UNIT I

Principles of feed and fodder processing and preservation techniques, their merits and demerits. Procurement, planning and purchase procedures; traditional and modern farm level storage structures. Feed storage and godown management, estimation of storage capacity and stack plan.

UNIT II

Evaluation of processed and preserved feeds and forages. Role of moisture, temperature and relative humidity during storage of feedstuffs and their effect on biotic factors. Handling and storage of liquid feed Ingredients. Physical and chemical changes in feeds during storage; storage losses; insect pests and rodents in feed stores and their control; Role of fungi, tolerance limits and measures to check them in stored products.

UNIT III

Factors affecting the quality of feed and feedstuffs on preservation. Microbiological evaluation of processed and preserved feeds, Effect of preservation on nutritional value of feed. Properties and mode of action of pesticides and fumigants; principles of good sanitation and hygiene of godowns.

UNIT IV

Proximate composition, Limitations of various systems of analysis, Partitioning of forage fibre by Van Soest method, Quality control of fed ingredients, Specifications of feed ingredients and finished feeds, BIS standard., Pesticide and insecticide residues in feeds

Practical

Laboratory evaluation of preserved and processed feed and forages. Physical properties of feeds and feedstuffs; identification of insect-pests and fungi in stored products; techniques for detection of hidden infestation in grains; quality control and inspection of stored feed materials; moisture equilibrium determination and estimation of chemical changes including alcoholic acidity, rancidity and uric acid in feeds during storage.

Weende proximate analysis, Van Soest fibre fractionation, Enzymatic evaluation, Pro rata deduction (Feed laws), urea, FFA, peroxide value, adulterants, and heavy metal

Suggested Readings

- Givens DI. 2000. *Forage Evaluation in Ruminant Nutrition*. Great Britain Publ.
- Khare BP. 1994. *Stored Grain Pests and their Management*. Kalyani.
- Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques in Nutritional Biochemistry*. Kalyani.
- Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.
- McEllihner Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.
- Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.

ANN 605

RUMINANT NUTRITION

2+1

Objective

Requirement of nutrients for different physiological functions in various ruminant species. Latest concepts of feeding the nutrients for maximising production.

Theory

UNIT I

Nutrients and their metabolism with special reference to milk, meat and wool production.

UNIT II

Feeding standards, their history, comparative appraisal and limitations. Classification of feedstuffs. Nutrient requirements for calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat.

UNIT III

Introduction to rumen microflora and fauna. Development of rumen. Role of milk replacers and calf starters

UNIT IV

Feed formulation of large and small ruminants for different physiological stages. Concept of complete feed. Limiting nutrients and strategic feeding of high yielding ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status. Importance of CLA, omega fatty acids, Scope for value addition in milk, Different systems of feeding buffalo for beef production.. Feeding during natural calamities, feeding in various agro-climatic zones of India.

Practical

Design and planning of feeding experiments. Identification of feed and fodder on the basis of its composition. Artificial rumen technique, Methods for evaluation of feedstuffs- in vitro gas, in sacco digestion kinetics. Determination of nutritive value of feeds and fodders by metabolism trial in dairy cattle, determination of nutritive value of pastures by the use of range techniques, study of rumen metabolic profile. Preparation of Bypass Nutrients Identification of rumen microbes and rumen studies.

laboratory , wild and zoo animals. Natural dietary habits. Nutritional requirements of various species of animals.

UNIT II

Feeding standards and feeding habits of companion / laboratory animals. Importance of colostrum and feeding of neonates and growing animals. Feeding and care of nursing mothers. Feeding of sick and old animals. Post Surgical nutrition.

UNIT III

Ration formulation for captive animals. Artificial feeding and feeding during emergency. Nutritive characteristics of forages for wild animals. Adequacy of forage plants for wild and zoo animals. Diets used in captivity. Raising orphans. Nutritional melodies. . Nutrition of semi wild and semi domestic animals like mithun and yak under special topography

UNIT IV

Composition, presentation, sterilization, palatability, assessment and storage of companion/laboratory animal diets. companion food tables and their nutritional assessment. Mistakes and misleading information on companion food labels and labeling.

UNIT V

Nutraceuticals in companion / laboratory foods and animal foods. Nutritional deficiency diseases. Geriatric nutrition – corrective measures

Practical

Formulation and preparation of hygienic, balanced diets and feeding for companion/laboratory animals. Characteristics of ration formulation and feeding schedules wild and zoo animals. Feeding schedules for sick and orphan wild / zoo animals. Artificial and emerging feeding. General feeding habits and different feed constituents of wild and captive animals. Research methodology of companion/laboratory animals. Processing and storage of companion/laboratory diets. Visit to Zoological parks and wildlife sanctuary.

Suggested Readings

Case LP. 1995. *Canine and Feline Nutrition*. St. Louis Publ.

Church DC. 1980. *Digestive Physiology and Nutrition in Ruminants*. Oxford Press.

Givens DI, Owel E, Aford REF & Omed HM. 2000. *Forage Evaluation in Ruminant Nutrition*. CABI.

Petter WL & Pearson AEG. 1971. *The Laboratory Animals- Principles and Practices*. Academic Press.

Reddy DV. 2003. *Applied Nutrition*. Oxford & IBH.

Robbins C & Cunha T. 1994. *Wildlife Feeding and Nutrition*. Reed Elsevier.

ANN 608

RESEARCH TECHNIQUES IN ANIMAL NUTRITION

1+3

Objective

Planning and designing of experiments, use of various techniques in estimating chemical and bio-chemical constituents in feeds, fodders, blood, milk, rumen liquor, meat, wool etc.

Theory

UNIT I

Principles of animal experimentation. Specialized feed compounding. Introduction and principle of GLC, HPLC, AAS, tracer technique, flame photometer, NIR, SF6, amino acid analyzer.

UNIT II

Importance and principle of various techniques in estimating chemical and biochemical constituents and toxic principles in feeds, fodders. Importance, principles and procedures for estimating chemical and biochemical constituents in blood, milk, rumen liquor, meat, wool etc.

Practical

Cell Wall partitioning, Lignin as internal marker in feedstuffs, Mineral estimation by atomic absorption spectrophotometer, In-vitro/in-sacco determination of digestibility and digestion kinetics. Determination of energy content of feed, faeces and urine using bomb calorimeter. Methodology for quality improvement of animal feeds. Interpretation and presentation of results. Tracer techniques in Animal Nutrition. Quality evaluation of silage and hay, feed energy estimation; nitrate, urea, aflatoxin, salmonella, glycosides and sedimentation tests. Blood profile, meat quality.

Suggested Readings

Bondi AA. 1987. *Animal Nutrition*. Wiley InterScience.

Gupta PC, Khatta VK & Mandal AB. 1988. *Analytical Techniques in Animal Nutrition*. CCS HAU Press.

Pandey DN & Bajpai A. 2003. *Recent Trends in Animal Nutrition and Feed Technology for Livestock, Pets and Laboratory Animals*. International Book Distr.

Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

ANN 609

NON CONVENTIONAL FEEDSTUFFS AND TOXIC CONSTITUENTS/ANTIMETABOLITES IN ANIMAL FEEDSTUFF

2+1

Objective

To understand the importance of alternate feeds and their use in augmenting profit in livestock farm. Different toxins present in feed stuffs, their properties and detoxification techniques.

Theory

UNIT I

Present and future feed requirements and current availability for livestock and poultry. Use of non-traditional feeds – By-products of agricultural, industrial, food processing units and forest by-products. Evaluation by chemical and biological methods. Formulation of economical rations. Level of inclusion of various non conventional feeds in livestock ration

UNIT II

Classification of toxic principles in animal feedstuffs. Chemico-physical properties of various toxins. Effect of toxins on biological system and nutrients utilization in different species of livestock. Detoxification of toxin principles

by various physical, chemical and biological techniques. Insecticide and pesticide residue detection.

Practical

Estimation of various protease inhibitors; tannins; and mycotoxins in various feeds and feedstuffs. Nitrates, HCN, oxalates, insecticide and pesticide residues, saponins, Gossypol, mimosine, heavy metals..

Suggested Readings

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.
Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*. Academic Press.
Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.
McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.
Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. 4th Ed. John Wiley & Sons.
Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.
Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

ANN 701

MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILAZIATION 3+0

Objective

To impart knowledge of modern concepts in nutrient requirement and feeding and enhanced utilization in ruminant and recent development in analysis of forages.

Theory

UNIT I

Developments in ruminant digestive physiology – Energy protein requirement and measurement – Requirements of other nutrients. Importance of energy and protein quantity and quality Feed input and milk output relationship.

UNIT II

Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat producing ruminants. Concept of Phase feeding. Bypass Nutrient technology. Feeding during stress. Nutrition-immunity interaction. Designer milk and meat. Rumen manipulation to reduce methanogenesis. Nitrogen oxide emission and heavy metal residues. Metabolic profile tests.

UNIT III

Use of conserved forages in ruminant feeding. Chemical composition of common and newer forage – Factors affecting nutritive value of commonly available grasses, pastures, silage, hay and crop residues, voluntary intake of fodder at different stages of growth.

Newer methods of forage evaluation – calculated in vitro ME and DOMD by using prediction equations. Merits and demerits of using leaf protein. Top feeds and their effective utilization – pasture consumption and evaluation studies.

UNIT IV

Seminars on current topics of special interest.

Suggested Readings

Selected articles from journals

ANN 702 MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS 2+0

Objective

To impart knowledge on modern concepts in nutrient requirement and feeding of monogastric livestock

Theory

UNIT I

Nutritional factors affecting egg quality and hatchability in poultry. Feeding for designer eggs. Role of essential fatty acids, amino acids imbalance, toxicity and interactions in monogastrics

UNIT II

Developments in digestive physiology of swine – equines – Measurement of protein and energy requirements – Influence of processing of feeds and fodders in mono-gastric animal nutrition.

UNIT III

Modern concepts of amino acid nutrition at various physiological status – Role of vitamins and minerals in health and disease. Advances in new generation feeds and feed additives.

Suggested Readings

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House.

Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Selected articles from journals

ANN 703 NUTRITION AND RUMEN FERMENTATION 1+1

Objective

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation

Theory

UNIT I

Nutrient requirements for fertility and gestation, prenatal growth and foetal nutrition. Post-natal feeding, growth and developments – Body composition at prenatal and postnatal stages, abnormalities due to malnutrition.

UNIT II

Rumen microflora and microfauna – considerations and limitations in relation to ruminant feeding practices. Manipulation of rumen fermentation – physical, chemical and biological means – Role of sulphur and phosphorus in rumen fermentation –. Modeling ruminant digestion and metabolism – principles.

Practical

Microbial and protozoal count, Determination TVFA by chromatography. Estimation of ammonia in rumen liquor – study on protection of protein in relation to degradability, Rumen fermentation products – Artificial rumen techniques. Rumen enzyme assay

Suggested Readings

Selected articles from journals.

ANN 704**ADVANCES IN MICRONUTRIENTS****1+0****Objective**

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation

TheoryUNIT I

Developments in the study of major, minor and toxic minerals in animals – animal – soil - plant interrelationship – concepts in absorption and transport of micronutrients – Kinetics and metabolism physiological and biochemical interactions among nutrients – interrelationship of minerals and vitamins in relation to metabolism and requirements – mineral toxicities in relation to livestock feeding.

UNIT II

Developments in vitamin and mineral requirements for growth, reproduction and lactation – Identification and correction of deficiencies and toxicities of minerals in farm animals.

UNIT III

Bio-availability of macro and micro nutrients – factors affecting the bio-availability of minerals – bio-marker concept for mineral requirement for correction of deficiencies and toxicity of minerals.

Suggested Readings

Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.

Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Selected articles from journals.

ANN 705**ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH****1+2****Objective**

To impart knowledge on use of advanced analytical techniques in nutrition research

TheoryUNIT I

Developments in analysis of nutrients in feeds. Estimation of toxins and mycotoxins – Application of atomic absorption spectrophotometer, HPLC – Enzymatic methods of feed analysis – Isotopes in nutrition research – Feed microscopy – Analytical aspect of feeds and fodders using N.I.R.

UNIT II

Effect of coccidiostats and dietary antigens in early weaned livestock. Nutrition in relation to emerging diseases. Effect of nutrition on fertility, reproduction and lactation. Toxic minerals and counter action (Selenium and fluorine).

UNIT III

Stress nutrition and post surgical nutrition. Nutritional manipulation and feeding of sick animals. Pesticides residues in feeds and fodders and their impact on animal health, reproduction and production.

Practical

Determination of blood glucose, blood urea nitrogen, SGOT SGPT, total protein, cholesterol and ketone bodies, Metabolic profile tests.

Suggested Readings

Selected articles from journals.

ANN 708 NUTRIENT AND DRUG INTERACTION 2+0

Objective

To impart knowledge on the effects of drugs on nutrient utilisation

Theory

UNIT I

Effects of drugs on digestion and absorption of nutrients – Drugs and intestinal microbial interaction – Effect of drugs and antibiotics as feed additives. Physiological effects – Use and abuse.

UNIT II

Nutrients in drug detoxification – Antagonists – Hormones and their effect on growth and carcass qualities. Drug residues in animal products - milk and meat – effect on food change. Legal aspects of drugs in animal products.

Suggested Readings

Selected articles from journals.

ANN 709 NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING 2+0

Objective

To impart knowledge on newer feed resources and their value in animal feeding and various toxic substances prevalent in feeds and fodders.

Theory

UNIT I

Demand and availability of feed – formulation of database in computer – strategy in food animal production – agricultural by-products – Agroindustrial by-products, Farm waste, crop residues, organic wastes of animal origin. Slaughter house waste, industrial waste and their feeding value in animals.

UNIT II

Processing to enhance feed utilization and availability. Possible health hazards due to waste utilization-chemical and nutritional changes in waste product due to processing. Quality standard and their acceptance.

UNIT III

Naturally occurring toxicants – Toxicants of plants and non-microbial origin. Naturally occurring alkaloids, mycotoxins and their toxicity – Acquired toxicants, pesticides, weedicides and heavy metals.

UNIT IV

Effect of toxins on rumen fermentation and nutrient utilization. Methods of detoxification. Food and feed contaminants – their impact on animal performance

Suggested Readings

Selected articles from journals.

ANIMAL NUTRITION

List of Journals

- ❖ Animal feed science and technology
- ❖ Animal research
- ❖ Animal science journal
- ❖ Archives of animal nutrition
- ❖ British journal of nutrition
- ❖ British poultry science
- ❖ Grass and forage science
- ❖ International journal of sheep and wool science
- ❖ Italian journal of animal science
- ❖ Journal of animal and feed sciences
- ❖ Journal of animal physiology and animal nutrition
- ❖ Livestock research for rural development
- ❖ Malaysian journal of nutrition
- ❖ Nutrition journal
- ❖ Pakistan journal of nutrition
- ❖ Small ruminant research
- ❖ Animal nutrition and feed technology
- ❖ Australian journal of animal sciences
- ❖ Canadian journal of animal sciences
- ❖ Feed industry review
- ❖ Feed international
- ❖ Feed management
- ❖ Feed stuffs
- ❖ Feed trends
- ❖ Indian journal of animal nutrition
- ❖ Indian journal of animal science
- ❖ Indian journal of dairy science
- ❖ Indian journal of poultry sciences
- ❖ Journal of animal nutrition
- ❖ Journal of food science and technology

e-Resources

- ❖ <http://www.vivo.colostate.edu/hbooks/pathphys/digestion/index.html>
- ❖ <http://www-biol.paisley.ac.uk/kinetics/contents.html>
- ❖ http://en.wikipedia.org/wiki/Enzyme_kinetics#column-one
- ❖ <http://mark.asci.ncsu.edu/SwineReports/2004-2005/Contents.htm>
- ❖ <http://www.das.psu.edu/dairynutrition/>
- ❖ <http://www.vet.ed.ac.uk/clive/cal/RUMENCAL/Frames/frmMega.html>
- ❖ <http://www.uky.edu/~dhild/biochem/supp.html>
- ❖ <http://vanat.cvm.umn.edu/run/plate7.html>
- ❖ <http://www.ales2.ualberta.ca/afns/drtc/>
- ❖ <http://www.clfmaofindia.org/>

- ❖ www.nianp.res.in/
- ❖ <http://www.nutrisocietyindia.com/>
- ❖ <http://www.fao.org>
- ❖ http://www.codexalimentarius.net/web/index_en.jsp
- ❖ <http://www.ars.usda.gov>
- ❖ <http://www.fao.org/ag/AGA/AGAP/FRG/afris/default.htm>
- ❖ <http://www.aphca.org/>
- ❖ <http://www.fao.org/ag/AGA/AGAP/FRG/frg1.htm>
- ❖ <http://www.fao.org/prods/index.asp>
- ❖ <http://www.fao.org/ag/AGA/AGAP/FRG/Feedsafety/feedsafety.htm>

Suggested Broad Topics for Masters and Doctoral Research

- ❖ Utilization of non conventional feed/ fodder resources
- ❖ Evolving / Assessing feed additives / supplements
- ❖ Manipulation of rumen fermentation to enhance productivity
- ❖ Feed processing for efficient utilization
- ❖ Improving palatability, digestibility of companion food
- ❖ Preservation and storage of feed / fodder
- ❖ Developing functional foods through dietary manipulation
- ❖ Neonatal growth stimulants
- ❖ Developing sick diet / Geriatric diet to companion/ domestic/ Wild animals
- ❖ Problem solving approach like formulating area specific mineral mixture
- ❖ Developing residue free animal produce through dietary management
- ❖ Addressing global issues /pollutants through feeding manipulation

LIVESTOCK PRODUCTION AND MANAGEMENT

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
LPM 601	CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	2+1
LPM 602	SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1
LPM 603	SWINE PRODUCTION AND MANAGEMENT	1+1
LPM 604	LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+1
LPM605	SHELTER MANAGEMENT	1+1
LPM 606	PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT	2+0
LPM 607	CLIMATOLOGY AND ANIMAL PRODUCTION	1+0
LPM 608	POULTRY FARM AND HATCHERY MANAGEMENT	2+1
LPM 609	FARM ANIMAL BEHAVIOR	1+0
LPM 610	INTEGRATED LIVESTOCK FARMING SYSTEM	2+1
LPM 611	EQUINE PRODUCTION AND MANAGEMENT	1+1
LPM 612	WILD LIFE MANAGEMENT AND CONSERVATION	2+0
LPM 613	LIVESTOCK BUSINESS MANAGEMENT	1+1
LPM 691	MASTER'S SEMINAR	1+0
LPM 699	MASTER'S RESEARCH	20
LPM 701	ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	3+0
LPM 702	ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1
LPM 703	ADVANCES IN SWINE PRODUCTION AND MANAGEMENT	2+1
LPM 704	ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+0
LPM 705	ADVANCES IN POULTRY PRODUCTION MANAGEMENT	2+1
LPM 706	ADVANCES IN ENVIRONMENTAL MANAGEMENT	1+1
LPM 707	ADVANCES IN EQUINE MANAGEMENT	2+0
LPM 791	DOCTORAL SEMINAR I	1+0
LPM 792	DOCTORAL SEMINAR II	1+0
LPM 799	DOCTORAL RESEARCH	45

LIVESTOCK PRODUCTION AND MANAGEMENT

Course Contents

LPM 601 CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT 2+1

Objective

To acquaint students on basic aspects of dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

Theory

UNIT I

Introduction – Development of Dairy Industry in India and world - Present status and future prospects of livestock development in India

UNIT II

Important breeds of cattle and buffalo, traits of economic importance and their inter-relationships - Selection of high quality animals - Role of management in improving the reproduction efficiency in farm animals. - Housing and rearing systems.

UNIT III

Breeding Management: System of breeding Economic traits. Methods of Breeding - Prenatal and postnatal care and management of cattle and buffalo - Care of neonate and young calves - Management strategies for reducing mortality in calves, age at first calving and calving interval in cattle and buffaloes.

UNIT IV

Management of labour, Milking management, Machine milking and hand milking, Different laws governing the livestock sectors to produce quality products on par with international standards - Technique of harvesting clean and hygienic livestock products, transportation of animals, health management. Wallowing in buffaloes- Management of draught animals and summer management

UNIT V

Feed and fodder resources used for feeding of cattle and buffaloes– Scientific technique of feeding, watering – Computation of practical and economical ration, supply of green fodder around the year and enrichment of poor quality roughages.

Practical

Visits to cattle farms and critical analysis of various types of managerial practices - Study of breeding management in the farm- Analysis of practical feeding management- Disease control- Housing – milking - calf, heifer and adult management- Dairy Cattle and Buffalo judging - Project preparation for external funding and commercial farms and enterprises for dairy products – marketing strategies for milk and milk products and meat.

Suggested Readings

Arora SP. 1997. *Feeding of Dairy Cattle and Buffaloes*. Kalyani.

Dutta G. 1994. *Care and Management of Dairy Cattle and Buffaloes*. 3rd Ed. ICAR.

Thomas CK & Sastry NSR.1991 *.Dairy Bovine Production*. Kalyani.

LPM 602 SHEEP AND GOAT PRODUCTION AND MANAGEMENT 2+1

Objective

To acquaint students on status of sheep and goat farming in India, importance of record keeping, principles of housing and feeding, breeding management to improve the reproductive efficiency and detailed account on care and management of different classes of sheep and goat.

Theory

UNIT I

Introduction - Population structure and importance- Advantages and disadvantages of sheep farming under different systems of management – type of housing and equipments- Important sheep and goat breeds- Advantages and disadvantages of sheep and goat farming.

UNIT II

Breeding Management: Breeding seasons - fitness of purchase for first breeding - methods of detection of heat - Natural Service and artificial insemination - Care of the pregnant Animals - Breeding stock - Use of teaser - Culling.

UNIT III

Feeding Management: Feeding methods - Principles to be followed in feeding and watering- feeder space, waterer space, Designing feeders and waterers. - Range management - Stocking rate and pasture improvement and utilization; management under stall fed conditions, Transportation of sheep and goat.

UNIT IV

Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming - Dipping and spraying- shearing - Avoidance of goaty odour in milk, Topping

UNIT V

Wool: Importance of wool - Fiber structure- Fleece characters - Goat fibers - Characters of mohair and pashmina, fur and Angora - Marketing of goat fibers / wool.- Planning of sheep and goat farm of various sizes - Economics of sheep and goat farming.

Practical

Visit to sheep and goat farms and critical analysis of various managerial practices under different conditions. Study of practical housing management - Analysis of practical diseases control management - Shearing management - Record keeping. - Preparation of project for commercial farming - Characterization of sheep and goats; handling of sheep and goat; daily and periodical operations for sheep and goats - Methods of identification of sheep and goat. Cost of rearing sheep and goat for mutton and wool - Housing plans for various age and categories of sheep and goat - Dipping; Vaccination of sheep and goat - Shearing of wool.

Suggested Readings

- Devendra C & Mecleroy GB. 1982. *Goat and Sheep Production in Tropics*. Longman.
- Gupta JL. 2006. *Sheep Production and Management*. BS Publ.
- ICAR. 2002. *Handbook of Animal Husbandry 3rd Ed*. ICAR.
- Kaushish 1994. *Sheep Production in the Tropics and Sub Tropics*. Scientific Publ.

LPM 603

SWINE PRODUCTION AND MANAGEMENT

1+1

Objective

To impart knowledge on various aspects of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of growth and economic pig production systems.

Theory

UNIT I

Introduction - Population and importance - Economic contribution of pigs - Advantages and disadvantages of swine keeping - Systems of management - Problems in pig farming.

UNIT II

Breeds of pigs - Selection of breeding stock - Breeding seasons - Age and weight at first services - Methods for detection of heat – Natural service and artificial insemination - Care of pregnant sows, piglets and growers - Care of breeding boar.

UNIT III

Housing, sanitation and hygiene, disease prevention measures - Housing and equipment –Wallowing - Sanitation and hygiene - Role of management in the prevention and the control of diseases.

UNIT IV

Feeding and management of new born, weaner and finishers, dry, pregnant and farrowing sows - Feeding principles to be followed - Methods of watering – Feeder space – Water space, etc - Marketing: Methods of marketing in swine production - Record keeping.

Practical

Visits to piggeries and critical Analysis of various types of managerial practices - Analysis of the trend and structures of pig population - Analysis of practical breeding management methods, practical disease control management - special management methods - Ageing and identification – Judging - Constraints and remedial measures in pig farming - Economics of production - Project preparation for research and commercial farms.

Suggested Readings

- Boden (e) S.1995. *Swine Practice*. WB London.
- Narayankhedkar SG. 1997. *Production and Management of Swine, Camel, Equine and Yak*. Tindall Publ.

horses, dairy cattle, calves, bulls, work cattle, dogs, pigs, sheep, goats, and poultry.

UNIT III

Improvement of existing buildings; water supply; feed and fodder delivery systems - Economics of Livestock housing.

UNIT IV

Housing - Disease control measures and sanitation of all classes of livestock

Practical

Score card for animal houses - Time and motion study in Animal houses - Preparation of plans for Animal houses for horses, cattle, sheep, pigs, goats, and other livestock - Dogs and other pet animals - Economics of livestock housing - Preparation of plan for animal houses of different sizes and climatic zones of India.

Suggested Readings

Sastry NSR & Thomas CK. 2006. *Livestock Production and Management*. Kalyani.

Thomas CK & Sastry NSR 1991. *Dairy Bovine Production*. Kalyani.

Wathes CM & Charles DR. 1994. *Livestock Housing*. CABI.

LPM 606

PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT

2+0

Objective

To familiarize students on principles of air and water hygiene with reference to impurities and inclusions of water, collection and disposal of waste from the animal house, modern techniques in manure disposal and biosecurity measures to be adapted for hygienic production of livestock products.

Theory

UNIT I

Animal air hygiene: Definition - Composition of air - Air pollution - Factors affecting outdoor and indoor pollution - Assessment of these factors on animal health and production - Methods to control these factors.

UNIT II

Water Hygiene: Importance of water - Impurities and inclusions - Sterilization - Examination of water and water supplies - Collection of samples- Topographical physical, chemical, bacteriological and microscopic examination of water - Hygienic requirements and standards for drinking water - Quantity of water required by domestic animals - Methods of watering.

UNIT III

Manure - Quantity of manure voided by domestic animals - Animal excreta a factor in spread of disease - Hygienic and economic disposal of farm waste - Modern techniques used in automation / semi-automation in disposal of farm waste.

UNIT IV

Environmental protection act, Air (Prevention and control of pollution) act and water (Prevention and control of pollution) act - Biosecurity measures to be adapted for efficient and healthy production

UNIT V

Effect of environmental pollution on livestock and its products directly and indirectly - Controlling environmental pollution - Different factors affecting the quality of livestock and its products meant for human consumption

Suggested Readings

- Baba MD. 2007. *Environmental Changes and Natural Disasters*. New India Publ.
- Overcash MR. 1983. *Livestock Waste Management*. CRC Press.
- Thapliyal DC & Misra DS. 1996. *Fundamentals of Animal Hygiene and Epidemiology*. International Book Distr. Co.

LPM 607 CLIMATOLOGY AND ANIMAL PRODUCTION 1+0

Objective

To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and assessing the heat tolerance of bovines.

Theory

UNIT I

Definition of climate -Classification of climatic regions - Climatic factors-Assessment of climate - Study of climatic factors in relation to animal production.

UNIT II

Light, natural and artificial light-mechanism of light action-photo period and light responses – Applications - Importance of light in production of animals and birds.

UNIT III

Introduction of breeds into different climatic regions - Agro meteorology and weather forecasting for Animal Husbandry activities - Micro climate modification in animal houses.

UNIT IV

Estimation of microclimatic conditions in Animal house - Measurement of Temperature, Relative humidity, Air Velocity and Mean temperature of the surrounding, measurement of intensity of light in animal houses - Construction of climographs and hythergraphs -Estimation of cooling power of atmosphere-heat tolerance test in bovines.

Suggested Readings

- Lal DS. 1998. *Climatology*. Sharda Pustak Bhavan, Allahabad.
- McDowell RE. 1972. *Improvement of Livestock Production in Warm Climates*. WH Freeman.
- Siddhartha K & Roger B. 1996. *Atmosphere, Weather and Climate*. ELBS.

LPM 608 POULTRY FARM AND HATCHERY MANAGEMENT 2+1

Objective

To acquaint students on basic aspects of housing, feeding, breeding and health care of poultry and comparing the performance under cage and floor system of

management of poultry, biosecurity measures to be followed to reduce mortality and efficient hatchery management to produce healthy young ones.

Theory

UNIT I

Poultry housing systems Cage Vs floor system, litter management and lights for poultry, rearing turkey, duck and quails.

UNIT II

Management of chicks, growing, laying and breeding flocks, broiler production, selection and culling of laying flocks.

UNIT III

Procuring, care and pre-incubation storage of hatching eggs - Method of incubation, sanitation disinfection and management of hatchery.

UNIT IV

Embryonic development and factors effecting fertility and hatchability of eggs.

UNIT V

Chick sexing, packing and hatchery business - Transporting management of farm and hatchery waste.

Practical

Poultry Farm management - Brooding of chicks; selection of laying flocks - Disease preventive measures - Selection and care of hatching eggs; incubator operation, fumigation and candling setting and hatching, packaging of chicks - Waste management - Marketing of products.

Suggested Readings

Ensminger ME. 1992. *Poultry Science*. International Book Distr. Co.

Hued LM. 2003. *Modern Poultry Farming*. Greenworld.

Powell-Owen W. 2008. *Poultry Farming and Keeping*. Daya Books.

Prashad J. 2005. *Poultry Production and Management*. Kalyani.

Singh RA. 1996. *Poultry Production*. 3rd Ed. Kalyani.

LPM 609

FARM ANIMAL BEHAVIOR

1+0

Objective

To make acquainted students on principles of farm animal behaviour with regard to environmental influence, group formation, social behaviour and behavioural adaptations under domestication.

Theory

UNIT I

Introduction to Animal behaviour - Importance of animal behaviour studies - Patterns of behaviour - Daily and seasonal cycles of behaviour - Physiological basis of behaviour.

UNIT II

Environmental modification of behaviour - Developmental changes in behaviour - Genetic differences in behaviour - Behavioural disorders.

UNIT III

Group formation - Social relationship, process of socialisation locality and behaviour - Practical application - Behavioural character for managerial

practices - Favourable and unfavourable behaviour for domestication - Behavioural adaptations under domestication.

UNIT IV

Physical environment and behaviour - Common vices and their remedial measures - Analysis of behaviour in relation to location - Analysis of behaviour in relation to climatic environment - Analysis of social behaviour.

Suggested Readings

Arora MP. 1995. *Animal Behaviour*. WB London.

Bouenger EG. 1994. *Animal Behaviour*. WB London.

Fraser AF & Broom DM. 1997. *Farm Animal Behaviour and Welfare*. CABI.

Fraser AF & Broom DM. 1999. *Farm Animal Behaviour and Welfare*.

Kumar V. 1996. *Animal Behaviour*. WB London.

LPM 610 INTEGRATED LIVESTOCK FARMING SYSTEM 2+1

Objective

To familiarize on various aspects viz., scope and limitations of integrated livestock farming system, recent approach and economic feasibility of different integration models for sustainable production

Theory

UNIT I

Scope and limitation of integrated farming systems - Sustainability of integrated Livestock Farming Systems and their economic importance.

UNIT II

Integration of fish, arable farming and different livestock enterprises vis-à-vis gobar gas plant, FYM, solar and wind energy utilization, cattle, buffalo sheep, goat, pig, poultry, rabbit, silk worm, bee keeping etc.

UNIT III

New approach for changing farming systems in present energy crises.

UNIT IV

Project formulation and evaluation of various livestock enterprises.

Practical

Various livestock farming units and their economic analysis - Evaluation of different farming systems and their economic importance - Preparing feasibility report for various farming projects.

Suggested Readings

Mukherjee TK. 1992. *Integrated Livestock Fish Production Systems*.

Raman KV & Balaguru T. (Eds.). 1992. *Farming Systems Research in India: Strategies for Implementation*. NAARM.

Renard C. (Ed.). 1997. *Crop Residues in Sustainable Mixed Crop/Livestock Farming Systems*. CABI.

Speirs M. & Opsen O. 1992. *Indigenous Integrated Farming System in the Sahel*. World Bank.

LPM 611

EQUINE PRODUCTION AND MANAGEMENT

1+1

Objective

To educate the students become familiarize with principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons .

Theory

UNIT I

Equine population in India - Breeds of native and exotic horses - Types and classes of light and work horses

UNIT II

Housing and routine management practices –Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses- unsoundness and stable vices

UNIT III

Feeding and breeding of horses donkey and Mules, foaling, care of foal

UNIT IV

Foot care and shoeing care, Stud farms - Race clubs - Race horses and their care - Horse behaviour and training - Exercising - Basic Horsemanship

UNIT V

Health management & diseases control. Control of internal and external parasites of horse- Colic and its prevention

UNIT VI

Mode of transport - Facilities requirement - Cleaning, disinfection and preparation of vehicles Transport stress - Management during transport - Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport - Laws governing the import and export of livestock and its products- - Horse passport and trading

Practical

Control of horse for examination, passing of stomach tube, dentition and ageing, saddling, exercising of horse, hoof care.

Suggested Readings

- Blancchard TL et al. 2002. *Manual of Equine Reproduction*. Mosby Publ.
Frape D. 1986. *Equine Nutrition and Feeding*. Blackwell Publ.
Kacker RN & Panwar BS. 1996. *Text Book of Equine Husbandry*. Vikas Publ.
Mills DS & Nankervis KJ. 1998. *Equine Behaviour: Principles and Practice*. Blackwell Publ.
Pilliner S. 1994. *Care of the competition Horse*. BT Batsford.
Rose RJ & Hodgson DR. 2000. *Manual of Equine Practice*. WB Saunders.

LPM 612

WILD LIFE MANAGEMENT AND CONSERVATION

2+0

Objective

To acquaint students with the principles and concepts of wild life sanctuaries and national parks, classification of wild animals, role of authorities in conservation and management of wild animals in captivity.

Theory

UNIT I

Zoo and captive wild animals - Principles and concepts – Ecology of wild life sanctuaries and National parks- wild life legislation in India - Status of forest in India - Biological and ecological basis of management of wild life.

UNIT II

Voluntary organization on wild life - Rules and regulations of zoo authority of India -Wild life protection act - Zoological classification of wild animals - Funding agencies for wild life research and preparation of project. - Conservation of wild animals.

UNIT III

Wild life health control - Reproduction in zoos - Population analysis - Population manipulation - Habit analysis and design - The resources and its management - Distribution of important Indian animals - Zoo animals and birds - Breeding characteristics – Movements - Cover requirements - Food - Population density – Mortality - Nesting losses caused by predators, predator and prey relationship - Human interference - Refuge rehabilitation

UNIT IV

Restraints - Maps - Survey and plans of management systems - Principles, protective measures - Development and conservation of water supply- puberty - Breeding seasons - pregnancy - Parturition - Lactation postnatal survival of the young - Social factors among various species - Miscellaneous management procedures.

Suggested Readings

Berwick SH & Saharia VB. (Eds.). 1995. *The Development of International Principles and Practices of Wild Life Research and Management*. Deford Univ. Press.

Bobbins CT. 1983. *Wild Life Feeding and Nutrition*. Daya Publ. House.

Giles RH. 1978. *Wild Life Management*. Wild Life Society.

Giles RH. 1984. *Wild Life Management Techniques*. 3rd Ed. Wild Life Society.

Jadhav NV, Baig MI & Devangare AA. 2004. *Handbook of Wild Animals and Livestock Management*.

WWF. 1994. *Wild Life (Protection) Act 1972 (as Amended up to 1991)*. Natraj Publ.

LPM 613

LIVESTOCK BUSINESS MANAGEMENT

1+1

Objective

To acquaint students with knowledge in principles, planning, technical approach and preparing financial statement in Livestock Business Management and preparing projects for financing.

Theory

UNIT I

Management principles - Planning - Techniques, strategic planning, organization structure, co-ordination and controlling techniques - Approaches to management.

UNIT II

SWOT analysis, financial accounting - Accounting records - Balance sheet, fund flow statement - Cost and analysis for managerial decisions - Budgeting and control .

UNIT III

Tools of financial analysis, working capital financing - Long term financial management - Investment analysis - Capital markets - Corporate risk management - Venture capital.

UNIT IV

Marketing - Objectives, strategies - Selecting and managing marketing channels - Pricing strategies - Sales promotion - Legislation relating licensing - Company law.

Practical

Preparation of financial statements, depreciation accounting methods, trend and variance analysis, cost-volume profit analysis - Financial planning and forecasting - Estimation of working capital requirement - Break even analysis - Visit to livestock business firms and banks - Preparing projects for financing.

Suggested Readings

- Koontz H & O'Donnel C. 1999. *Essentials of Management*. Tata McGraw Hill.
- Kotler P. 2000. *Marketing Management – Analysis, Planning and Control*. Prentice Hall of India.
- Maheswari SN. 1998. *Management Accounting*. Tata McGraw Hill.
- Massie JL. 1995. *Essential of Management*. Prentice Hall of India.
- Srinivasan NP. 1998. *Management Accounting*. Sterling Publications.

LPM 701

ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT

3+0

Objective

To acquaint students on latest developments on dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

Theory

UNIT I

Dairy farming in India – Global scenario - Present status and reasons for the same – Avenues for progress – The needs of the nation and how to achieve it.

UNIT II

Advances in housing management of dairy cattle and buffaloes in various agroclimatic zone of India - Management systems for cattle and buffaloes.

UNIT III

Establishing Dairy Cattle Enterprise – Characteristics of a successful dairy farm – Choice of the foundation stock – Breeding Management Problems associated with reproduction.

UNIT IV

Advances in Feeding Management of cattle and buffalo, Feed for milking herd, dry cows, bulls and calves, Management of high yielding animals.

UNIT V

Milking Management – Biosynthesis of milk - Factors affecting the composition and yield of milk - milk ejection reflex - Milking systems – Sanitary standards for the f quality milk – Cessation of milking, advances in herd management- raising calves – growing heifers, replacements and culling – marketing, Computerization of dairy enterprises.

UNIT VI

Advance in health management of dairy animals, metabolic diseases of high yielders- advances in preventive measures for production related diseases

Suggested Readings

Clarence HE . 2007. *Dairy Cattle & Milk Production*. Daya Publ. House.

Selected articles from journals.

Thomas CK & Sastry NSR. 1991. *Dairy Bovine Production*. Kalyani.

LPM 702

ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT

2+1

Objective

To educate the students on advances in sheep and goat farming for improving their productivity through different management practices.

Theory

UNIT I

Utility origin – Domestication - Numbers and distribution of meat and dual purpose breeds - Methods of rearing – Range sheep production –

UNIT II

The farm flock – Pure bred flock - Management during breeding season - The sexual seasons and its control - Puberty – Time of the year to breed – Flushing – Ram-Ewe ratio.

UNIT III

Advances in feeding management, Nutrient deficiencies in range forage, Feed to supplement range forage, General feeding practices, Feeding materials, Lamb feeding, Use of antibiotics and hormones, Hand feeding, Self feeding, Pellet feeding , Feeding lambs and ewes during lactation.

UNIT IV

Recent development in sheep and goat management and their relevance under Indian economic conditions, needs and possibilities for future research.

UNIT V

Role of sheep husbandry in dry farming in India, Present development programmes in sheep and goat production, Advances in reproduction, housing, feeding and watering, diseases, Shearing methods and culling of sheep and goat.

& guinea pigs, measures to reduce the mortality in young ones at different seasons .

Theory

UNIT I

Importance and limitations of rabbits for meat and fur production, rats, mice & guinea pigs - Common breeds and strains .

UNIT II

Advances in system of housing, Common diseases and their control measure .

UNIT III

Breeding strategies - Age at maturity, litter size , Weaning, Feeding of growers, Selection of replacement stock, transportation of rabbit.

UNIT IV

Transportation of Laboratory animals – marketing of meat and fur.

UNIT V

Management of specific pathogen free and gnotobiotic animals ,concepts to related to welfare of laboratory animals

Practical

Visit to Rabbit farms - Study of the various chores in government farms and private farms - Critical analysis of breeding, feeding, disease control management and housing - Rabbit slaughter technique.

Suggested readings

Selected articles from journals.

LPM 705 ADVANCES IN POULTRY PRODUCTION MANAGEMENT 2+1

Objective

To educate the students on advances in housing, feeding, breeding and health care in poultry farming.

Theory

UNIT I

Planning, organisation, executive and management of poultry farms and hatcheries of various sizes - alternative in poultry production

UNIT II

Demand, supply, present status of poultry production.

UNIT III

Problems and new management techniques in poultry for egg and meat in India vis-à-vis in other countries of the world, automation in poultry houses, management of specific pathogen free flocks.

UNIT IV

Poultry development policies and planning for higher production constraints in development and solutions, Ethology and entology in relation to poultry production

Practical

Planning and preparation of research and commercial projects on broiler and layer production management.

Suggested Readings

Selected articles from journals.

LPM 706

ADVANCES IN ENVIRONMENTAL MANAGEMENT

1+1

Objective

To educate the students on advances in climate, weather, various climatic factors monitoring and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and environmental influences on the performance of farm animal production.

Theory

UNIT I

The animal Industry and the quality of the environment – Management of the living environment - Microenvironment and macro environment.

UNIT II

Air Pollution: Indoor and out door - Chemical, physical and bacteriological changes - Causes – Standards and the extent tolerated by animals - Effects on animal production.

UNIT III

Fixing standards in relation to CO₂ - Air supply in relation to cubic space, temperature, air, velocity, relative humidity, dust particles, bacterial count, effective temperature and cooling power - Methods to get over pollution – Cleaning and washing - Air conditioning.

UNIT IV

Utilisation and disposal of animal waste, Health hazards, Waste utilization, technologies for processing and treatment of animal wastes, Health and economic impacts, Legal constraints, Microbiology of wastes, Waste properties, Gases and odour.

UNIT V

Water Pollution: Significance, treatment and control - Funding agencies for animal welfare

Practical

Assessment of various factors in Indoor and outdoor environment- Assessment of CO₂, air supply, dust particles and bacterial count in air - Visit to sewage treatment plant - Planning farm waste disposals - Physical chemical and bacteriological examination of water watering of farm animals.

Suggested Readings

Baba MD. 2004. *Environmental Changes and Natural Disasters*. New India Publ. Agency.
Selected articles from journals.

LPM 707

ADVANCES IN EQUINE MANAGEMENT

2+0

Objective

To familiarize the students on latest aspects of principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons.

Theory

UNIT I

New indigenous and exotic horses breeds- Types and classes of light and work horses

UNIT II

Advances in housing and routine management practices –Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses- unsoundness and stable vices

UNIT III

New Feeding techniques and breeding of horses donkey and Mules, foaling, care of foal

UNIT IV

Foot care and shoeing care, Stud farms,Race clubs,Race horses and their care, Horse behaviour and training, Exercising ,Basic Horsemanship

UNIT V

Advances in health management & diseases control. Control of internal and external parasites of horse- Colic and its prevention

UNIT VI

Mode of transport, Facilities requirement, Cleaning, disinfection and preparation of vehicles Transport stress,Management during transport , Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport, Laws governing the import and export of livestock and its products, Horse passport and trading.

Suggested Readings

Selected articles from journals.

LIVESTOCK PRODUCTION AND MANAGEMENT

List of Journals

- ❖ Asian Journal of Buffalo Production and Management
- ❖ Australian Journal of Animal Science
- ❖ British Poultry Science
- ❖ Canadian Journal of Animal Science
- ❖ Indian Dairyman
- ❖ Indian Journal of Animal Nutrition
- ❖ Indian Journal of Animal Production and Management
- ❖ Indian Journal of Animal Science
- ❖ Indian Journal of Dairy Science
- ❖ Indian Journal of Poultry Science
- ❖ Indian Journal of Field Veterinarians
- ❖ Internal Journal of Animal Science
- ❖ Journal of Animal Sciences
- ❖ Journal of Dairy Sciences
- ❖ Livestock Production Science
- ❖ Poultry Science
- ❖ The Indian Veterinary Journal
- ❖ World Poultry Science Journal

e-Resources

- ❖ www.pork.org
- ❖ www.ilri.org
- ❖ www.fao.org
- ❖ www.defra.org.uk
- ❖ www.aciar.gov.au
- ❖ www.asap.asn.au
- ❖ www.thepigsite.com
- ❖ www.epa.com
- ❖ <http://animalscience.ucdavis.edu>
- ❖ www.tanu.edu
- ❖ www.sciencedirect.com
- ❖ <http://trop.edmgr.com>
- ❖ www.nianp.res.in/
- ❖ <http://www.aphca.org>
- ❖ <http://www.ars.usda.gov>

Suggested Broad Topics for Master's and Doctoral Research

Dairy cattle and buffalo Production

- ❖ Pre and postpartum management of dairy animals
- ❖ Reducing age at first calving
- ❖ Reducing calf mortality
- ❖ Reducing calving intervals
- ❖ Increasing reproductive efficiency
- ❖ Farming system research / extension approach
- ❖ System approach to livestock development
- ❖ Housing management of animals in semi arid region

Poultry Production

- ❖ Poultry housing system
- ❖ Stocking density in poultry
- ❖ Environmental effects on poultry
- ❖ Feeding management of poultry
- ❖ Methods of processing poultry manure
- ❖ System of approach for poultry development

Small ruminant production

- ❖ Sheep and goat housing system
- ❖ Impact study on scientific management of sheep and goat
- ❖ Environmental effects on sheep and goat
- ❖ Feeding management of sheep and goat

Rabbit production

- ❖ Rabbit housing system
- ❖ Feeding management of rabbit
- ❖ Productive and reproductive performance of rabbit under tropical climate

Swine production

- ❖ Swine housing system
- ❖ Feeding management of swine
- ❖ Productive and reproductive performance of pigs under tropical climate

LIVESTOCK PRODUCTS TECHNOLOGY
Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
LPT 601	FRESH MEAT TECHNOLOGY	1+1
LPT 602	MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING	2+1
LPT 603	POULTRY AND FISH PRODUCTS TECHNOLOGY	2+1
LPT 604	EGG AND EGG PRODUCTS TECHNOLOGY	1+1
LPT 605	ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES	1+1
LPT 606	SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY	2+1
LPT 607	PROCESSING AND MARKETING OF WOOL	2+1
LPT 608*	MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES	2+1
LPT 609	QUALITY CONTROL OF MILK AND MILK PRODUCTS	1+1
LPT 610	TECHNOLOGY OF MILK PRODUCTS	2+1
LPT 611	BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN	1+1
LPT 612*	IN-PLANT TRAINING (NON CREDIT)	0+2
LPT 691	MASTER'S SEMINAR	1+0
LPT 699	MASTER'S RESEARCH	20
LPT 701	ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION	2+1
LPT 702	ADVANCES IN FRESH AND PROCESSED MEAT PRODUCTS TECHNOLOGY	3+1
LPT 703	ADVANCES IN POULTRY PRODUCTS TECHNOLOGY	2+1
LPT 704	ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY	3+1
LPT 705	ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS	2+0
LPT 706	BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS	1+1
LPT 791	DOCTORAL SEMINAR I	1+0
LPT 792	DOCTORAL SEMINAR II	1+0
LPT 799	DOCTORAL RESEARCH	45

* Non-Credit (Satisfactory/Unsatisfactory)

LIVESTOCK PRODUCTS TECHNOLOGY

Course Contents

LPT 601 FRESH MEAT TECHNOLOGY 1+1

Objective

To impart knowledge about history, current status of meat industry, muscle composition, functions and sensory quality of meat. To educate on factors influencing quality of meat and nutritive value.

Theory

UNIT I

History and development of meat science and meat industry, current trends and prospects of meat industry-Structure and chemistry of animal tissues, muscle functions and postmortem changes- Rigor mortis – Effect of transport on meat quality – its veterinary and clinical importance – PSE and DFD in meat quality – Conversion of muscle to meat.

UNIT II

Composition, nutritional content and general quality characterization and evaluation of meat and its products- meat microbiology –Factors affecting quality of meat – Essential nutrients in meat and poultry meat – Tenderization. Chemical residues in meat and their effects on the health of the consumer.

Practical

Microbiological sampling and evaluation of meat. Evaluation of physico-chemical and sensory properties of meat and meat products. Estimation of pH – Colour - Water holding capacity – ERV – Tyrosine value – Thiobarbituric acid number – Estimation of texture profile of meat – Estimation of glycogen, R-value, myoglobin, proximate analysis of meat and meat products including poultry products – Estimation of drip loss - Determination of Sarcomere length, fibre diameter and myofibrillar fragmentation index. Retail and wholesale cuts.

Suggested Readings

- Gracey JF. 1999. *Thornton's Meat hygiene*. 10th Ed. WB Saunders.
- Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
- Pearson AM & Dutson TR. 1999. *Advances in Meat Research*. Vol. IX. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.
- Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 602 MEAT PROCESSING, PACKAGING, QUALITY 2+1
CONTROL AND MARKETING

Objective

To impart knowledge on preservations, methods, product development, quality control and packaging practices in meat.

Theory

UNIT I

Factors affecting fresh meat quality, ageing, basic principles of preservation, chilling, freezing, thermal processing, dehydration, irradiation and use of chemicals and antibiotics; meat curing and smoking.

UNIT II

Comminuted meat; preparation of various kinds of fresh and cooked meat products-Canning – Heat processing – Sausages – Ham, Bacon, Tandoori-Barbecueing of Poultry.Senses of taste and olfaction-factors influencing sensory measurements, physical and chemical properties related to sensory evaluation, types of sensory panels, discriminate and descriptive testing.

UNIT III

Meat adulteration and substitution – Different techniques for meat speciation – Agar gel immuno diffusion techniques – Démonstration of CIE, IEF, ELISA, PCR

UNIT IV

Principles of packaging- Product characteristics affecting packaging requirements; packaging material and their characteristics - different methods of packaging meat – Vacuum packaging – MAP – Retort pouch processing.

UNIT V

Marketing of meat, setting up of a meat retailing unit and other meat merchandising practices. MFPO, BIS Standards for meat products.National and international specifications and standards.

Practical

Proximate composition of meat, tyrosine value, nitrite content, TBARS value, peroxide value, Formulation of different meat products, emulsion stability, shear force value, cooking determinants, subjective and objective method of sensory evaluations.

Suggested Readings

- Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
- Pearson AM & Dutson TR. 1999. *Advances in Meat Research*. Vol. IX. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.
- Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 603

POULTRY AND FISH PRODUCTS TECHNOLOGY

2+1

Objective

To impart knowledge on structure, functional quality, microbiology, processing and preservation of poultry meat, eggs and fish.

Theory

UNIT I

History and development of poultry meat and egg processing industry. Different species of poultry and their production potentials- commonly occurring anti nutrients, and antibiotics in poultry feed ingredients and its

effect on egg and meat nutrition - Quality identification, quality maintenance, chemical, nutritional and microbiological quality of poultry meat. Preservation and packing techniques of shelled and liquid eggs. Quality identification of shell eggs and factors influencing the quality

UNIT II

Pre-slaughter care, transportation, resting, fasting, ante-mortem examination, methods of slaughter and slaughtering procedure-postmortem inspection-reasons for condemnation of carcass-yield and grading of dressed chicken,cut-up parts and de boned meat.UNIT III

Structure, nutritive value, compositional chemistry, microbiology and functional properties of eggs. Low cholesterol eggs, GMP, HACCP procedures for food safety – Codex regulation for food products safety – WTO/GOI regulations for import and export of poultry products. National and international regulations, standards, quality control and marketing of fish and fish products, utilization of fish processing waste.

UNIT IV

Fishery resources, marine and fresh water fishes, transportation, processing, preservation, grading, standards.Quality control, labeling and marketing of fish and fish products, utilization of fish processing waste.

UNIT V

Post processing value added meat for export- Integration,poultry and fish processing and marketing-Storage, packaging and chilling, freezing, dehydration, canning, irradiation, curing, smoking, barbecuing, cooking and preparation of further processed poultry and fish products.

Practical

Organization, sanitation and maintenance of poultry processing plants. Slaughtering, ante-mortem and postmortem inspection, meat cutting, grading, production of ready to eat, smoked and cured poultry meatComminuted and other poultry based convenient items.Visit to poultry processing plant/egg processing plant. Postmortem inspection, carcass yield and grading. Meat bone ratio,quality maintenance, tenderization water holding capacity. TBA values and preparation of further processed and freeze dried poultry products. Whole egg powder,shell meal processing plant waste meal-HACCP-egg powder processing plant. Grading of shelled eggs, liquid eggs,egg powder foaming property , posteurization of liquid egg, testing microbial load in different foams of egg, visit of egg powder plant/egg processing plant poultry and fish products and its Proximate analysis, microbiological and sensory evaluation and poultry meat and fish.

Suggested Readings

Mead GC.1989. *Processing of Poultry*. Elsevier.

Mounthey GJ. *Poultry Products Technology*. 2nd Ed. AVI Publ.

Pearson AM & Gillett TA.1996. *Processed Meats*. 3rd Ed. Chapman & Hall.

Stadelman W & Cotterill OJ. 2002. *Eggs Science and Technology*. 4th Ed. CBS.

Suzuki T. 1981. *Fish and Krill: Protein Processing Technology*. Applied Science Publ.

LPT 604 EGG AND EGG PRODUCTS TECHNOLOGY 1+1

Objective

To impart knowledge about composition and marketing of eggs and nutritive value of eggs, preservation methods –quality maintenance, functional and value added egg product development, packaging and standards

Theory

UNIT I

Preservation and maintenance of quality of eggs- spoilage of egg and its prevention.-Preparation of fast foods.

UNIT II

Egg breaking plant lay out and organization- freezing- pasteurization- desugarisation-dehydration – quality estimation.

UNIT III

Principles involved in preparation of egg powder and other egg products- Development of convenient egg based products- packaging of egg and egg products.

UNIT IV

Specifications, standards and marketing of egg and egg products-Quality control of egg products.

Practical

Evaluation of physical, chemical, functional and microbial quality of egg and egg products. Preservation of eggs- Preparation of dehydrated and convenient egg products- Visit to egg processing plant.

Suggested Readings

Romanoff AL & Romanoff AJ. 1949. *Avian Egg*. John Wiley & Sons.
Stadelman WL & Cotterill OJ. 2002. *Egg Science and Technology*. 4th Ed. CBS.

LPT 605 ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES 1+1

Objective

Teaching about abattoir design, sanitation and basic slaughterhouse practices, effluent treatment and proper disposal of wastes.

Theory

UNIT I

Layout, designing – operation and maintenance of slaughter houses and processing plants-disposal of slaughter house effluents and different designs of effluent treatment plants - equipments, organization and Slaughter house, maintenance, record keeping and operation-sanitation of slaughterhouse-Sanitary practices in meat plant and its benefits; quality control.

UNIT II

Pre-slaughter judging, inspection, grading, pre-slaughter care, slaughter of meat animals; Humane slaughter – Principles and methods of stunning – Ritual slaughter of food animals and poultry – Machineries for slaughter and dressing- processing of different kinds of meat animals- Ante-mortem inspection and Post-mortem examination of animals. Disposal and

condemnation of unfit materials.

UNIT III

Carcass quality appraisal, judgement and their grading, meat cutting, measuring yields. Application of HACCP, GMP, ISO 9000, ISO 14000, ISO 22000, BIS Standards and any recent standards for meat and processing industries

Practical

Visit to slaughterhouse– Plan and outlay of modern abattoir- Procedure for slaughter of food animals and poultry - Ante-mortem and postmortem inspection, slaughtering, grading and meat cutting, carcass yield, meat bone ratio measurement of effluent characteristics: pH, BOD, COD, suspended solids etc.

Suggested Readings

Gerrard F. 1977. *Meat Technology*. Northwood.

Gracey JF. 1999. *Thornton's Meat hygiene*. 10th Ed. WB Saunders.

LPT 606 SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY 2+1

Objective

To Impart knowledge on animal by-products, processing and industrial utilization.

Theory

UNIT I

Slaughterhouse byproducts industry in India and abroad – Importance of utilizing slaughterhouse offals – Rendering- Planning a by-product plant - Utilization of blood, bones, hooves, glands, intestines, feathers, glandular by-products and other minor by-products for industrial exploitation.

UNIT II

Meat fat characteristics - Preservation and Processing of ruminal contents – Ensiling of ruminal contents – Value products preparation from slaughterhouse by-products. processing of animal byproducts for pet foods.

UNIT III

Flaying - Classification and factors affecting quality of hides and skin- Physical and chemical characteristics of hide and skin- Processing of hide and skin for manufacture of leather- Preparation and quality control of gelatin and glue. Microscopic, physical and chemical characteristics of leather; testing and marketing of leather- Preservation and packaging practices of various kinds of hides and skin.

UNIT IV

Designing of animal byproduct plant. Collection and scope for further utilization of slaughter house byproducts. Waste treatment and pollution control- Environmental Audits-Regulations on pollution control.

Practical

Identification of quality defects in leather- preparation of sausage casing- blood meal, feather meal and meat meal. Demonstration of carcass meal – Meat meal – Bone meal - Preparation of animal casings – Grading of casings and wool – Preparation of slime meal – Collection and preservation of

UNIT III

Layout Designing and organization of dairy plant, Milk procurement, handling and transportation. Chilling, centrifugation, separation, clarification, bacto-fugation and homogenization. Thermal processing- pasteurization, UHT processing, sterilization, bacto-therm and packaging, Storage and distribution of processed milk. Fortified, reconstituted and mild floured milks.

UNIT IV

Membrane processing and related techniques; application of ultrafiltration, reverse osmosis; nanofiltration and microfiltration in the dairy industry.

UNIT V

Current trends in cleaning and sanitization of dairy equipment, biological detergents, ultrasonic techniques in cleaning; biodegents. Disposal of dairy effluents.

Practical

Platform tests. Determination of fat, SNF, TS, protein, lactose and ash contents of milk. Standardization, pasteurization and sterilization. HCT profile of milk systems. Judging of different types of milks. Layout plan of market milk plant.

Suggested Readings

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

Web BH, Johnson AH & Alford JA. 1987. *Fundamental of Dairy Chemistry*. 3rd Ed. Westport AVI Publ.

LPT 609 QUALITY CONTROL OF MILK AND MILK PRODUCTS 1+1

Objective

To impart knowledge about quality control, TQM, HACCP, SPS, CAC and legal standards.

Theory

UNIT I

Importance of quality control in dairy industry. PFA Act, BIS standards, AgMark standards and ISO standards of milk products.

UNIT II

Total quality management in processing of milk products – HACCP and SPS.

UNIT III

Types of microorganisms associated with milk and milk products-Milk borne diseases.

UNIT IV

Physico-chemical and microbial changes during procurement, processing and storage of milk and milk products.

UNIT V

Fundamental rules for sensory evaluation, Hedonic scale, score cards and their use for grading of milk and milk products.

Practical

Determination of pH and acidity, electrical conductivity, viscosity, phosphatase test, MBRT, Resazurin test, DMC, SPC. Analysis of milk and milk products in reference to BIS/PFA standards. Grading of milk and milk products.

Suggested Readings

Jennes R & Patton S. 1969. *Principles of Dairy Chemistry*. Wiley Eastern.
Yadav JS, Grover S & Batish VK. 1993. *Comprehensive Dairy Microbiology*. Metropolitan Publ.

LPT 610

TECHNOLOGY OF MILK PRODUCTS

2+1

Objective

To impart knowledge about techniques for preparation of different milk products.

Theory

UNIT I

Drying of milk and milk products; freeze dehydration, water activity; sorption behaviour of foods- dried ice cream mix – cream and butter powder.

UNIT II

Hurdle technology and its application in development of dairy products.

UNIT III

Manufacture of milk products; butter, evaporated milk, condensed milk, milk powders, ice cream and other frozen desserts. Manufacture of yoghurt-acidophilus milk-bulgaricus milk- kumiss-kefir. Manufacture of cheddar-mozzarella- cottage and processed cheese. Manufacturing of indigenous milk products- paneer- channa- khoa- ghee- dahi and shrikhand.

UNIT IV

Manufacturing of casein- caseinate- co-precipitates- Whey protein concentrate (WPC) - lactose- dairy whiteners; functional properties of whey proteins- casein- co-precipitates- Ultra Filtration retentate and their modifications.

UNIT V

Evaluation of functional properties. Packing, storage and marketing of milk products. Defects in milk products, their preventions and remedies.

Practical

Preparation of butter- paneer- channa- ghee- ice cream- cheese-cheddar-Mozzarella and cottage cheese- khoa- dahi- yoghurt- casein- caseinate-coprecipitate- determination of degree of browning chemical/physical methods; measurement of different functional properties of different milk products.

Suggested Readings

Aneja RP, Mathur BN, Banerjee AK & Chandan RC. 2002. *Technology of Indian Milk Products*. Dairy India.
Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

LPT 611 BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN 1+1

Objective

To impart knowledge about new techniques of biotechnology for improving food value.

Theory

Role of Biotechnology in productivity of livestock, Meat Speciation and quality control. Use of Biotechnology in production of food additive. Use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, consumer concerns about risks and values, biotechnology and food safety. Future of food biotechnology in India.

Practical

Introduction of basic biotechnological techniques such as western blotting, enzyme isolation and identification, DNA extraction, amplification, different types of PCR, Acquaintance with RT-PCR, Multiplex PCR, gene identification and characterization.

Suggested Readings

Selected articles from journals.

LPT 612 IN-PLANT TRAINING 0+2
(Non Credit: Satisfactory/Unsatisfactory)

Objective

To impart industrial exposure to post graduate students in meat, milk, poultry and fish industry.

Practical

APT students will undergo in-plant training in any one of the specialized area of Animal Products Technology for a period of three weeks in an institute in private/public sector industry. After completion of the training, the student will submit a training report. Evaluation will be based on viva-voce examination and a report submitted by student-Preparation of Project report.

Suggested Readings

Selected articles from journals.

LPT 701 ADVANCES IN ABATTOIR PRACTICES AND ANIMAL 2+1
BYPRODUCTS UTILIZATION

Objective

To impart knowledge on advances in animal byproducts utilization such as leather, fat, casings, gelatin and abattoir effluent treatment. To expose the importance of environmental pollution and their pollutants.

Theory

UNIT I

Existing situation of slaughterhouses and processing plants in India - Collection of inedible and edible by-products for industrial uses – Disposal of

Prefabricated meat – Chemical residues in meat and their effects on the health of the consumer.

UNIT II

Principles of preservation – Methods - temperature control – Refrigeration – Chilling – Freezing – Mechanisation of chiller and freezer - Thermal processing – Canning – retort processing - Intermediate moisture meat – Moisture control – Dehydration – Freeze drying – Curing – Smoking – Direct microbial inhibition – Irradiation – Use of antibiotics and chemical preservatives – Organic acids – Recent advances in preservation of meat.

Meat adulteration and substitution – Different techniques for meat speciation - Packaging of meat and meat products-Critical assessment of ageing, chilling, freezing, smoking, curing, tenderization and irradiation techniques.

UNIT III

Basic meat processing procedure-Functional properties of tissue component in meat processing-forming processed meat products. Approaches for new product development-different equipments used for processing of meat products-Indigenous and heritage meat products-purpose of smoking-composition of smoke-method of smoking-liquid smoke preparation-Ham, bacon,sausages, patties, burger, meat loaves-various novel meat products.

UNIT IV

Fermented meat products-heat processing-restructured meat products-Reformed meat products-Effect of massaging,tumbling and flaking techniques and quality-intermediate, moisture meat-Enrobed meat products-Meat analogues and substitutes-Thermal processing of meat-Browning reaction-Enzymatic and non enzymatic-Protein changes in processed meat products-lipid changes-protein and lipid interaction-protein and carbohydrate interaction.

UNIT V

Meat additives and regulations pertaining to processed and convenient meat based products-Meat packaging and retailing practices-National and international standards, grading, specifications and quality control of meat and meat products.

Practical

Estimation of Colour - Estimation of texture profile of meat – Estimation of glycogen, Lactic acid, R-value, myoglobin, proximate analysis of meat and meat products – Estimation of hydroxy proline - Histological structure of muscle - Estimation of emulsion stability, thawing in meat and meat products– Identification of different packaging material – Agar gel immuno diffusion techniques – Demonstration of CIE, IEF, ELISA, PCR – Different methods of packaging of meat and meat products including poultry products - Visit to different cold stores.Evaluation of carcass quality,Estimation of muscle fiber diameter, Estimation of lipid profile of meat.

Organoleptic evaluation of meat-Estimation of Nitrate-Preparation of some novel meat products and studies on their shelf life-Total viable count and differential counts of meat and meat products-Visist of meat /poultry processing units.

Suggested Readings

- Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publ. Ltd., UK.
Selected articles from journals.
Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 703 ADVANCES IN POULTRY PRODUCTS TECHNOLOGY 2+1

Objective

Discussion on latest development in processing, preservation, quality control, packaging, regulations and standards of poultry meat.

Theory

UNIT I

Indian scenario of poultry processing industry Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. Automation in broiler farming, catching, transporting, control of shrinkage and methods of slaughter.

UNIT II

Preservation techniques, Room temperature preservation of poultry fast foods by multi hurdle technology critical evaluation of application of refrigeration, tenderization, canning, dehydration, irradiation, curing, smoking and cooking techniques in poultry processing and development of additional processed products.– Regulation of CAC and European standards of poultry meat and meat products.

UNIT III

Recent trends in packing and marketing of poultry and poultry products. Modified atmosphere packaging- Different packing materials for meat and cooked products.

UNIT IV

Policies and marketing trends in poultry meat -Regulations, specifications, standards and use of additives in poultry products.

UNIT V

Poultry product development formulation and profitability.

Practical

Cooked and uncooked meat quality standards- sensory evaluation of poultry meat- packaging material- Modified Atmosphere Packaging-Factors influencing meat quality at different freezing temperatures and thawing.

Suggested Readings

Selected articles from journals.

LPT 704 ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY 3+1

Objective

To disseminate knowledge about production of high quality milk, preservation method, advances in processing of milk and milk products and packaging.

Theory

UNIT I

Principles and practices of production of high quality milk Advances in methods of chilling and preservation of milk. Thermal processing of milk, principles and methods, types of UHT-processing plants. Advances in packaging of milk.

UNIT II

Bacteriological, physical, chemical and nutritional effects of processing on milk - New concepts in milk processing – radiation and microwave processing- Membrane processing in dairy industry such as Reverse Osmosis(R.O), Ultra Filtration (UF), Nano Filtration (NF) and Micro Filtration (MF)- Fouling and cleaning of membranes.

UNIT III

New concepts in technology of dairy products. Cream powder, sterilized cream, frozen products, ice-cream mix, low, medium, high heat milk powder, milk based infant foods. Advances in starter cultures and their application, butter, butter spread, butter powder, cheese and cheese spread, probiotic products.

UNIT IV

Indigenous dairy products, khoa powder, paneer/channa powder, gulab jamun powder, kulfi powder- Recent advances in utilization of dairy byproducts in product development, preservation of milk products. Application of immobilized enzyme in dairy products.

Practical

Use of Starter cultures, lyophilization process, Maintenance of cultures. Demonstration of Membrane processing Technology, Advances in Packaging-Retort, Vacuum and Control Atmosphere Packaging Technology.

Suggested Readings

Selected articles from journals.

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

LPT 705

ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS 2+0

Objective

To impart knowledge about the advances in quality control in dairy and meat industry.

Theory

UNIT I

Recent advances in quality control in dairy and meat industry in special reference to Total Quality management, HACCP – good manufacturing practices for manufacturing of quality and safe livestock products.

UNIT II

PFA and BIS standards, international standards organization (ISO 9000), product quality certification, international standards for milk powders, American Dairy Products Institute (ADPI) standards.

UNIT III

Rheology of milk products-Preservatives, antioxidants, antibiotics and pesticides residue in milk- Advances in bacteriological and physico-chemical analysis of milk and milk products

UNIT IV

Importance of quality assurance of livestock products for domestic and export trade – quality standards for meat - Effect of processing on nutritional and chemical qualities of meat products – Sensory evaluation of meat products – Physicochemical and microbiological quality assessment and standards - Economics of processing and product development.good manufacturing practices, meat hygiene regulations in relation to slaughter houses and processing plants-international regulations-State Municipal and other regulations pertaining to meat trade-Meat Food Products Order-ISO certification-Codex alimentarius-Bureau of Indian standards.

Suggested Readings

Selected articles from journals.

LPT 706

BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS

1+1

Objective

To impart knowledge about biotechnological techniques, methods, starter cultures and industrial application of biotechnology in meat industry.

Theory

UNIT I

Introduction, development and prospects of biotechnology in animal products, ancient and traditional food processing biotechniques.

UNIT II

Modern biotechnological methods and processes in animal products development, chemical and physical factors required for growing microbial cultures in nutritive substrate- Meat species identification- Quality control – Screening products for contaminants – Polymerase Chain Reaction (PCR) based products.

UNIT III

Basic principles of the industrial use of bio-reactions for production of biomass-upstream and downstream processing-application of micro-organisms as starter cultures in meat industry, microbial production of food ingredients.

Practical

Production, selection and purification of microbial cultures, making products using different microbial cultures, production of acidulation, buttery flavour, pigments, anti-microbial agents to improve the product quality and safety-Polymerase Chain Reaction (PCR).

Suggested Readings

Selected articles from journals.

LIVESTOCK PRODUCT TECHNOLOGY

List of Journals

- ❖ Advances in Food Research
- ❖ Beverage and Food World
- ❖ British Poultry Science
- ❖ Dairy Foods
- ❖ Dairy Indian
- ❖ Dairy Industries International
- ❖ Dairy Science Abstracts
- ❖ Flieshwirtschaft
- ❖ Food Processing
- ❖ Food Technology
- ❖ Food Technology
- ❖ Indian Dairy Man
- ❖ Indian Food Industry
- ❖ Indian Journal of Dairy Technology
- ❖ Indian Journal of Food Science and Technology
- ❖ Indian Journal of Poultry Science
- ❖ Indian Journal of Veterinary Research
- ❖ International Dairy Federation
- ❖ International Dairy Journal
- ❖ International Food Hygiene
- ❖ International Journal of Dairy Technology
- ❖ Journal of Animal Science
- ❖ Journal of Dairy Research
- ❖ Journal of Dairy Science
- ❖ Journal of Food Protection
- ❖ Journal of Food Science
- ❖ Journal of Meat Science
- ❖ Milk Industry
- ❖ Poultry Science
- ❖ Processed Food Industry
- ❖ Science of Food and Agriculture

e-Resources

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| ❖ www.meatscience.org | ❖ www.usa.gov |
| ❖ www.amis.org | ❖ www.fsis.usda.gov |
| ❖ www.meatami.com | ❖ www.poultryhelp.com |
| ❖ www.mla.org.au | ❖ www.nddb.org |
| ❖ www.FAO.org | ❖ www.ndri.res.in |
| ❖ www.agresearch.co.nz/mirinz | ❖ www.amul.com |
| | ❖ www.idfa.org |

Suggested Broad Topics for Master's and Doctoral Research

- ❖ Development of shelf stable meat products
- ❖ Development of intermediate moisture meat products
- ❖ Application of active packaging for improving shelf life
- ❖ Development of low sodium meat products
- ❖ Development of low fat meat products
- ❖ Enrichment of meat with fiber
- ❖ Enrichment of meat with calcium
- ❖ Utilization of edible byproducts
- ❖ Utilization inedible byproducts
- ❖ Prevention of oxidative rancidity in meat products
- ❖ Development in processing of poultry meat.
- ❖ Recent advances in processing of egg and egg products.
- ❖ Recent advances in preservation and quality control of egg and egg products
- ❖ Development in packaging, regulations and standards of poultry meat.
- ❖ Development in preservation and quality control of poultry meat.
- ❖ Development of functional casinates for food industry
- ❖ Development of phytoformula
- ❖ Development of geriatric biofoods
- ❖ Development of hydrolysed lactose milk drinks to lactose intolerants
- ❖ Membrane utilization in indigenous dairy products

POULTRY SCIENCE
Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
PSC 601	POULTRY BREEDING AND GENETICS	2+1
PSC 602	POULTRY NUTRITION AND FEEDING	2+1
PSC 603	COMMERCIAL LAYER PRODUCTION	2+1
PSC 604	COMMERCIAL BROILER PRODUCTION	2+1
PSC 605	BREEDER STOCK, FLOCK HEALTH AND HATCHERY MANAGEMENT	3+1
PSC 606	MANAGEMENT OF POULTRY OTHER THAN CHICKEN	2+1
PSC 607	POULTRY PRODUCTS TECHNOLOGY AND MARKETING	2+1
PSC 608	POULTRY ECONOMICS , PROJECTS AND MARKETING	2+1
PSC 609	PHYSIOLOGY OF POULTRY PRODUCTION	2+1
PSC 691	MASTER'S SEMINAR	1+0
PSC 699	MASTER'S RESEARCH	20
PSC 701	APPLIED POULTRY NUTRITION	2+1
PSC 702	CONCEPTS IN COMMERCIAL POULTRY PRODUCTION	2+1
PSC 703	DEVELOPMENTS IN POULTRY PRODUCTS TECHNOLOGY	2+1
PSC 704	EMERGING DISEASES OF POULTRY AND FLOCK HEALTH	2+1
PSC 705	ADVANCED POULTRY BREEDING METHODS	2+1
PSC 706	POULTRY ECONOMICS, MARKETING AND INTEGRATION	2+1
PSC 791	DOCTORAL SEMINAR I	1+0
PSC 792	DOCTORAL SEMINAR II	1+0
PSC 799	DOCTORAL RESEARCH	45

POULTRY SCIENCE

Course Contents

PSC 601 POULTRY BREEDING AND GENETICS 2+1

Objective

To impart knowledge on different systems of breeding, selection methods, design and implementation of breeding programme in developing egg-type and meat type birds. Modern tools in poultry breeding.

Theory

UNIT I

Genetic classification of Poultry –Origin and breed characteristics of poultry- Development of Poultry Industry in India - Mendel's laws of inheritance related to poultry -Qualitative and Quantitative traits in Poultry breeding -Additive, Non Additive, Epistatic and complementary gene action – Lethal and mutations in poultry – Sex linked, Sex limited and Sex influenced traits – Economic traits - Heritability – Quantitative inheritance — Phenotype, Genotype & environment interactions.

UNIT II

Systems of Breeding – Systems of Mating – Selection methods – Breeding programme for developing egg-type and Broiler type of birds – Developing hybrids - Other species of Poultry breeding and management - Formation and Management of inbred, pure lines, grand parent and parent stock.

UNIT III

Industrial breeding-Artificial insemination in chicken-Autosexing-Random SampleTest. Use of molecular genetics in poultry breeding-Quantitative trait loci and marker-assisted selection-Conservation of poultry genetic resources.

Practical

Breeds of poultry – Factors affecting inheritance of qualitative and quantitative traits in poultry - Constructing index and Osborne index-Estimating heritability – Breeding program for developing commercial hybrid layers, broilers, Japanese quail, duck, turkey, fancy birds, Guinea Fowl and Pigeons – Semen collection, evaluation & insemination in chicken & turkey – Breeding records –Use of computers to maintain breeding records and for selection.

Suggested Readings

Crawford RD. 1990. *Poultry Breeding and Genetics*. Elsevier.
Singh RP & Kumar J. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani.

PSC 602 POULTRY NUTRITION AND FEEDING 2+1

Objective

Teaching about nutrients & their functions, nutrient requirements of poultry and factors influencing the same. Imparting knowledge of different types of feeds and feeding methods.

Theory

UNIT I

Digestive system, digestion, metabolism and absorption of feed in poultry – Factors influencing the feed consumption in birds – Macro and micro-nutrients – Nutrient requirements for various species of poultry. Partitioning of energy -

Calorie: protein ratio – Nutrient interrelationships – Factors influencing the nutrient requirements.

UNIT II

Feed ingredients composition, feed storage technique-milling and quality control- Processing of feed – Types & forms of feeds and feeding methods - Commonly occurring anti nutrients and toxicants in poultry feed ingredients – Mycotoxins and their prevention – Feeding chicks, growers, layers, broilers and breeders – Principles of computing feed- – Balanced feeds -Least cost feed formulation and programming – Feeding in different seasons and stress conditions - Nutritional and metabolic disorders in poultry.

UNIT III

Systems of feeding – restricted, forced, controlled and phase feeding -Use of Additives and Non additives- enzymes, probiotics, prebiotics antibiotics, herbs, performance enhancers – Utilization of non-conventional feedstuff - Feeding of ducks, turkeys, Japanese quails, Guinea fowls.

UNIT IV

Organic, functional, designer & SPF feed production - Production of drug residue, pesticide residue & toxin free feeds – regulations for Import and Export of feed and feed supplements.

Practical

Physical and sensory evaluation of feed ingredients- sampling techniques for ingredients and compounded feed-Estimation of proximate principles of feed and feed ingredients – Computing various poultry feed formulae based on commonly available feed ingredients – Estimation of Aflatoxin, Calcium, Phosphorus, Sand, Silica and Salt – Mash, pellet & crumble feed preparation – Feeding procedures. Visit to feed mills – Preparation of Project report for a feed mill–Hands on Training in feed analytical lab- Preparation & quality control of organic and designer feeds.

Suggested Readings

- Einsminger ME. 1992. *Poultry Science*. Poultry International Book Distributing Co.
- Mac O' North & Bell D. 1990. *Commercial Chicken Production Manual*. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.
- Singh RA & Panda B.1992. *Poultry Production*. Kalyani Publishers.

PSC 603

COMMERCIAL LAYER PRODUCTION

2+1

Objective

To impart knowledge on different systems of rearing commercial egg laying birds, care and management of commercial layers for optimal egg production.

Theory

UNIT I

Layer Industry in India and the World – Systems of layer farming – Location – Lay out of the farm – Systems of housing – Types of roofs, roof materials, pillars, trusses for poultry houses – Design of different Poultry Houses for large & medium size layer farms – Cages & modified cages for egg type birds – Layer

farm equipments –Automation in poultry houses and its maintenance – Management of layers in different systems of rearing.

UNIT II

Deep litter & cage system of management – Medication and vaccination schedules & procedure for layers – Lighting programme for egg type birds - Water quality standards, watering of layer and water sanitation – Brooder, grower and layer management – All in All out and Multiple batch system of rearing layers.

UNIT III

Management of layers during peak egg production and maintaining the persistency in production–Factors causing uneven growth and low egg production -Monitoring egg production curve.

UNIT IV

Culling of unproductive birds – Record keeping – Biosecurity & health management – Management during different seasons – Induced moulting.- HACCP application for safe egg, value added egg production – Production of eggs free from harmful microbes, Mycotoxins & drug residues- Integration in layer production.

Practical

Layer farm lay out and blue print– Design of different chick, grower & layer houses, their specifications & blue print of deep litter and cage system– Selection & culling of layers, debeaking, dubbing, deworming, delicing, vaccination & other farm routines and operations – Farm sanitation, disinfection & waste disposal – Maintaining farm records – Visit to commercial layer farms – Record keeping – Calculating Hen day egg production, Hen housed egg production and other economic traits – Case study of production loss, reasons and corrective measures – Preparing project reports for layers under different batch systems – Calculating the cost of production of eggs.

Suggested Readings

Mac O' North & Bell D. 1990. *Commercial Chicken Production Manual*. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

PSC 604

COMMERCIAL BROILER PRODUCTION

2+1

Objective

To deal with different systems of rearing commercial broilers, manage mental practices for higher bodyweight with best feed efficiency in commercial broilers. Marketing of broilers efficiently.

Theory

UNIT I

Broiler Industry in India and the World – Systems of rearing broilers – Location, layout and design of Broiler houses – Broiler farm equipment.

UNIT II

Brooding and rearing of broilers- All in all out and multiple batch systems – Litter materials and deep litter management – Lighting for broilers – Environmentally controlled broiler houses & their management – Water quality and Watering of broiler and water sanitation- Management during different seasons.

UNIT III

Mash, crumble and pellet feeding of Broilers – weekly growth rate, feed conversion and livability in broilers- sex separate feeding – Feeding broilers for optimum growth rate & feed efficiency- Broiler performance indices – Broiler farm records.

UNIT IV

Broiler farm routine, medication and vaccination schedule – Bio-security and health management and their control – Systems of Integration in broiler production and marketing –transport of broilers– Different ways of marketing of broilers- Regulations and specifications for production of export quality broilers – Organic broiler meat production.

Practical

Location and blue print for a broiler farm – Broiler house design – Preparation of project report for broiler farm – Visit to broiler farms – Judging of live broilers and ready-to-cook broilers– Broiler vaccination, medication, brooding and transportation and farm routines. Record keeping - Calculating the cost of production of broilers – Feeding of broilers at different ages – Working out Feed efficiency – Case study on low body weights, reasons and corrective measures.

Suggested Readings

Mac O' North & Bell D. 1990. *Commercial Chicken Production Manual*. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

PSC 605

BREEDER STOCK, FLOCK HEALTH AND HATCHERY MANAGEMENT 3+1

Objective

To impart knowledge about care and management of breeders, hatchery operation, health management. And to study about common diseases and disorders of poultry, diagnosis, vaccination, prevention, control and treatment. Bio security measures in control of general & hatchery borne diseases.

Theory

UNIT I

History of Natural and Artificial incubation- embryo development-different breeder flocks – Planning a hatchery, breeder farm – Special care of breeder flock –Collection, selection and care of hatching eggs – Breeder male and female management – Flock testing & culling - Farm and hatchery equipments – Incubation practices – Ventilation and temperature control – Hatchery Management, Fumigation and sanitation – Breeder farm and hatchery operations, routine & schedule - Factors affecting fertility and hatchability.

UNIT II

Care of day old chicks and their vaccination - Restricted & controlled feeding of breeders – Sex separate feeding and nutrient supplementation. – Seasonal management of breeders – Location of hatchery – Layout and design of breeder houses, hatchery & other buildings.

UNIT III

Biosecurity, health management and waste disposal – Vaccination & medication schedule for breeders. Control of vertically transmissible & hatchery borne diseases.

UNIT IV

Principles of bio security- Farm sanitation and disinfection procedures-Common bacterial diseases- Salmonella, Pasteurella, E.coli, Fowl typhoid, CRD, Infectious Coryza, Viral diseases-Newcastle, Infectious bronchitis, Infectious laryngo tracheitis, Mareks, Fowl pox, Infectious Bursal disease, Egg drop syndrome-76, Avian Encephalomyelitis, Avian influenza, Duck viral Enteritis, Duck viral hepatitis-Fungal diseases- Aspergillosis, Mycotoxicosis, Metabolic disorders-Fatty liver haemorrhagic syndrome(FLHS), Gout and Ascites, Protozoan diseases-Coccidiosis, Ecto and endo parasitic infestation of poultry. Diagnosis, vaccination, prevention, treatment and control – Locational, structural & operational biosecurity in Poultry farms – Water sanitation & control of water borne diseases – Quarantine of poultry. Packaging and transportation of hatching eggs and chicks.

UNIT V

Hatching egg & SPF egg import and export regulations – Maintaining Salmonella and Mycoplasma free breeding flock –Application of HACCP and Good Management Practices (GMP) in hatchery management for better chick quality.

Practical

Breeder farms and hatchery records, selection, fumigation, care and storage of hatching eggs. Layout and blue prints for breeder farm and hatchery –Incubation requirements –Incubator management – Hatchery sanitation & fumigation procedures – Pedigree hatching – Hatchery waste disposal and recycling – Calculating cost of production of hatching eggs and day-old-chicks – Attending breeder farm routines & operation – Flock testing & culling of reactors – Analyzing hatchability results and hatchery records-Economics of layer and broiler hatchery.

Suggested Readings

Crawford.RD. 1993. (Ed.). *Poultry Breeding and Genetics*. Elsevier.

Mac O' North & Bell D. 1990. *Commercial Chicken Production Manual*. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

PSC 606

MANAGEMENT OF POULTRY OTHER THAN CHICKEN 2+1

Objective

Care and management of different breeds, varieties of poultry other than chicken, methods of rearing and common diseases affecting them and their control measure.

Theory

UNIT I

Breeds and varieties of Turkey, Duck, Goose, Pigeon, Guinea fowl, Budgerigar, Japanese quail, Emu and Ostrich – Incubation periods & incubation procedure for different species – Housing, cage & equipments for different species – Duck, Turkey, Japanese Quail, Guinea fowl, Emu, Ostrich production and rearing under different systems.

UNIT II

Management and rearing of Turkey, duck, goose, Guinea fowl, Japanese quail, pigeon, emu and ostrich- Feeding standards and feeding, watering and rearing

systems and procedure for different species of poultry- Breeding policies of egg and meat production in different species – Preparation of Project reports for different species for commercial exploitation.

UNIT III

Common diseases affecting poultry other than chicken and their control – Regulations for import and export of different species of poultry – prevention of exotic diseases through import of poultry products and live birds.

Practical

Layout and design of housing & cages for other species of poultry. Visit to commercial Japanese quail, turkey and duck farms. Incubation and care of hatching eggs and young ones – Rearing practices followed by duck, quails and turkey farmers under field conditions. Preparing project reports for different species and calculating the cost of production.

Suggested Readings

Einsminger ME. 1992. *Poultry Science*. Poultry International Book Distr. Co.

PSC 607

POULTRY PRODUCTS TECHNOLOGY AND MARKETING

2+1

Objective

Composition and nutritive value of eggs and chicken meat, grading and preservation methods of eggs and meat, functional and value added poultry products, marketing of eggs and poultry meat.

Theory

UNIT I

Physical and chemical composition and nutritive value of eggs and meat – Grading of eggs & meat by different standards –Preservation of eggs - Egg quality deterioration - Factors affecting egg quality – Handling, processing, packaging materials, packaging, transport and marketing of eggs.

UNIT II

Quality control of poultry meat – Quality preservation – Marketing of egg and poultry meat – Marketing channels – Integration in poultry processing and marketing-Functional and value added eggs and meat – Further processing of eggs and meat – Various egg and meat fast foods.

UNIT III

Sanitary and phyto sanitary measures to ensure food safety – Post oviposition value addition to the eggs & Post processing value addition to the meat for export – Production of low cholesterol eggs – Microbial safety of poultry products – Import and export of poultry products – Further processing of poultry for export – Implementation of GMP and HACCP procedures for food safety – Codex regulations for poultry products safety.

Practical

Measuring internal and external egg qualities – Preservation of table eggs, grading of eggs – Processing of chicken – Further processing of poultry – Preservation of poultry meat – Preparation of various eggs and poultry meat products and fast foods – Preservation, packaging and transport – Quality control of value added poultry products – Estimation of pesticides, antibiotics and mycotoxin residues in eggs and meat – Measures of microbial safety of poultry products for export.

Suggested Readings

Mountney GJ & Parkhairst CR. 1995. *Poultry Products Technology*. 3rd Ed. AVI Publ.

PSC 608 POULTRY ECONOMICS, PROJECTS AND MARKETING 2+1

Objective

To study about measures of performance efficiency in poultry farms and its allied sector, components of project reports and preparation of viable projects related to poultry Industry.

Theory

UNIT I

Glossary of terms used in poultry economics & projects – Measures of performance efficiency in broiler, layer, breeder and other poultry species, hatcheries and other poultry related operations – Production standards and goals.

UNIT II

Planning poultry enterprise –Bank norms for poultry projects – Poultry insurance – Methods to improve the production efficiency and reduce the production cost - Components of project reports and preparing projects.

UNIT III

Integration in Poultry production – Marketing channels for eggs and meat – Integration in marketing of eggs and meat - Cost of production of egg, broiler, hatching egg, day-old chick, compounded feed - Effect of new economic policies on poultry industry – Viability of poultry projects.

Practical

Preparing different poultry projects for bank finance – Calculating the cost of production of various products under various systems-case study – Preparation of Balance sheet, break even points, benefit: cost ratio & other farm economic indices - Preparation of feasibility & viability reports.

Suggested Readings

Mac O' North & Bell D. 1990. *Commercial Chicken Production Manual*. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.

PSC 609 PHYSIOLOGY OF POULTRY PRODUCTION 2+1

Objective

To study the basic principles of physiology of poultry production in relation to egg formation, production, incubation, stress and role of environment.

Theory

UNIT I

Skeletal system of poultry – Comb pattern, plumage - Physiology of poultry digestive system- Digestion, metabolism and absorption of feed and water – Role of enzymes – Poultry circulatory system – Respiratory system – Physiology of growth- muscle growth-bone growth and growth of body parts-Types of muscle fibre and functions.

UNIT II

Poultry nervous system and its function – Excretory system – Male and female reproductive system-Reproductive tract-Semen production-semen characteristics-

Artificial insemination-Semen extenders-reproductive tract-egg formation-egg laying pattern-photo periodic responses – Role of endocrine glands and their functions. Thermoregulatory mechanism – Stress due to adverse environmental factors –Acid –base balance – Poultry ethology.

UNIT III

Neuro-endocrine control of egg production-Ovulation and Oviposition – Clutch and Pause.

Practical

Demonstration of various systems of birds – structure of feather- Identification of endocrine glands –hormones in poultry production and reproduction- Haematology of poultry species - SGOT, SGPT, free fatty acids - Morphology of Poultry spermatozoa.

Suggested Readings

Rose SP.1997. *Principles of Poultry Science*. CABI.

PSC 701

APPLIED POULTRY NUTRITION

2+1

Objective

Teaching about nutrients and their functions, nutrient requirements of poultry and factors influencing the same. Different methods and forms of feeds and feeding of poultry.

Theory

UNIT I

Developments in the nutrient requirement for egg and meat-type chicken - Concepts in various poultry feeding procedures and methods for optimal production - Factors influencing the nutrient requirements, feed intake and feed efficiency in poultry-Problems encountered in nutritional deficiencies - Protein and energy utilization and calorie protein ratio, Vitamins, minerals and their interactions in poultry rations.

UNIT II

In Ovo -Juvenile nutrition for optimal growth rate and feed efficiency – Care in grower feeding - Nutrition and feeding of layers /breeders during peak egg production- Nutritional requirements for higher egg production, broiler meat production, higher fertility and hatchability and other special purposes.

UNIT III

Feeding of broilers for uniform growth rate and feed efficiency – Feeding to enhance egg quality and nutrients-Enzymes-additives-non-additives in feed production – organic, functional and designer feeds. Advances in feed milling technology – Specialty feed production to produce microbial safe foods, SPF eggs and organic foods.

UNIT IV

HACCP implementation in feed quality control – Production of drug, Mycotoxins and pesticide residue free feeds.

Practical

Computing of specialty and functional feeds – Estimation of available carbohydrate, Aflatoxin, tannins, hydro cyanic acid and other toxins in the feed. Evaluation of various feeds for its quality – Field methods of feed quality control

including feed microscopy – Estimation of carotenes, cholesterol and peroxides.
Quality control of functional poultry feeds – Preservation of feed quality from production to consumption.

Suggested Readings

Einsminger ME. 1992. *Poultry Science*. Poultry International Book Distributing Co.
Selected articles from journals.

PSC 702 CONCEPTS IN COMMERCIAL POULTRY PRODUCTION 2+1

Objective

To impart knowledge on different systems of poultry rearing, care and management of commercial layers/broilers for optimal egg and meat production.

Theory

UNIT I

Global trends in poultry production - Advances in broiler production in India – concepts in egg production – Latest concepts in breeder management – advances in hatchery operations for higher hatchability & chick quality.

UNIT II

Optimal microclimatic condition in poultry houses and cages for higher production – Management of poultry in environmentally controlled houses – Management of poultry under adverse climatic conditions – advances in the management of other species of poultry - Behaviour patterns of poultry in different growing systems.

UNIT III

Advanced management techniques for egg and meat production - advances in lighting management, feeding management, litter management and manure management.

UNIT IV

The role of integration in poultry production – Factors influencing egg production in different species of poultry – Factors influencing growth rate and egg production - Automation in poultry production.

UNIT V

Regulations for cage-free egg production and organic chicken production – Functional feeds for functional foods – Production of HACCP and GMP certified table eggs, meat, chicks, hatching eggs and other value added products for export.

Practical

Performance study in commercial layer, broiler, Japanese quail, duck, turkey and other species of poultry farms by Interpretation of the farm records - Managerial routines of different species of poultry - calculating the cost of production –Estimation of microclimatic condition and comparing the productive traits– Modern poultry house and cage design for optimal efficiency and cost reduction.

Suggested Readings

Selected articles from journals.

PSC 703

DEVELOPMENTS IN POULTRY PRODUCTS TECHNOLOGY

2+1

Objective

Composition and nutritive value of eggs and chicken meat, grading, packaging and preservation methods of eggs and meat, functional and value added poultry products, marketing of eggs and poultry meat.

Theory

UNIT I

Global trends in poultry and egg processing - Indian scenario of poultry processing industry - Nutrients & Non-nutrient components in regular and value added poultry products – various measures of egg and meat quality control – advances in value addition to poultry products.

UNIT II

Concepts in poultry meat and egg preservation – Newer concepts in meat tenderization, canning, dehydration, curing, irradiation, etc. - Modified atmosphere packaging – Other processed products - Room temperature preservation of poultry fast foods by multi hurdle technology.

UNIT III

Egg desugarization - pasteurization – Functional properties of eggs – Industrial uses of eggs – Marketing trends in poultry meat and eggs.

UNIT IV

Improving the product quality to meet Codex & European standards – Standards for egg, meat and their products -Production of immunoglobulins, lecithin, lysozyme, sialic acid and other pharmaceutical products from eggs – Sanitary & phytosanitary measures for food safety.

Practical

Preparation of value added products suitable for preservation at room temperature – Further processing – Barbecuing and Tandoori preparation – preparation of locale specific poultry meat and egg products – Meat balls, meat patties - Estimation of various egg and meat qualities – Preservation of meat and eggs - Measuring the microbial quality of poultry foods – Drug, pesticide, mycotoxin and antibiotic residue assay

Suggested Readings

Selected articles from journals.

PSC 704

EMERGING DISEASES OF POULTRY AND FLOCK HEALTH

2+1

Objective

To study about common diseases and disorders of poultry, their diagnosis, vaccination, prevention & treatment, emphasis on control of emerging poultry diseases of zoonotic importance, disease diagnostic techniques.

Theory

UNIT I

The concepts of disease prevention in poultry – Emerging and reemerging avian diseases -Factors influencing immuno suppression and stimulation – Developing immunity in poultry

UNIT II

Water sanitation, hatchery sanitation procedures - Control of vertically transmissible diseases – non-infectious and metabolic diseases in poultry and their control – Bio security – Mycotoxins and their control.

UNIT III

Stress alleviation – prevention and control of bacterial and viral diseases in poultry – Biosecurity measures – Control measures of problematic re-emerging diseases of poultry like Ranikhet, Avian influenza, Marek's disease, Infectious bursal disease, Infectious Bronchitis, Infectious laryngo tracheitis.

UNIT IV

Flock management for Specific pathogen free egg production – Maintaining the HACCP standards in poultry farms – developments in the Exim policies for flock health.

Practical

Studying the Immune status of birds – Egg inoculation techniques in laboratory diagnosis –differential diagnosis of various poultry diseases by postmortem, and laboratory techniques – Antibiotic sensitivity test – Vaccination – Disinfection and ectoparasite control, medication procedures.

Suggested Readings

Selected articles from journals.

PSC 705

ADVANCED POULTRY BREEDING METHODS

2+1

Objective

To impart knowledge about different systems of breeding, selection methods and implementation of breeding programme in developing egg-type and broiler hybrids. Modern tools in poultry breeding.

Theory

UNIT I

Gene and genotypic frequency- Sex linked, limited and influenced traits-Auto sexing- Qualitative and quantitative traits and its inheritance in poultry- methods of selection – family selection – selection for multi characteristics and construction of selection indices – restricted selection indices – indirect selection - Reciprocal recurrent selection – Recurrent selection – Random bred control populations - Selection limit - Osborne's index – construction of selection index for multiple traits – Advances in commercial poultry breeding.

UNIT II

Modern methods in commercial layer and broiler breeding, performance testing – Pure line breeding – Inbreeding and hybridization - Diallele mating, lethal and semi lethals in poultry. Pedigree hatching. Genotype versus environmental interaction.

UNIT III

Exploitation of additive and non-additive gene action for commercial poultry production - Heterosis – Exploitation of hybrid vigour for commercial production of layers and broilers- Formation of synthetic lines – Development of strains in poultry-Comparative efficiency of different selection methods in poultry.

Practical

Construction of selection index – Analysis of breeding data collected from breeding records – Problem in qualitative and quantitative inheritance- Estimation of heritability and standard error of heritability by different methods – analysis of heritability for different traits – Estimation of inbreeding coefficient – Artificial insemination in poultry.

Suggested Readings

Muir WM & Aggrey SE. 2003. Poultry Genetics and Biotechnology. CABI.
Selected articles from journals.

PSC 706 POULTRY ECONOMICS, MARKETING AND INTEGRATION 2+1**Objective**

To study about measures of performance efficiency in poultry farms and its allied sectors, hatcheries and developing poultry projects.

TheoryUNIT I

Present practices and future trends in production of egg and meat – consumption – demand and supply-seasonal variations in production and consumption. Marketing channels- procedures of marketing for eggs and meat - Market intelligence-Advertising and branding of poultry products – wholesaling and retailing – quality of eggs and meat.

UNIT II

Various poultry enterprises – choice of production size of business – input and output analysis – calculating cost of various inputs – calculating cost of production . Price determination – Least demand and supply indices of performance – Performance targets and achievements-marketing and business management-market managerial skills and human resource development-cost and financial management.

UNIT III

Future trends in broiler and egg production –factors influencing the profit margin in poultry enterprises.

Practical

Study of marketing channels of egg and meat, calculating cost of production of eggs, meat, day-old chick, feed and processing plants– preparing other related poultry projects.

Suggested Readings

Einsminger ME. 1992. *Poultry Science*. Poultry International Book Distri. Co.
Selected articles from journals.

POULTRY SCIENCE

List of Journals

- | | |
|---------------------------------------|---|
| ❖ Avian Diseases | ❖ Journal Avian Biology |
| ❖ Avian Pathology | ❖ Poultry Abstract |
| ❖ Avian Research | ❖ Poultry Science |
| ❖ British Poultry Science | ❖ World Poultry Science Channel |
| ❖ Indian Journal of Poultry Science | ❖ Tamilnadu Journal of Veterinary and Animal Sciences |
| ❖ International Poultry Production | ❖ Indian Journal of Veterinary and Animal Sciences |
| ❖ Japanese Poultry Science | |
| ❖ Journal of Applied Poultry Research | |

e-Resources

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|---|---|
| ❖ http://www.alabamapoultry.org | ❖ http://www.ag.auburn.edu/dept/ph/index.html |
| ❖ http://www.egg.com | ❖ http://www.aes.ucdavis.edu |
| ❖ http://www.dpicken.com | ❖ http://animalscience.ucdavis.edu/ |
| ❖ http://www.georgiaeggs.org | ❖ http://animalscience.ucdavis.edu/extension/ |
| ❖ http://www.ansc.purdue.edu/ISEB | ❖ http://www.calstate.edu |
| ❖ http://www.ansc.purdue.edu/ISP | ❖ http://www.csupomona.edu |
| ❖ http://www.MidwestPoultry.com | ❖ http://www.animalscience.calpoly.edu |
| ❖ http://www.MinnesotaTurkey.com | ❖ http://www.clemson.edu/avs/ |
| ❖ http://www.nebraskapoultry.org | |
| ❖ http://www.ncegg.org | |
| ❖ http://www.ohiopoultry.org | |
| ❖ http://www.aeb.org | |
| ❖ http://www.fb.org | |
| ❖ http://www.afia.org | |
| ❖ http://www.albucusa.org | |
| ❖ http://www.amerpoultryassn.com | |
| ❖ http://www.avianresearch.co.uk | |
| ❖ http://www.canr.uconn.edu/ansci/ | |
| ❖ http://www.ansc.cornell.edu | |
| ❖ http://www.castscience.org | |
| ❖ http://www.enconline.org | |
| ❖ http://www.internationalegg.com | |
| ❖ http://www.eatchicken.com | |
| ❖ http://www.foodsafety.gov/~dms/fs-toc.html | |
| ❖ http://www.nmaonline.org | |
| ❖ http://www.eatturkey.com | |
| ❖ http://www.naga.org | |
| ❖ http://www.mtgplace.com | |
| ❖ http://www.poultryscience.org | |
| ❖ http://www.wposc.tamu.edu/library/dother.html | |
| ❖ http://www.poultryegg.org | |
| ❖ http://www.usapeec.org | |
| ❖ http://www.wattpoultry.com | |
| ❖ http://www.afns.ualberta.ca | |
| ❖ http://www.poultryresearchcentre.ch | |
| ❖ http://www.poultryscience.uark.edu/poult | |

Suggested Broad Topics for Master's and Doctoral Research

- ❖ Breeding programs for different species of poultry to improve the economic traits.
- ❖ Utilization of conventional and unconventional feeds in poultry rations.
- ❖ Study on exogenous enzymes, probiotics for increasing the feed efficiency in poultry.
- ❖ Evolving ways and means for the improving the performance of commercial, broilers and layers for higher economic gains.
- ❖ Micro and trace minerals requirements study for broiler and layers.
- ❖ Designing and development of eco friendly and environmentally controlled houses for large commercial poultry farms.
- ❖ Standardizing the disinfections procedures for sustainable poultry production.
- ❖ Standardizing the sanitary and phyto sanitary measures for safe production of eggs and broilers.
- ❖ Prevention and control of toxin, pesticides and antibiotic residues in egg and meat.
- ❖ Value added egg and poultry meat products program
- ❖ Development of fast foods by utilizing poultry egg and meat.
- ❖ Development and standardization of designer eggs and low fat high protein poultry meat.
- ❖ Preservation, storage, packaging of value added egg and meat products and their standardization.
- ❖ Reduction of pollution from poultry farms and processing plants.
- ❖ Profitable utilization of Poultry waste and manure.
- ❖ Development and standardization of organic poultry farming and standards for phyto sanitary measures
- ❖ Standardization of managerial, nutritional methods and schedules for rearing turkeys, guinea fowls, geese, Japanese quails and domesticated ratites.
- ❖ Development of suitable varieties of turkeys and guinea fowl suitable for different agro climatic conditions.
- ❖ Development of suitable birds for backyard poultry.
- ❖ Poultry bio security measures in organized farms.
- ❖ Studies on diseases affecting turkeys, guinea fowl, Japanese quail and their preventive measures.
- ❖ Disease surveillance, forecasting and development of field level diagnostic kits.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination,

numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article. **Communication Skills** - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
 Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
 Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
 James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
 Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
 Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
 Richard WS. 1969. *Technical Writing*. Barnes & Noble.
 Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
 Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
 Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503
(e-Course)

**INTELLECTUAL PROPERTY AND ITS
MANAGEMENT**

1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of animal varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

PGS 506
(e-Course)

DISASTER MANAGEMENT

1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

- Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.
- Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.
- Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

**BSMA Committee on Livestock Production Technology &
Production Management**

(Animal Sc./Animal Husb./Animal Bre./Animal Nutrition & AFT/LPM/APT/Poultry Sciences)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR dated January 14, 2008)

Name	Address	Specialization
Dr. N. Balaraman Former Vice-Chancellor Convener	Tamil Nadu Univ. of Vety. & Animal Science, Chennai	Animal Nutrition
Dr. B. K. Joshi Director	NBAGR, Karnal	Animal Breeding
Dr. S. K. Jindal Principal Scientist	Animal Physiology, CIRG, Makhdoom, Farh, Mathura (UP)	Animal Physiology
Dr. B. T. Deshmukh Prof.& Head	Deptt. of Physiology & Biochemistry, Bombay Vety. College, Parel, Bombay	Animal Physiology
Dr. Arjava Sharma Head	Division of Animal Genetics & Breeding, IVRI, Izatnagar, Bareilly	Animal Breeding
Dr. V. K. Tanwar Professor	Veterinary College, GBPUA & T, Pantnagar	LPT
Dr. C. L. Marwah Professor	Dept. of LPM, COVS, CSKHPAU, Palampur	LPM
Dr. R .S. Yadav Professor Member Secretary	Dept. of LPM, College of Animal Science, CCS HAU Hisar	LPM

**NEW AND RESTRUCTURED
POST-GRADUATE CURRICULA & SYLLABI**

Biotechnology & Bioinformatics

Plant Molecular Biology & Biotechnology
Animal Biotechnology
Bioinformatics



**Education Division
Indian Council of Agricultural Research
New Delhi**

January 2009

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PREAMBLE

Economic growth and development in India continues to be propelled by growth in agriculture and allied sectors. Since majority of our population is dependent on agriculture, it is pertinent to ensure their economic security under changing competitive globalized environment. This can only be done through technological advancements and competent human resource to serve the needs of highly receptive farming community. In past such efforts have led to green, white, yellow and blue revolutions to make the country self sufficient in food needs. However, over the time, changed circumstances, declining total factor productivity, rising unemployment, fast degrading natural resources etc., have led to declining agricultural growth. Agricultural production through most conventional science and technology innovations has reached a plateau. Therefore, there is need to break the plateau. Thus to put the country's agricultural growth on fast track, development of cutting edge technologies and competent human resource is the need of the hour.

Biotechnology and Bioinformatics are relatively newer cutting edge sciences which incorporate principles of biological, physical and chemical sciences. Biotechnology is based on techniques involving genes, genomes, nucleic acids and other related macro and micro biomolecules. Bioinformatics apply computer based information technology for storage, retrieval and analysis of vast data bases being generated on genes, genomics and nucleic acids. Advances so far made in these disciplines have already found valuable applications in quality and quality of production and productivity, processing and value addition of produce of agriculture and allied sectors.

The tremendous impetus received for biotechnological research and education has been due to its direct impact on human and animal health, agricultural productivity and environment issues. Due to increasing acceptance of genetically modified foods and agricultural produce, big pharmaceutical and agribusiness companies are investing huge funds in the biotechnology R&D sector. At present in India the number of companies involved in R&D or product development or production related to biotechnology and life sciences products has grown close to 350. To sustain these efforts, biotechnology R&D as well as education sector needs high quality human resources for inventing and creating value added products through intervention of biotechnology. It is felt that the second green-blue-white revolution can be achieved only through sustained improvement in the genetic upliftment of native crops and livestock. Because of tremendous global interest in biotechnology in the last two decades, the genetic blue print of a number of organisms has been worked out, which has led to the accumulation of huge genetic data. This has created requirement of highly skilled manpower equipped with biotechnological as well as information technology skills to analyze, annotate and make use of the genetic information for genetic enhancement of breeds or developing new age drugs for personal medicine to name a few application. These two subjects have gained importance in the recent time not only from industrial point of view but also from basic and strategic future research.

Major interest and scope of Biotechnology has emerged from the techniques which permit manipulation of biological systems in a defined and deliberate manner for beneficial purposes. Both human genome and rice genome projects have demonstrated the tremendous power of biotechnology and bioinformatics tools and techniques and their enormous applications as a commercial activity which is anticipated to grow exponentially. In view of the fast expanding scope of Biotechnology and Bioinformatics, the post graduate programme, non-existent a few decades ago is now being offered in hundreds of public and private universities and institutes. Twenty seven agricultural universities offer Biotechnology programmes, some of which offer both Animal Biotechnology and Plant/Agricultural Biotechnology & Molecular Biology Programmes. Bioinformatics programme is offered only by CCS Haryana Agricultural University. Department of Biotechnology of Union Ministry of

Science & Technology supports PG Biotechnology programmes of ten agricultural universities.

The existing Biotechnology Departments of agricultural universities vary greatly in terms of infrastructure, facilities and human resources which at several places are inadequate for full realization of Biotechnology potential. Also in most cases, these Departments have been created by regrouping of willing and trained human resource from old well established disciplines like Biochemistry, Microbiology, Genetics, Plant Physiology, Plant Breeding etc. Biotechnology and Bioinformatics are fast developing disciplines in which scientific and technological advancements are taking place rapidly. There is strong need for continuous faculty competence improvement, for updating skill and knowledge of scientists through national and international human resource development activities and programmes.

The BSMA Committee has worked with the stakeholders of Biotechnology & Bioinformatics on issues concerning PG education. Curricula and Syllabi recommended by the ICAR and by the Department of Biotechnology of the Government of India, and some Agricultural Universities were considered in preparing the first draft of Curricula and Syllabi of Animal Biotechnology, Molecular Biology & Biotechnology and Bioinformatics. This was prepared by the concerned faculties of CCS Haryana Agricultural University, Hisar. The first draft was thoroughly discussed through e-mail exchanges among BSMAC Members and 64 stakeholders representing academia, biotech industries and government organizations. Curricula & Syllabi were further critically examined and thoroughly discussed in two BSMAC Meetings and a Stakeholders Workshop. All the suggestions and opinions received were properly considered in formulating the restructured Curricula & Syllabi.

The contents of most of the courses in all the three programmes have been revised keeping in view the advances in the respective subject area. Title of quite a few courses has been modified to make them contemporary. Following new courses have been included in the revised curricula:

Plant Molecular Biology & Biotechnology: Molecular Breeding; Nano-biotechnology; Biosafety, IPR and Bioethics; Immunology and Molecular Diagnostics; Crop Biotechnology; Plant Tissue Culture and Genetic Transformation, Environmental Biotechnology, Advances in Crop Biotechnology, Advances in Functional Genomics and Proteomics, Advances in Animal Biotechnology, Commercial Plant Tissue Culture.

Animal Biotechnology: Techniques in Molecular Biology & Genetic Engineering; Biodiversity, Biosafety & Bioethics; Molecular Forensics, Industrial Biotechnology; Animal Biotechnology; Functional Genomics & Proteomics; Gene Cloning and Expression; Trends in Vaccinology.

Bioinformatics: Basic Molecular Biology; Mathematics for Bioinformatics; Pharmacogenomics & IPR.

The new curricula and syllabi has increased practical component to provide hands on training and analytical skills to the students. The new courses such as Techniques in Molecular biology I & II, Techniques in Bioinformatics and Techniques in Molecular Biology & Genetic Engineering have been included with only practical format. The practical exercises have been distinctly out lined in the courses as these are to be conducted rather than in descriptive running text. Such courses are aimed at strengthening the practice/practical skills of the students to equip the students with modern research skills and knowledge to meet requirements of R&D organizations, private sector and global competitiveness for their employability.

H. S. Nainawatee

Convener, BSMAC (Biotechnology & Bioinformatics)

EXECUTIVE SUMMARY

Plant Molecular Biology & Biotechnology

- In the last thirty years, a revolution has taken place that has put molecular biology and biotechnology at the heart of all the biological sciences with extensive applications in agriculture, health, industry and environment. Keeping these developments in view, the new course curriculum for PG program in 'Plant Molecular Biology and Biotechnology' has been developed
- The curriculum now includes courses on 'Plant Tissue Culture and Genetic Transformation', 'Molecular Breeding', 'Genomics and Proteomics', 'Bioinformatics', 'Nano-biotechnology', 'Biosafety, IPR and Bioethics', 'Biostatistics and Computers', 'Environmental Biotechnology', 'Immunology and Molecular Diagnostics', which have direct application in improving agriculture and industry.
- The curriculum also includes seven advanced courses (for Ph.D.) on Molecular Biology, 'Genetic Engineering', 'Microbial Biotechnology', 'Crop Biotechnology', 'Functional Genomics and Proteomics', "Commercial Plant Tissue Culture" and "Animal Biotechnology", which are meant to provide the latest developments in the respective fields of Biotechnology.
- The curriculum also includes two practical courses namely 'Techniques in Molecular Biology I and II' that includes exhaustive hands-on training on various techniques of molecular biology and genomics.
- Highly specialized faculty in different areas of Molecular Biology and Biotechnology, well-equipped laboratories and other resources shall be required for teaching of the courses and conducting practicals given in the new course curriculum. While teaching and research skills of the already employed faculty needs to be improved, new young faculty from advanced Institutes/Universities in India or abroad may be appointed. Exchange of faculty among the various Universities could also be a viable option.
- The new course curriculum shall provide ample opportunity to the students to specialize in several different areas of Biotechnology including 'Plant Tissue Culture', 'Genomics', 'Microbial Biotechnology', 'Animal Biotechnology', 'Molecular Breeding' and 'Genetic Transformation'.
- The proposed curriculum is now tuned with fast evolving area of 'Molecular Biology' and likely to generate qualified human resource at par with those from other elite National and International institutions.
- Training of the faculty is required to teach new courses.
- Approximately, Rs. 10 crores are required for building laboratories, equipment, furniture, etc. for effective implementation of both Ph. D. and M. Sc. Programmes.

Animal Biotechnology

- Opportunities in animal husbandry seek to improve product quality, production efficiency, and animal health & well-being, all while reducing the environmental impact of animal production.
- Animal biotechnology has long been source of innovation in production and processing, profoundly impacting the animal husbandry sector.
- Biotechnological research products, such as vaccines, diagnostics, *in vitro* fertilization, transgenic animals, stem cells, and a number of other therapeutic recombinant products are now commercially available.

- In view of the immense potential of biotechnology in the livestock and poultry sectors, the specialization in animal biotechnology has emerged as a distinct discipline.
- The PG programme in ‘Animal Biotechnology’ is aimed at providing cutting edge concepts, as well as practical applications of the exciting field of Animal Biotechnology.
- The revised course curriculum covers wide ranging topics including molecular genetics, molecular and cell biology, immunotechnology, transgenic animal technology, animal genomics, proteomics, reproductive biotechnology, molecular diagnostics, molecular forensics and vaccinology and bioprocess technology and bioinformatics.
- The course curriculum also explores the economic, social, legal, environmental safety, IPR, ethical issues and controversies associated with modern biology and biotechnology.
- Extensive laboratory exercises pertaining to analytic biochemistry, molecular biology, genetic engineering, immunology, molecular diagnostics, reproductive biotechniques, animal cell culture, animal genomics and proteomics tools have been included in course syllabi.
- Laboratory sessions will allow students to plan, implement and report on their results of laboratory and simulation experiments.
- The first part of animal biotechnology focuses on the basic sciences, allowing the student to gain a good understanding of the core subject areas, before moving on to study more specialist topics.
- The courses have been designed to encourage critical thinking, use of the scientific method, integration of technology, development of student leadership skills, and application of knowledge and skills related to practical questions and problems.
- In addition to a strong scientific knowledge, the students will also gain an understanding of entrepreneurship related Animal Biotechnology.
- Since, several new courses have been introduced; faculty training is required to teach new courses.
- Infrastructure commensurate to recent development also needs to be created. A separate building and 8000 square foot covered area housing, Cloning and Expression Laboratory, Animal Cell Culture Laboratory, Embryo Biotechnology, Animal Genomics and Proteomics Laboratory, Molecular biology Teaching Laboratory, Molecular Forensics Laboratory, Seminar room and lecture halls, department office, committee room, department library etc. Equipment, furniture etc are also required.
- Approximately Rs. 10 crores as one time grant and Rs. 50 lacs as recurring grant is required to effectively run Masters and Ph.D. programmes.

Bioinformatics

- Bioinformatics involves the integration of computers, software tools, and databases in an effort to understand biological systems.
- The emergence of new Internet technologies, new and more accurate algorithms and the development of High Performance Computing coupled with DNA sequencing, serial analysis of gene expression, microarrays, and new mass spectrometry has enabled bioinformatics to address the biological problems from several different angles. It is this change in paradigm that has led to the development of Bioinformatics as a separate skill-oriented discipline.

- The future of bioinformatics is integration of a wide variety of data sources such as GIS data, such as maps, weather systems, with crop health and genotype data, will allow us to predict successful outcomes of agriculture experiments.
- One of the biggest hurdles facing bioinformatics today is the small number of trained manpower and researchers in the field. This scenario needs to be addressed in changed perspective so that bioinformatics moves to the forefront of research.
- In order to produce trained manpower in the area of Bioinformatics, this curriculum has been prepared.
- The syllabus addresses modern concepts (of computing and Biology) and practices, and emphasizes the hands-on training.
- The basic subjects *viz.* Statistics, mathematics, Biological Chemistry, Genetics, Mathematics, Immunology, and computer Advanced courses such as Basic Molecular Biology, Pharmacogenomics & IPR.
- Bioinformatics Courses are Biological Databanks and Data Mining, Biomolecular Sequence and Analysis, Structural Genomics and Proteomics, Molecular modelling and drug design.
- The infrastructure (~ 2500 sq. ft. covered area) required to impart teaching according to present curriculum includes the provision of one high-end PC per student, two workstations, one server with 1 TB or more storage and an internet connectivity of 2 MBPS (for 15 students) or more.
- More emphasis should be on Open Source applications and OS.
- The faculty should be trained in advanced concepts of sequence analysis, systems biology, molecular modelling and data/text mining.
- Since it is new subject area, fresh recruitments should be made in this discipline. Approx. budget required is Rs. 5 crores.

ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level (corresponding Code nos. for Animal Biotechnology are 600- and 700-series).
- A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's programme. Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
- Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end, which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	20	15
Minor	09	08
Supporting	05	05
Seminar	01	02
Research	20	45
Total Credits	55	75
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject (e.g., if the major subject is Entomology, the appropriate minor subjects should be Plant Pathology or Nematology).

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
MBB 501**	PRINCIPLES OF BIOTECHNOLOGY	2+1
MBB 502**	FUNDAMENTALS OF MOLECULAR BIOLOGY	3+0
MBB 503**	MOLECULAR CELL BIOLOGY	3+0
MBB 504	PLANT TISSUE CULTURE & GENETIC TRANSFORMATION	1+2
MBB 505**	TECHNIQUES IN MOLECULAR BIOLOGY I	0+3
MBB 506	MICROBIAL/ INDUSTRIAL BIOTECHNOLOGY	2+1
MBB 507	MOLECULAR BREEDING	2+0
MBB 508	GENOMICS & PROTEOMICS	2+0
MBB 509	TECHNIQUES IN MOLECULAR BIOLOGY II	0+3
MBB 510*	BIOSAFETY, IPR AND BIOETHICS	2+0
MBB 511*	ANIMAL BIOTECHNOLOGY	3+0
MBB 512*	IMMUNOLOGY AND MOLECULAR DIAGNOSTICS	2+1
MBB 513*	NANO-BIOTECHNOLOGY	3+0
MBB 551*	PRINCIPLES OF GENETICS	3+1
MBB 552*	GENERAL BIOCHEMISTRY	3+0
MBB 553*, **	BIostatISTICS AND COMPUTERS	2+1
MBB 554*	PRINCIPLES OF MICROBIOLOGY	3+1
MBB 555	INTRODUCTION TO BIOINFORMATICS	2+1
MBB 556	ENVIRONMENTAL BIOTECHNOLOGY	3+0
MBB 591	MASTER'S SEMINAR	1+0
MBB 599	MASTER'S RESEARCH	20
MBB 601	ADVANCES IN PLANT MOLECULAR BIOLOGY	3+0
MBB 602	ADVANCES IN GENETIC ENGINEERING	3+0
MBB 603	ADVANCES IN MICROBIAL BIOTECHNOLOGY	3+0
MBB 604	ADVANCES IN CROP BIOTECHNOLOGY	3+0
MBB 605	ADVANCES IN FUNCTIONAL GENOMICS AND PROTEOMICS	2+0
MBB 606	COMMERCIAL PLANT TISSUE CULTURE	2+0
MBB 607	ADVANCES IN ANIMAL BIOTECHNOLOGY	2+0
MBB 691	DOCTORAL SEMINAR I	1+0
MBB 692	DOCTORAL SEMINAR II	1+0
MBB 699	DOCTORAL RESEARCH	45

*May be taken as minor/supporting courses; **Compulsory for M.Sc. Programme

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Contents

MBB 501 PRINCIPLES OF BIOTECHNOLOGY 2+1

Objective

To familiarize the students with the fundamental principles of Biotechnology, various developments in Biotechnology and its potential applications.

Theory

UNIT I

History, scope and importance; DNA structure, function and metabolism.

UNIT II

DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications.

UNIT III

Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics.

UNIT IV

General application of biotechnology in Agriculture, Medicine, Animal husbandry, Environmental remediation, Energy production and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

Practical

- i. Isolation of genomic and plasmid DNA
- ii. Gel electrophoresis techniques
- iii. Restriction enzyme digestion, ligation, transformation and screening of transformants
- iv. PCR and molecular marker analysis
- v. Plant tissue culture: media preparation, cell and explant culture, regeneration and transformation.

Suggested Readings

- Becker JM, Coldwell GA & Zachgo EA. 2007. *Biotechnology - a Laboratory Course*. Academic Press.
- Brown CM, Campbell I & Priest FG. 2005. *Introduction to Biotechnology*. Panima Pub.
- Brown TA. *Gene Cloning and DNA Analysis*. 5th Ed. Blackwell Publishing.
- Dale JW & von Schantz M. 2002. *From Genes to Genomes: Concepts and Applications of DNA Technology*. John Wiley & Sons.
- Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publications.
- Sambrook J, Fritsch T & Maniatis T. 2001. *Molecular Cloning - a Laboratory Manual*. 2nd Ed. Cold Spring Harbour Laboratory Press.
- Singh BD. 2007. *Biotechnology Expanding Horiozon*. Kalyani Publishers.

MBB 502 FUNDAMENTALS OF MOLECULAR BIOLOGY 3+0

Objective

To familiarize the students with the basic cellular processes at molecular level.

Theory

UNIT I

Historical developments of molecular biology; Nucleic acids as genetic material; Chemistry, structure and properties of DNA and RNA.

UNIT II

Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutations; DNA repair mechanisms.

UNIT III

Transcription process; RNA processing; Reverse transcriptase; RNA editing; Ribosomes structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacyl tRNA synthases.

UNIT IV

Translation and post-translational modifications; Operon concept; Attenuation of *trp* operon; important features of gene regulation in eukaryotes.

Suggested Readings

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.

Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publishers.

Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. W.H. Freeman & Co.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*. 6th Ed. Pearson Education International.

MBB 503

MOLECULAR CELL BIOLOGY

3+0

Objective

To familiarize the students with the cell biology at molecular level.

Theory

UNIT I

General structure and constituents of cell; Similarities and distinction between plant and animal cells; Cell wall, cell membrane, structure and composition of biomembranes, cell surface related functions.

UNIT II

Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Microbodies, Golgi apparatus, Vacuoles, etc.

UNIT III

Organellar genomes and their manipulation; Ribosomes in relation to cell growth and division; Cyto-skeletal elements.

UNIT IV

Cell division and regulation of cell cycle; Membrane transport; Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

Suggested Readings

Gupta PK. 2003. *Cell and Molecular Biology*. 2nd Ed. Rastogi Publ.

Lodish H. 2003. *Molecular Cell Biology*. 5th Ed. W.H. Freeman & Co.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

Objective

To familiarize the students and provide hands on training on various techniques of plant tissue culture, genetic engineering and transformation.

TheoryUNIT I

History of plant cell and tissue culture; Culture media; Various types of culture; callus, suspension, nurse, root, meristem, etc.; *In vitro* differentiation: organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on *in vitro* culture and regeneration; Molecular basis of plant organ differentiation.

UNIT II

Micropropagation; Anther and microspore culture; Somaclonal variation; *In vitro* mutagenesis; *In vitro* fertilization; *In vitro* germplasm conservation; Production of secondary metabolites; Synthetic seeds.

UNIT III

Embryo rescue and wide hybridization; Protoplast culture and regeneration; Somatic hybridization: protoplast fusion, cybrids, asymmetric hybrids, etc.

UNIT IV

Methods of plant transformation; Vectors for plant transformation; Genetic and molecular analyses of transgenics; Target traits and transgenic crops; Biosafety issues, testing of transgenics, regulatory procedures for commercial approval.

Practical

- i. Laboratory set-up.
- ii. Preparation of nutrient media; handling and sterilization of plant material; inoculation, subculturing and plant regeneration.
- iii. Anther and pollen culture.
- iv. Embryo rescue.
- v. Suspension cultures and production of secondary metabolites.
- vi. Protoplast isolation, culture and fusion.
- vii. Gene cloning and vector construction
- viii. Gene transfer using different methods, reporter gene expression, selection of transformed tissues/plants, molecular analysis.

Suggested Readings

- Bhojwani SS. 1983. *Plant Tissue Culture: Theory and Practice*. Elsevier.
- Christou P & Klee H. 2004. *Handbook of Plant Biotechnology*. John Wiley & Sons.
- Dixon RA. 2003. *Plant Cell Culture*. IRL Press.
- George EF, Hall MA & De Klerk GJ. 2008. *Plant Propagation by Tissue Culture*. Agritech Publ.
- Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publ.
- Herman EB. 2005-08. *Media and Techniques for Growth, Regeneration and Storage*. Agritech Publ.
- Pena L. 2004. *Transgenic Plants: Methods and Protocols*. Humana Press.
- Pierik RLM. 1997. *In vitro Culture of Higher Plants*. Kluwer.
- Singh BD. 2007. *Biotechnology: Expanding Horiozon*. Kalyani.

MBB 505 TECHNIQUES IN MOLECULAR BIOLOGY-I 0+3

Objective

To provide hands on training on basic molecular biology techniques.

Practical

UNIT I

Good lab practices; Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques (TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography).

UNIT II

Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); Growth of bacterial culture and preparation of growth curve; Isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA; Restriction digestion of plasmid and phage DNA; Isolation of high molecular weight DNA and analysis.

UNIT III

Gene cloning – Recombinant DNA construction, transformation and selection of transformants; PCR and optimization of factors affecting PCR.

UNIT IV

Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.

Suggested Readings

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. John Wiley.
Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Laboratory Press.

MBB 506 MICROBIAL/ INDUSTRIAL BIOTECHNOLOGY 2+1

Objective

To familiarize about the various microbial processes/systems/activities, which have been used for the development of industrially important products/processes.

Theory

UNIT I

Introduction, scope and historical developments; Isolation, screening and genetic improvement (involving classical approaches) of industrially important organisms.

UNIT II

Primary metabolism products, production of industrial ethanol as a case study; Secondary metabolites, bacterial antibiotics and non ribosomal peptide antibiotics; Recombinant DNA technologies for microbial processes; Strategies for development of industrial microbial strains with scale up production capacities; Metabolic pathway engineering of microbes for production of novel product for industry.

UNIT III

Microbial enzymes, role in various industrial processes, production of fine chemicals for pharmaceutical industries; Bio-transformations, Bio-augmentation with production of vitamin C as a case study; Bioreactors,

their design and types; Immobilized enzymes based bioreactors; Microencapsulation technologies for immobilization of microbial enzymes.

UNIT IV

Industrial biotechnology for pollution control, treatment of industrial and other wastes, biomass production involving single cell protein; Bio-remediation of soil; Production of eco-friendly agricultural chemicals, bio-pesticides, bio-herbicides, bio-fertilizers, bio-fuels, etc.

Practical

- i. Isolation of industrially important microorganisms, their maintenance and improvement.
- ii. Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery.
- iii. Study of bio-reactors and their operations.
- iv. Production of biofertilizers.
- v. Experiments on microbial fermentation process, harvesting purification and recovery of end products.
- vi. Immobilization of cells and enzymes, studies on its kinetic behavior, growth analysis and biomass estimation.
- vii. Determination mass transfer co-efficients.

Suggested Readings

Huffnagle GB & Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.
Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
Primrose SB. 2001. *Molecular Biotechnology*. Panima.

MBB 507

MOLECULAR BREEDING

2+0

Objective

To familiarize the students about the use of molecular biology tools in plant breeding.

Theory

UNIT I

Principles of plant breeding; Breeding methods for self and cross pollinated crops; Heterosis breeding; Limitations of conventional breeding; Aspects of molecular breeding.

UNIT II

Development of sequence based molecular markers - SSRs and SNPs; Advanced methods of genotyping; Mapping genes for qualitative and quantitative traits.

UNIT III

QTL mapping using structured populations; AB-QTL analysis; Association mapping of QTL; Fine mapping of genes/QTL; Map based gene/QTL isolation and development of gene based markers; Allele mining by TILLING and Eco-TILLING; Use of markers in plant breeding.

UNIT IV

Marker assisted selection (MAS) in backcross and heterosis breeding; Transgenic breeding; Foreground and background selection; MAS for gene introgression and pyramiding; MAS for specific traits with examples.

Suggested Readings

Chittaranjan K. 2006-07. *Genome Mapping and Molecular Breeding in Plants*. Vols. I-VII. Springer.

Newbury HJ. 2003. *Plant Molecular Breeding*. Blackwell Publ.
Weising K, Nybom H, Wolff K & Kahl G. 2005. *DNA Fingerprinting in Plants: Principles, Methods and Applications*. Taylor & Francis.

MBB 508 GENOMICS AND PROTEOMICS 2+0

Objective

To familiarize the students with recent tools used for genome analysis and their applications.

Theory

UNIT I

Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of genomes; Genome sequencing, sequence assembly and annotation; Comparative genomics, etc.

UNIT II

Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways, etc.

UNIT III

Proteomics - Protein structure, function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, etc.

UNIT IV

Applications of genomics and proteomics in agriculture, human health and industry.

Suggested Readings

Azuaje F & Dopazo J. 2005. *Data Analysis and Visualization in Genomics and Proteomics*. John Wiley & Sons.

Brown TA. 2007. *Genome III*. Garland Science Publ.

Campbell AM & Heyer L. 2004. *Discovery Genomics, Proteomics and Bioinformatics*. Pearson Education.

Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.

Jollès P & Jörnvall H. 2000. *Proteomics in Functional Genomics: Protein Structure Analysis*. Birkhäuser.

Kamp RM. 2004. *Methods in Proteome and Protein Analysis*. Springer.

Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.

Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley CVH.

MBB 509 TECHNIQUES IN MOLECULAR BIOLOGY-II 0+3

Objective

To provide hands on training on various molecular techniques used in molecular breeding and genomics.

Practical

UNIT I

Construction of gene libraries; Synthesis and cloning of cDNA and RT-PCR analysis; Real time PCR and interpretation of data.

UNIT II

Molecular markers (RAPD, SSR, AFLP etc) and their analysis; Case study of SSR markers (linkage map, QTL analysis etc); SNP identification and analysis; Microarray studies and use of relevant software.

UNIT III

Proteomics (2D gels, mass spectrometry, etc.); RNAi (right from designing of construct to the phenotyping of the plant); Yeast 1 and 2-hybrid interaction.

UNIT IV

Generation and screening of mutants; Transposon mediated mutagenesis.

Suggested Readings

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley.

Caldwell G, Williams SN & Caldwell K. 2006. *Integrated Genomics: A Discovery-Based Laboratory Course*. John Wiley.

Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Laboratory Press.

MBB 510

BIOSAFETY, IPR AND BIOETHICS

2+0

Objective

To discuss about various aspects of biosafety regulations, IPR and bioethic concerns arising from the commercialization of biotech products.

Theory

UNIT I

Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

UNIT II

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

UNIT III

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-radio isotopic procedure; Benefits of transgenics to human health, society and the environment.

UNIT IV

The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

Suggested Readings

Singh BD. 2007. *Biotechnology: Expanding Horizon*. Kalyani.

<http://patentoffice.nic.in>

www.wipo.org

www.dbtindia.nic.in

www.dbtbiosafety.nic.in

Objective

Intended to provide an overview and current developments in different areas of animal biotechnology.

TheoryUNIT I

Structure of animal cell; History of animal cell culture; Cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT II

Introduction to immune system, cellular and hormonal immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, nucleic acid based diagnostic methods, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits, probiotics.

UNIT III

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation for conservation endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

UNIT IV

Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance, Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including

bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

Suggested Readings

- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.
- Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.
- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
- Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.
- Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.
- Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.
- Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.
- Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

MBB 512 IMMUNOLOGY AND MOLECULAR DIAGNOSTICS 2+1

Objective

To discuss the application of various immunological and molecular diagnostic tools.

Theory

UNIT I

History and scope of immunology; Components of immune system: organs, tissues and cells, Immunoglobulin chemistry, structure and functions; Molecular organization of immunoglobulins and classes of antibodies.

UNIT II

Antibody diversity; antigens, haptens, antigens- antibody interactions; immuno-regulation and tolerance; Allergies and hypersensitive response; Immunodeficiency; Vaccines; Immunological techniques.

UNIT III

Immunological application in plant science, monoclonal antibodies and their uses, molecular diagnostics. Introduction to the basic principles of molecular technology and techniques used in pathogen detection, Principles of ELISA and its applications in viral detection.

UNIT IV

Basics and procedures of PCR, Real time PCR, PCR based and hybridization based methods of detection, microarrays based detection, multiplexing etc, detection of soil borne and seed born infections, transgene detection in seed, planting material and processed food, molecular detection of varietal impurities and seed admixtures in commercial consignments.

Practical

- i. Preparation of buffers and reagents.
- ii. Immunoblotting, immunoelectrophoresis and fluorescent antibody test.
- iii. Enzyme immunoassays including ELISA western blotting.
- iv. Extraction and identification of DNA/RNA of pathogenic organisms.
- v. Restriction hybridoma technique and production of monoclonal antibodies.

- vi. Immunogenic proteins, expression and immunogenicity studies, purification of immunogenic protein and immunization of laboratory animals.

Suggested Readings

- Bloom BR & Lambert P-H. 2002. *The Vaccine Book*. Academic Press.
Elles R & Mountford R. 2004. *Molecular Diagnosis of Genetic Disease*. Humana Press.
Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby's Immunology*. WH Freeman.
Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.
Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.
Male D, Brostoff J, Roth DB & Roitt I. 2006. *Immunology*. Elsevier.
Rao JR, Fleming CC & Moore JE. 2006. *Molecular Diagnostics*. Horizon Bioscience.
Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2nd Ed. Humana Press.
Spinger TA, 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

MBB 513

NANO-BIOTECHNOLOGY

3+0

Objective

Understanding the molecular techniques involved in structure and functions of nano-biomolecules in cells such as DNA, RNA and proteins.

Theory

UNIT I

Introduction to Biomacromolecules: The modern concepts to describe the conformation and dynamics of biological macromolecules: scattering techniques, micromanipulation techniques, drug delivery applications etc.

UNIT II

Cellular engineering: signal transduction in biological systems, feedback control signaling pathways, cell-cell interactions etc. Effects of physical, chemical and electrical stimuli on cell function and gene regulation.

UNIT III

Chemical, physical and biological properties of biomaterials and bioresponse: biomineralization, biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins); Aerosol properties, application and dynamics; Statistical Mechanics in Biological Systems,

UNIT IV

Preparation and characterization of nanoparticles; Nanoparticulate carrier systems; Micro- and Nano-fluidics; Drug and gene delivery system; Microfabrication, Biosensors, Chip technologies, Nano- imaging, Metabolic engineering and Gene therapy.

Suggested Readings

- Nalwa HS. 2005. *Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology*. American Scientific Publ.
Niemeyer CM & Mirkin CA. 2005. *Nanobiotechnology*. Wiley Interscience.

MBB 551 **PRINCIPLES OF GENETICS** **2+1**

Objective

This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problem-solving skills from classical to molecular genetics.

Theory

UNIT I

Early concepts of inheritance; Discussion on Mendel's paper; Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage, recombination and genetic mapping in eukaryotes, Somatic cell genetics.

UNIT II

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes; Mutations and mutagenic agents.

UNIT III

Genetic code and protein biosynthesis; Gene regulation, Genes in development; Extra chromosomal inheritance, Male sterility and incompatibility; Recombination in bacteria, fungi and viruses, tetrad analysis.

UNIT IV

Inheritance of quantitative traits; Concepts in population genetics; Genes and behavior; Genetics and evolution; Recombinant DNA technology; Genetic fine structure analysis, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families; An overview of some recent discoveries in the field of genetics.

Practical

- i. Laboratory exercises in probability and chi-square.
- ii. Demonstration of genetic principles using laboratory organisms.
- iii. Chromosome mapping using three point test cross.
- iv. Tetrad analysis.
- v. Induction and detection of mutations through genetic tests.
- vi. Pedigree analysis in humans.
- vii. Numerical problems on Hardy Weinberg Equilibrium, Quantitative inheritance and Molecular genetics.

Suggested Readings

- Klug WS & Cummings MR. 2003 *Concepts of Genetics*. Peterson Education.
- Lewin B. 2008. *Genes IX*. Jones & Bartlett Publ.
- Russell PJ. 1998. *Genetics*. The Benjamin/Cummings Publ. Co.
- Strickberger MW. 1990. *Genetics*. Collier MacMillan.
- Tamarin RH. 1999. *Principles of Genetics*. Wm. C. Brown Pubs.
- Uppal S, Yadav R, Subhadra & Saharan RP. 2005. *Practical Manual on Basic and Applied Genetics*. Dept. of Genetics, CCS HAU Hisar.

MBB 552 **BASIC BIOCHEMISTRY** **2+1**

Objective

To provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.

Theory

UNIT I

Scope and importance of biochemistry in agriculture; Fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; General introduction to physical techniques for determination of structure of biopolymers.

UNIT II

Classification, structure and function of carbohydrates, lipids and biomembranes, amino acids, proteins, and nucleic acids.

UNIT III

Structure and biological functions of vitamins, enzymes classification and mechanism of action; regulation, factors affecting enzyme action. Fundamentals of thermodynamic principles applicable to biological processes, Bioenergetics.

UNIT IV

Metabolism of carbohydrates, photosynthesis and respiration, oxidative phosphorylation, lipids, proteins and nucleic acids. DNA replication, transcription and translation; recombinant DNA technology, Nutritional aspects of carbohydrates, lipids, proteins and minerals.

Practical

- i. Preparation of standard and buffer solutions.
- ii. Extraction and estimation of sugars and amino acids.
- iii. Estimation of proteins by Lowry's method.
- iv. Estimation of DNA and RNA by Diphenylamine and orcinol methods.
- v. Estimation of ascorbic acid.
- vi. Separation of biomolecules by TLC and paper chromatography

Suggested Readings

Conn EE & Stumpf PK. 1987. *Outlines of Biochemistry*. John Wiley.
Metzler DE. *Biochemistry*. Vols. I, II. Wiley International.
Nelson DL & Cox MM. 2004. *Lehninger's Principles of Biochemistry*. MacMillan.
Voet D & Voet JG. *Biochemistry*. 3rd Ed. Wiley International.

MBB 553

BIostatISTICS AND COMPUTERS

2+1

Objective

This is the special course for M.Sc. students of Biotechnology. They are exposed to various statistical methods to analyze their experimental data.

Theory

UNIT I

Aims, scope and idea of elementary statistics; Measures of central tendency and dispersion, skewness and kurtosis.

UNIT II

Concept of probability and probability laws, mathematical expectation, moments, moments generating function; Standard probability distributions- Binomial, Poisson and Normal distributions.

UNIT III

Tests of significance based on Z, χ^2 , t and F statistics; Correlation and regression, curve fitting by least squares methods.

UNIT IV

Basic principles, organization and operational aspects of computers, operating systems. Introduction to MS-Office, MS-Word, MS-Excel. Statistical Data analysis based on above topics through MS-Excel.

Practical

- i. Data analysis using probability, test of significance
- ii. Correlation and regression analysis
- iii. Usage of MS-Windows
- iv. Exercises on test processing, spreadsheet and DBMS
- v. SPSS

Suggested Readings

Agarwal BL. 2003. *Basic Statistics*. New Age.
Gupta SP. 2004. *Statistical Methods*. S. Chand & Sons.
Dutta NK. 2002. *Fundamentals of Bio-Statistics*. Kanishka Publ.

MBB 554

PRINCIPLES OF MICROBIOLOGY

2+1

Objective

To acquaint the students with history, classification and role of microbiology in agriculture, food and environment.

Theory

UNIT I

Development of Microbiology in the 18th and 19th century. Morphology, structure and function of prokaryotic and eukaryotic cell. Archea. Classification of prokaryotes – Basic principles and techniques used in bacterial classification.

UNIT II

Evolutionary relationship among prokaryotes. Phylogenetic and numerical taxonomy. Use of DNA and r-RNA sequencing in classifications.

UNIT III

Study of major groups of bacteria belonging to Gracilicutes, Firmicutes, Tanericutes and Mendosicutes.

UNIT IV

Viruses – morphology, classification and replication of plant, animal and bacterial viruses. Cultivation methods of viruses. Immune response – specific and non-specific resistance. Normal microflora of human body; some common bacterial and viral diseases of humans and animals.

Practical

- i. Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).
- ii. Enrichment culture technique – isolation of asymbiotic, symbiotic nitrogen fixing bacteria. Isolation of photosynthetic bacteria.
- iii. Use of selective media, antibiotic resistance and isolation of antibiotic producing microorganisms.
- iv. Morphological, physiological and biochemical characterization of bacteria.

Suggested Readings

Brock TD. 1961. *Milestones in Microbiology*. Infinity Books.
Pelczar ML Jr. 1997. *Microbiology*. Tata McGraw Hill.

detergents etc; aerobic processes (activated sludge, oxidation ditches, trickling filter, rotating drums, etc); anaerobic processes: digestion, filtration, etc.

UNIT III

Renewable and non-Renewable resources of energy; energy from solid waste; conventional fuels and their environmental impact; biogas; microbial hydrogen production; conversion of sugar to alcohol; gasohol; biodegradation of lignin and cellulose; biopesticides; biofertilizers; composting; vermiculture, etc.

UNIT IV

Treatment schemes of domestic waste and industrial effluents; food, feed and energy from solid waste; bioleaching; enrichment of ores by microorganisms; global environmental problems: ozone depletion, UV-B, greenhouse effects, and acid rain; biodiversity and its conservation; biotechnological approaches for the management environmental problems.

Suggested Readings

Evans GM & Furlong JC. 2002. *Environmental Biotechnology: Theory and Application*. Wiley International.

Jordening H-J & Winter J. 2006. *Environmental Biotechnology: Concepts and Applications*. Wiley-VCH Verlag.

MBB 601 ADVANCES IN PLANT MOLECULAR BIOLOGY 3+0

Objective

To discuss the specialized topics and recent advances in the field of plant molecular biology.

Theory

UNIT I

Arabidopsis in molecular biology, Forward and Reverse Genetic Approaches, Transcriptional and post-transcriptional regulation of gene expression, isolation of promoters and other regulatory elements.

UNIT II

RNA interference, Transcriptional gene silencing, Transcript and protein analysis, use of transcript profiling to study biological systems.

UNIT III

Hormone regulatory pathways: Ethylene, Cytokinin, Auxin and ABA, SA and JA; ABC Model of Floral Development, Molecular basis of self incompatibility, Regulation of flowering: photoperiod, vernalization, circadian rhythms.

UNIT IV

Molecular biology of abiotic stress responses: Cold, high temperature, submergence, salinity and drought; Molecular Biology of plant-pathogen interactions, molecular biology of *Agrobacterium* Infection, Molecular biology of *Rhizobium* infection (molecular mechanisms in symbiosis), Programmed cell death in development and defense.

Suggested Readings

Buchanan B, Gruissen W & Jones R. 2000. *Biochemistry and Molecular Biology of Plants*. American Society of Plant Physiologists, USA.

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.

Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publ.

Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. WH Freeman & Co.

Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*. 6th Ed. Pearson Education.

MBB 602 ADVANCES IN GENETIC ENGINEERING 3+0

Objective

To discuss the specialized topics and advances in field of genetic engineering and their application in plant improvement.

Theory

UNIT I

General overview of transgenic plants; Case studies: Genetic engineering of herbicide resistance, Transgenic plants resistant to insects/pests, Genetic engineering of abiotic stress tolerance, Engineering food crops for quality, Genetically engineered pollination control, Induction of male sterility in plants.

UNIT II

Molecular farming of plants for applications in veterinary and human medicine systems: Boosting heterologous protein production in transgenics, Rapid production of specific vaccines, High-yield production of therapeutic proteins in chloroplasts.

UNIT III

Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement; Gene stacking; Pathway engineering; Marker-free transgenic development strategies; High throughput phenotyping of transgenic plants.

UNIT IV

Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

Suggested Readings

Christou P & Klee H. 2004. *Handbook of Plant Biotechnology*. John Wiley & Sons.

Specific journals mentioned later.

MBB 603 ADVANCES IN MICROBIAL BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics about industrially important microorganisms.

Theory

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostate cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Down stream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

Suggested Readings

Specific journals and published references.

MBB 604 ADVANCES IN CROP BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics on the application of molecular tools in breeding of specific crops.

Theory

UNIT I

Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement.

UNIT II

Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses; Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc); edible vaccines, etc.

UNIT III

Molecular breeding: constructing molecular maps; integrating genetic, physical and molecular maps; diversity assessment and phylogenetic analysis; molecular tagging of genes/traits; selected examples on marker-assisted selection of qualitative and quantitative traits.

UNIT IV

Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane etc.

Suggested Readings

Specific journals and published references.

MBB 605 ADVANCES IN FUNCTIONAL GENOMICS 2+0 AND PROTEOMICS

Objective

To discuss recent advances and applications of functional genomics and proteomics in agriculture, medicine and industry.

Theory

UNIT I

Genome sequencing and functional genomics; Human, animal, plant, bacterial and yeast genome projects; genome annotation; *ab initio* gene discovery; functional annotation and gene family clusters; etc.

UNIT II

Functional analysis of genes; RNA-mediated interference; gene knockoffs; Gene traps/ T-DNA insertion lines; homologous recombination; microarray profiling; SAGE; SNPs/variation; yeast-two hybrid screening; gene expression and transcript profiling; EST contigs; EcoTILLING; allele/gene mining; synteny and comparative genomics; Genome evolution, speciation and domestication etc.

UNIT II

Proteomics: protein annotation; protein separation and 2D PAGE; mass spectroscopy; protein microarrays; protein interactive maps; structural proteomics: protein structure determination, prediction and threading, software and data analysis/ management, etc.

UNIT IV

Discussion on selected papers on functional genomics, proteomics, integrative genomics etc.

Suggested Readings

Specific journals and published references.

MBB 606 COMMERCIAL PLANT TISSUE CULTURE 2+0

Objective

To discuss the commercial applications of plant tissue culture in agriculture, medicine and industry.

Theory

UNIT I

Micropropagation of commercially important plant species; plant multiplication, hardening, and transplantation; genetic fidelity; scaling up and cost reduction; bioreactors; synthetic seeds; management and marketing.

UNIT II

Production of useful compounds via biotransformation and secondary metabolite production: suspension cultures, immobilization, examples of chemicals being produced for use in pharmacy, medicine and industry.

UNIT III

Value-addition by transformation; development, production and release of transgenic plants; patent, bio-safety, regulatory, environmental and ethic issues; management and commercialization.

UNIT IV

Some case studies on success stories on commercial applications of plant tissue culture. Visits to some tissue culture based commercial units/industries.

Suggested Readings

Specific journals and published references.

Objective

Intended to provide cutting edge knowledge on advances in different areas of animal biotechnology.

TheoryUNIT I

Advances in animal cell culture technology, suspension culture technology, advances in commercial scale productions of mammalian cells.

UNIT II

Advances in cell cloning and cell hybridization, advances in monoclonal antibody production technology, Advances in diagnostic technology, Computational vaccinology, reverse genetics based vaccines.

UNIT III

Advances in embryo manipulation, knock out and knock in technology, advances in animal cloning technology, stem cell technology, Advances in development of animal models for human diseases using transgenic animal technology.

UNIT IV

Advances in genetic basis for animal disease resistance, Molecular methods for animal forensics, Advances in animal genomics, proteomics,

Suggested Readings

Selected articles from journals.

PLANT MOLECULAR BIOLOGY & BIOTECHNOLOGY

List of Journals

- ❖ Advances in Botanical Research
- ❖ Advances in Enzyme Regulation
- ❖ Advances in Enzymology
- ❖ Advances in Genetics
- ❖ Agricultural and Biological Research
- ❖ Analytical Biochemistry
- ❖ Annals of Botany
- ❖ Archives of Biochemistry and Biophysics
- ❖ Archives of Microbiology
- ❖ Biochemical and Biophysical Research Communication
- ❖ Biochemical Genetics
- ❖ Biochemistry
- ❖ Biotechnology and Bioengineering
- ❖ Critical Reviews in Plant Sciences
- ❖ Crop Science
- ❖ EMBO Journal
- ❖ Euphytica
- ❖ Genetic and Plant Breeding
- ❖ Genome
- ❖ Indian Journal of Genetics and Plant Breeding
- ❖ Journal of Biotechnology
- ❖ Journal of Experimental Botany
- ❖ Journal of General Microbiology
- ❖ Journal of Heredity
- ❖ Journal of Plant Biochemistry and Biotechnology
- ❖ Journal of Plant Biology
- ❖ Molecular and Cellular Biochemistry
- ❖ Molecular Breeding
- ❖ Molecular Genetics and Genomics
- ❖ Nature
- ❖ Nature Biotechnology
- ❖ Plant Cell
- ❖ Plant Molecular Biology
- ❖ Plant Physiology
- ❖ Plant Physiology and Biochemistry
- ❖ Proceedings of The National Academy of Sciences (USA)
- ❖ Science
- ❖ Trends in Biochemical Sciences
- ❖ Trends in Biotechnology
- ❖ Trends in Cell Biology
- ❖ Trends in Food Science and Technology
- ❖ Trends in Genetics
- ❖ Trends in Microbiology
- ❖ Trends in Plant Sciences

e-Resources

- ❖ National Center for Biotechnology Information
<http://www.ncbi.nlm.nih.gov/>
- ❖ The World Wide Web Virtual Library: Biotechnology.

- <http://www.cato.com/biotech/>
- ❖ The Transgenic/Targeted Mutation Database (TBASE)
<http://www.bis.med.jhmi.edu/Dan/tbase/tbase.html>
- ❖ Primer on Molecular Genetics
<http://www.bis.med.jhmi.edu/Dan/DOE/intro.html>
- ❖ Biportal
<http://biportal.gc.ca/english/BioPortalHome.asp>
- ❖ Access Excellence
<http://www.gene.com/ae>
- ❖ BioTech Biosources Database: Indiana University
<http://biotech.chem.indiana.edu/>
- ❖ Information Systems for Biotechnology
<http://gophisb.biochem.vt.edu/>
- ❖ All About The Human Genome Project (HGP)
<http://www.genome.gov/>
- ❖ *Human Genome Project at the Sanger Institute*
<http://www.sanger.ac.uk/HGP/>
- ❖ UCSC Genome Browser
<http://genome.ucsc.edu/>
- ❖ Gramene
www.gramene.org/
- ❖ The Institute for Genomic Research
www.tigr.org

Suggested Broad Topics for Master's and Doctoral Research

- ❖ Micropropagation of important crop plants, cash crops, ornamentals, forest and horticultural trees, medicinal and aromatic plants.
- ❖ Development of transgenics in field crops for resistance against biotic and abiotic stresses, and to improve the nutritional quality, etc.
- ❖ DNA fingerprinting of important plant species and germplasm.
- ❖ Development of molecular markers (SNP, SSR, transposable elements, etc) and their utilization for genetic diversity and phylogenetic analysis.
- ❖ Molecular mapping and marker-assisted selection for major-gene traits in crop species.
- ❖ Value-addition including biopesticides, biofertilizers, biofuels, biodegradable plastics, secondary metabolites, etc.
- ❖ Genome sequencing and functional analysis of genes of important organisms.
- ❖ Allele mining, proteomics, genomics and metabolic engineering for crop improvement.
- ❖ Immobilization of enzymes/microorganisms.
- ❖ Protein engineering.
- ❖ To develop crops with improved mineral (Fe, Zn, Vitamin A, etc) bioavailability.
- ❖ Biodiversity and conservation of endangered plant species.
- ❖ Bioprocess engineering and down stream processing.

ANIMAL BIOTECHNOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
ABT 601*	BASIC & APPLIED BIOTECHNOLOGY	3+0
ABT 602**	FUNDAMENTALS OF CELL & MOLECULAR BIOLOGY	3+0
ABT 603*	APPLIED MOLECULAR BIOLOGY	2+1
ABT 604**	ANIMAL CELL CULTURE: PRINCIPLES & APPLICATIONS	1+2
ABT 605**	MOLECULAR DIAGNOSTICS	1+2
ABT 606	VACCINE BIOTECHNOLOGY	2+0
ABT 607	IMMUNOLOGY APPLIED TO BIOTECHNOLOGY	1+1
ABT 608	INTRODUCTION TO BIOINFORMATICS	1+1
ABT 609**	ANIMAL GENOMICS	2+1
ABT 610**	REPRODUCTIVE BIOTECHNOLOGY	2+1
ABT 611**	TECHNIQUES IN MOLECULAR BIOLOGY & GENETIC ENGINEERING	0+3
ABT 612	BIODIVERSITY, BIOSAFETY & BIOETHICS	2+0
ABT 613	MOLECULAR FORENSICS	2+1
ABT 614	INDUSTRIAL BIOTECHNOLOGY	2+1
ABT 615*	PROBIOTICS & FEED BIOTECHNOLOGY	3+0
ABT 616	ANIMAL BIOTECHNOLOGY	3+0
ABT 691	MASTER'S SEMINAR	1+0
ABT 699	MASTER'S RESEARCH	20
ABT 701	GENE CLONING AND EXPRESSION	1+1
ABT 702*	FUNCTIONAL GENOMICS & PROTEOMICS	2+1
ABT 703	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	2+1
ABT 704	TRENDS IN VACCINOLOGY	3+0
ABT 705	ADVANCES IN ANIMAL CELL CULTURE	2+1
ABT 706	TRANSGENIC ANIMAL TECHNOLOGY	2+0
ABT 791	DOCTORAL SEMINAR I	1+0
ABT 792	DOCTORAL SEMINAR II	1+0
ABT 799	DOCTORAL RESEARCH	45

* Courses may also be taken as Minor/Supporting

** Compulsory for Master's Programme

target cell adaptation. Cell growth and divisions: Cell cycle, cell division controls and transformation, growth factors, genes for social control of cell division, mechanism of cell division, cell adhesion, cell junctions and the extra cellular matrix, growth, development and differentiation.

UNIT III

History of molecular biology, nucleic acid as hereditary material, structure of DNA, chromatin, rRNA, tRNA and mRNA, proteins. DNA replication, transcription, translation, genetic code, operon, positive and negative control of gene expression, important enzymes such as RNA replicase, reverse transcriptase, ligase, polymerase, ribozyme, etc.

UNIT IV

Molecular mechanism of mutation. Molecular organization of cell, structure of genomes, synthetic chromosomes. RNA processing and alternative splicing, molecular biology of photosynthesis, nitrogen fixation and stress tolerance, development and differentiation and molecular evolution, RNAi and application.

Suggested Readings

Lewin B. 2008. *Gene IX*. Jones & Bartlett.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

ABT 603

APPLIED MOLECULAR BIOLOGY

2+1

Objective

Understanding the principle and application of recombinant DNA in biotechnology.

Theory

UNIT I

Enzymes used in molecular biology and recombinant DNA research, cloning and expression vectors, gene identification, construction of gene libraries, gene mapping and DNA structure analysis.

UNIT II

Methods of DNA sequencing, synthesis of double stranded DNA and complementary DNA, cDNA library identification and enrichment of recombinant clones.

UNIT III

Methods for transfer of cloned DNA, analysis and expression of recombinant DNA, site directed DNA alterations and gene manipulations, cloning in bacteria, yeast, plant and animal cells.

UNIT IV

Genetics of tumourogenic region of agrobacteria and its applications in agriculture, veterinary and medical sciences, biotechnology applications for production of high value and industrial products, safety aspects of genetic manipulations.

Practical

- i. Extraction of DNA and RNA.
- ii. Polyacrylamide gel electrophoresis (PAGE).
- iii. Agarose gel electrophoresis.
- iv. Restriction endonuclease analysis of DNA.
- v. Isolation and purification of plasmid.
- vi. Polymerase chain reaction.

- vii. Cloning of gene.
- viii. Expression of cloned gene.
- ix. Purification of recombinant protein.
- x. Blotting
- xi. RFLP
- xii. RAPD.

Suggested Readings

- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

ABT 604 ANIMAL CELL CULTURE: PRINCIPLES AND 1+2 **APPLICATIONS**

Objective

Understanding the principles of animal cell culture and its application.

Theory

UNIT I

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture etc.

UNIT II

Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.

UNIT III

Behavior of cells in culture conditions, division, their growth pattern, metabolism of estimation of cell number.

UNIT IV

Development of cell lines, characterization and maintenance of cell lines, stem cells, cryopreservation, common cell culture contaminants.

Practical

- i. Packing and sterilization of glass and plastic wares for cell culture.
- ii. Preparation of reagents and media for cell culture.
- iii. Primer culture technique chicken embryo fibroblast.
- iv. Secondary culture of chicken embryo fibroblast.
- v. Cultivation of continuous cell lines.
- vi. Quantification of cells by trypan blue exclusion dye.
- vii. Isolation of lymphocytes and cultivation of lymphocytes
- viii. Study of effect of toxic chemicals on cultured mammalian cells
- ix. Study of effect of virus on mammalian cells.
- x. Suspension culture technique
- xi. Cryopreservation of cell primary cultures and cell lines.
- xii. Effect of viruses on cultured mammalian cells.

Suggested Readings

- Freshney RI. 2005. *Culture of Animal Cells*. Wiley Liss.
Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.

Objective

Understanding the molecular techniques involved in diagnosis of diseases.

TheoryUNIT I

Introduction, importance and historical perspective of development of molecular diagnostic technology, concept of development of group specific and strain specific nucleic acid based diagnostics, basis for selection of gene/nucleotide sequence of pathogenic organism to target for detection.

UNIT II

Application of restriction endonuclease analysis for identification of pathogens, principle of development of pathogen specific DNA probes, Southern and Northern hybridization.

UNIT III

Theoretical background of development of PCR and Real time PCR and its variations, application of PCR for diagnosis of infectious diseases of animals and poultry, nucleic acid sequence based diagnostics.

UNIT IV

Advancements in diagnostic technology including DNA array technology, biosensors and nanotechnology. OIE guidelines in development of diagnostics.

Practical

- i. Preparations of buffers and reagents.
- ii. Collection of clinical and environmental samples from animal and poultry farms for molecular detection of pathogens.
- iii. Isolation of bacterial pathogens from the samples.
- iv. Extraction of nucleic acids from bacteria and clinical specimens.
- v. Restriction endonuclease digestion and analysis in agarose electrophoresis.
- vi. Development of animal pathogen specific nucleic acid probes.
- vii. Southern blotting for detection of pathogens.
- viii. Polymerase chain reaction for detection of pathogens in blood and other animal tissues.
- ix. RT-PCR for detection of RNA viruses.
- x. Real time PCR for detection of pathogens in semen and other animal tissues.
- xi. DNA fingerprinting for identification of animal species.
- xii. PCR based detection of meat adulteration in processed and unprocessed meats.
- xiii. Detection of food borne pathogenic organisms in vegetables and fruits using PCR technology.
- xiv. PCR based detection of potential pathogens in milk, eggs and meat.

Suggested Readings

- Elles R & Mountford R. 2004. *Molecular Diagnosis of Genetic Disease*. Humana Press.
- Rao JR, Fleming CC & Moore JE. 2006. *Molecular Diagnostics*. Horizon Bioscience.

Objective

Understanding different approaches of vaccine development and production.

TheoryUNIT I

History of vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems.

UNIT II

Instruments related to monitoring of temperature, sterilization, environment, quality assurance and related areas. Production techniques, growing the microorganisms in maximum titre, preservation techniques to maintain good antigen quality, freeze drying.

UNIT III

Introduction to newer vaccine approaches namely sub-unit vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, Nano particles in vaccine delivery systems, etc.

UNIT IV

Introduction to pharmacopeal requirement, disease security and biosecurity principles and OIE guidelines such as seed management, method of manufacture, in-Process control, batch control, tests on final product.

Practical

- i. Inoculation of embryonated chicken eggs for cultivation of virus.
- ii. Harvesting of virus from inoculated embryos.
- iii. Inactivation of harvested viruses.
- iv. Safety and sterility testing of inactivated vaccine.
- v. Inoculation of tissue culture for propagation of virus.
- vi. Harvesting and production of inactivated virus vaccine.
- vii. Isolation and cloning of genes encoding immunogenic proteins.
- viii. Expression of cloned gene.
- ix. Purification of recombinant immunogenic protein.
- x. Immunogenicity studies of recombinant protein
- xi. Immunization of laboratory animals.
- xii. Titration of antibodies against the recombinant protein.

Suggested Readings

- Barry R Bloom, Paul-Henri Lambert 2002. *The Vaccine Book*. Academic Press.
- Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.
- Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.
- Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2nd Ed. Humana Press.

Objective

Understanding the application of immunological techniques in biotechnology.

Theory

UNIT I

Introduction, principles of immunology, immune system, immune response, major histocompatibility complex, various techniques used in biotechnology.

UNIT II

Application of antibodies in purification, immunoblotting, expression of recombinant proteins and detection in different expression systems, industrial production of cytokines and interferon, expression of immunoglobulin genes in plants and production of antibodies.

UNIT III

Application of antibodies in chemiluminescence and fluorescence assay used for actions for recombinant genes, antibody based nucleic acid probes and their applications, immunoinformatics.

UNIT IV

Somatic cell hybridization, hybridoma technology, commercial production of antibodies using monoclonal antibodies.

Practical

- i. Immunodiffusion.
- ii. Immunoelectrophoresis.
- iii. Fluorescent antibody test.
- iv. Enzyme immunoassays including ELISA.
- v. Immunoblotting.
- vi. Affinity chromatography,
- vii. Bioinformatics tools for immunological research.
- viii. Cultivation of normal lymphocytes and myeloma cell line.
- ix. Somatic cell hybridization and production of hybridoma.
- x. Screening of hybrids for production of monoclonal antibodies.

Suggested Readings

- Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.
- Male D, Brostoff J, Roth DB & Roitt I. 2006. *Immunology*. Elsevier.
- Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

ABT 608

INTRODUCTION TO BIOINFORMATICS

2+1

Objective

To impart an introductory knowledge about the subject of Bioinformatics to the students studying any discipline of science.

Theory

UNIT I

Introduction, biological databases – primary, secondary and structural, Protein and Gene Information Resources – PIR, SWISSPROT, PDB, genbank, DDBJ. Specialized genomic resources.

UNIT II

DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, multiple sequence alignment.

UNIT III

Secondary database searching, building search protocol, computer aided drug design – basic principles, docking, QSAR.

UNIT IV

Analysis packages – commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

Practical

- i. Usage of NCBI resources
- ii. Retrieval of sequence/structure from databases
- iii. Visualization of structures
- iv. Docking of ligand receptors
- v. BLAST exercises.

Suggested Readings

- Attwood TK & Parry-Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.
- Rastogi SC, Mendiratta N & Rastogi P. 2004. *Bioinformatics: Concepts, Skills and Applications*. CBS.

ABT 609

ANIMAL GENOMICS

2+1

Objective

Understanding structural, functional and comparative genomics of farm animals and its application for livestock improvement.

Theory

UNIT I

Historical perspective, genome organization in eukaryotes, satellite DNA including mini and microsatellites and their various families, long and short interspersed nucleotide elements, DNA markers- RAPD, STR, SSCP, RFLP, DNA fingerprinting, SNP, EST etc.

UNIT II

Importance of gene mapping in livestock, methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, *in-situ* hybridization, comparative gene mapping.

UNIT III

Genetic distance analysis, breed characterization on the basis of DNA markers, genetic markers for quantitative traits loci, marker assisted selection for incorporation of desirable traits DNA markers with economic traits, restriction fragment length polymorphism (RFLP) of different structural genes.

UNIT IV

Current status of gene maps of livestock, MHC and its relevance to disease resistance and immune response, genes influencing production traits, mitochondrial DNA of farm animals, evolutionary significance, applications of genome analysis of animals in breeding.

Practical

- i. Chromosome preparation (normal karyotyping, different types of banding) in farm animals.
- ii. Isolation and purification of animal genomic DNA from blood lymphocytes.
- iii. Analysis of DNA by agarose or polyacrylamide gel electrophoresis.

- iv. Checking the quality and quantity of genomic DNA.
- v. Restriction digestion and analysis.
- vi. Southern hybridization
- vii. DNA fingerprinting.
- viii. Techniques for revealing polymorphism-DNA fingerprinting, RFLP, SSCP, AFLP, STRP etc.
- ix. Genomic DNA cloning or cDNA cloning.
- x. Differentiation of tissues of different species by mitochondrial genome analysis.

Suggested Readings

- Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.
- Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.
- Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley-CVH.

ABT 610

REPRODUCTIVE BIOTECHNOLOGY

2+1

Objective

Understanding *in-vitro* reproductive techniques for ovum and embryo manipulation.

Theory

UNIT I

History, importance of assisted reproductive biotechnology in man and animal, introduction to embryo biotechnology, endocrine therapeutics.

UNIT II

Biotechnological approaches to reproduction, methodology of super ovulation, *in vitro* fertilization, embryo culture and micromanipulation, preparation of sperm for IVF.

UNIT III

Different method of gene transfer and their limitations, embryo splitting, embryo sexing by different methods, production of transgenic livestock by nuclear transfer and its application, regulatory issues.

UNIT III

Cloning of domestic animals. Conservation of endangered species. Characterization of embryonic stem cells. Different applications of embryonic stem cells.

Practical

- i. Synchronization and superovulation protocols.
- ii. Collection of embryos using non-surgical procedures.
- iii. Transferring embryos using non- surgical procedures.
- iv. Embryo freezing protocols.
- v. Oocyte collection and evaluation from slaughterhouse ovaries.
- vi. In vitro fertilization protocols.
- vii. Micromanipulation of early embryos.

Suggested Readings

- Ball PJH & Peter AR. 2004. *Reproduction in Cattle*. Blackwell.
- Gordon I. 2003. *Laboratory Production of Cattle Embryos*. CABI.
- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.

ABT 611

**TECHNIQUES IN MOLECULAR BIOLOGY
AND GENETIC ENGINEERING**

0+3

Objective

To provide comprehensive hands-on training on techniques of molecular biology and genetic engineering.

Practical

UNIT I

Isolation of bacterial plasmids and chromosomal DNA. Isolation of DNA from mammalian cells. Isolation of mRNA/RNA. Quantitation of nucleic acids.

UNIT II

Plasmid miniprep; Restriction endonuclease digestion of plasmid and chromosomal DNA. Agarose gel electrophoresis of RE digested DNA; Isolation of DNA; cDNA synthesis

UNIT III

Polymerase Chain Reaction using random primers as well as specific primers. Different types of PCR, Real time polymerase chain reaction

UNIT IV

Cloning of bacterial and viral genes into plasmid vectors. DNA ligation and transformation; Confirmation of insert by RE digestion and touch PCR; Transformation of yeast; Synthesis of nucleic acid probes; Nucleic acid hybridization

Suggested Readings

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.

Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.

Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

ABT 612

BIODIVERSITY, BIOSAFETY AND BIOETHICS

2+0

Objective

Understanding the basis of genetic diversity and its maintenance, biosafety procedures.

Theory

UNIT I

Historical and geographical causes of diversity, genetic diversity, molecular taxonomy, species and population biodiversity. Quantifying biodiversity, maintenance of ecological biodiversity, biodiversity and centres of origin of animals, biodiversity hotspots in India.

UNIT II

Collection and conservation of biodiversity, conservation of animal genetic resources, assessing, analyzing and documenting biodiversity. Morphological and molecular characterization of biodiversity, vulnerable and extinction of biodiversity, introduction to biodiversity database, global biodiversity information system, bioethics, CBD.

UNIT III

Biosafety and Risk assessment issues; Health aspects; toxicology, allergenicity; Ecological aspects; Regulations; National biosafety policy and law. The Cartagena Protocol on biosafety. The WTO and other international agreements; Cross border movement of germplasm; Risk management issues; Monitoring strategies and methods for detecting

transgenics; Risks, benefits and impacts of transgenics to human health, society and the environment.

UNIT IV

Bio-safety and bio-hazards; general principles for the laboratory and environmental bio-safety; Environment Impact Assessment; Gene flow in natural and artificial ecologies; Sources of gene escape; Ecological risks of genetically modified plants. Implications of intellectual property rights on the commercialization of biotechnology products.

Suggested Readings

- Arya R. 2005. *Biodiversity*. Deep & Deep.
Gaston KJ. 2004. *Biodiversity: an Introduction*. Blackwell.
Kannaiyan S & Gopalam A. 2007. *Biodiversity in India: Issues and Concerns*. APC.

ABT 613

MOLECULAR FORENSICS

2+1

Objective

Understanding the application of DNA based techniques in animal forensics.

Theory

UNIT I

General history of forensic science, introduction to DNA forensics, scope and application of DNA forensics in animal and human criminal investigations in variety of situations.

UNIT II

Isolation methods and techniques such as DNA finger-printings, PCR, nucleic acid hybridization, restriction endo-nuclease analysis and sequencing, Individual Animal Identification using DNA fingerprinting

UNIT III

Animal species identification in religious disputes, adulteration of meat, theft of farm animals and pets etc., advantages, disadvantages and limitations of DNA forensics.

UNIT III

Mass spectroscopy, protein detections methods, immunological techniques including ELISA, immunoelectrophoresis and immunofluorescence.

Practical

- i. Collection of material for forensic analysis.
- ii. Dispatch of material for forensic investigations.
- iii. Storage and processing of forensics material.
- iv. Preparation of different bio-reagents.
- v. Isolation and extraction of nucleic acid from samples.
- vi. Isolation and extraction of nucleic acid from wild animal scat.
- vii. Isolation of nucleic acid from blood, skin, meat, milk, hair and cooked and putrefied meat.
- viii. Designing of primers.
- ix. Polymerase chain reaction (PCR).
- x. Randomly amplified polymorphic DNA (RAPD)
- xi. Restriction fragment length polymorphism (RFLP).
- xii. Multiplex PCR for species identification.
- xiii. Detection of adulteration in meat by PCR & nucleic acid hybridization assay.

ABT 615 **PROBIOTICS AND FEED BIOTECHNOLOGY** **3+0**

Objective

Understanding the concept of probiotics and applications of new tools of biotechnology for quality feed/food production.

Theory

UNIT I

Introduction, history of probiotics, normal microflora of GI tract, methods for analysis of intestinal microflora, microorganisms and proteins used in probiotics, genetic modification of intestinal lactobacilli and bifidobacteria, recombinant probiotics. Mechanism of action of probiotics, immune response to probiotics, anti-mutagenic and anti-tumor activities of lactic acid bacteria, probiotics and immune system, lactic acid bacteria as live vaccines.

UNIT II

Application of probiotics for humans, farm animals and poultry, probiotics and intestinal infections, lactose mal-digestion, probiotics regulatory issues. Symbiotics, traditional probiotic products, probiotics industrial perspectives, contradictions, precautions and adverse reactions.

UNIT III

Introduction, feed processing and preservation, microbial bioconversion of lignin and cellulose rich feeds, factors affecting delignification. Diversity of organisms involved, fermentation techniques, large scale bioconversion of substrates, pre-treatment of feeds, chemical vs. microbial treatment of feeds, anti-nutritional factors present in feeds, microbial detoxification of aflatoxins, mimosine and other anti-metabolites present.

UNIT IV

Genetic manipulation of organisms to enhance bioconversion ability, manipulation of rumen fermentation by selective removal of protozoa and fungi, effect of feed additives like antibiotics, methane inhibitors, genetic manipulation of rumen microflora to improve feed utilization, single cell protein as animal feed.

Suggested Readings

- Fuller R. 1997. *Probiotics 2: Applications and Practical Aspects*. Springer.
Huffnagle GB & Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.
Kalidas S, Paliyath G, Pometto A & Levin RE. 2004. *Functional Foods and Biotechnology*. CRC Press.
Perdigón G & Fuller R. 2000. *Probiotics 3: Immunomodulation by the Gut Microflora and Probiotics*. Springer.
Roger A. 1989. *Food Biotechnology*. Cambridge Univ. Press.
Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
Trenv N. 1998. *Probiotics: Nature's Internal Healers*. Avery.

ABT 616 **ANIMAL BIOTECHNOLOGY** **3+0**

Objective

Intended to provide an overview and current developments in different areas of animal biotechnology.

Theory

UNIT I

Structure of animal cell, history of animal cell culture, cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT II

Introduction to immune system, cellular and humoral immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, nucleic acid based diagnostic methods, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits, probiotics.

UNIT III

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation for conservation endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

UNIT IV

Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance, Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

Suggested Readings

Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.

Theory

UNIT I

Transcriptome and different methods to study gene expression, single gene analysis, northern blots, quantitative PCR, SAGE, MPSS and Microarray.

UNIT II

Introduction to basic microarray technology, Design of experiments, Types of microarray, nanoarray, Customised microarray design, Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, gene expression databases.

UNIT III

SAGE and Microbeads, massive parallel signature sequencing, Microbial transcriptome. Role of functional genomics to study cancer and various clinical applications, Development, physiology, and behavior, evolutionary and ecology.

UNIT IV

Proteomics technology, identification and analysis of proteins by 2D analysis, mass spectrophotometry, NMR and X-ray crystallography, MALDI-TOF, Differential display proteomics, Protein -protein interaction, yeast two hybrid system and phage display.

Practical

- i. Northern blotting
- ii. Quantitative PCR.
- iii. Design of microarray experiments.
- iv. Microarray image processing.
- v. Basic statistical methods.
- vi. Clustering methods to study gene expression.
- vii. Analytical software related to genomics and proteomics

Suggested Readings

- Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.
- Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.
- Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II Wiley-CVH.

ABT 703

**ADVANCES IN REPRODUCTIVE
BIOTECHNOLOGY**

2+1

Objective

Understanding the new developments in reproductive technology.

Theory

UNIT I

Reproductive cloning, somatic cell nuclear transfer and transgenic animal production, cryopreservation of gametes.

UNIT II

Preimplantation genetic diagnosis (PGD), genomic imprinting and assisted reproduction, receptors of different hormones and their estimation.

UNIT III

Introduction to stem cells, types, identification, characterization and development of stem cells, transfection of gene in embryonic blastomeres.

UNIT IV

Stem cell therapeutics, social, ethical religious and regulatory issues.

Practical

- i. Embryo micromanipulation.
- ii. Microinjection.
- iii. Intra-cytoplasmic sperm injection.
- iv. ICSI Embryo biopsy for PGD and sexing.
- v. Culture of embryonic stem cell.
- vi. Characterization of embryonic stem cells.

Suggested Readings

Selected articles from journals.

ABT 704

TRENDS IN VACCINOLOGY

3+0

Objective

Understanding the latest developments in vaccine production technologies.

Theory

UNIT I

Molecular approaches to development of vaccines including: recombinant peptide vaccines, vectored vaccines, DNA vaccines, genetically manipulated live vaccines.

UNIT II

Plant expression system based vaccines, idiotypic and synthetic peptide based vaccines, reverse genetic approach and computational vaccinology.

UNIT III

Immunomodulators including cytokines and new adjuvants, Immunomodulation, innovative methods of delivery of immunogens through liposomes, microspheres, ISCOMS, etc.

UNIT IV

Large scale production technology and quality control, regulatory issues, environmental concerns with the use of recombinant vaccines.

Practical

- i. Preparation of gene construct for recombinant and nucleic acid vaccine.
- ii. Expression of gene encoding immunogenic protein in prokaryotic/ yeast/ animal cell culture system.
- iii. Study of immune response against recombinant vaccine.
- iv. Protection and evaluation studies.
- v. Use of modern adjuvants in vaccines.
- vi. Vaccine delivery systems including use of nanoparticles

Suggested Readings

Selected articles from journals.

ABT 705

ADVANCES IN ANIMAL CELL CULTURE

2+1

Objective

Understanding the latest developments in cell culture techniques.

Theory

UNIT I

Development of cell lines, characterization of cell lines by morphology, chromosome analysis, DNA content, enzyme activity and antigenic markers, differentiation.

UNIT II

Cultivation requirements of different types of cells, flow cytometry, DNA transfer by calcium phosphate co-precipitation, lipofection, electroporation.

UNIT III

Expression of recombinant proteins in mammalian and avian cell lines.

UNIT IV

Up-scaling of cells for production of vaccines, diagnostic antigens and other pharmaceutical agents, up-stream and downstream processing, cell culture fermentors.

Practical

- i. Primary and secondary mammalian cell culture.
- ii. Development of transformed cell lines.
- iii. Characterization of cell lines.
- iv. Transfection of cells with recombinant DNA.
- v. Expression of recombinant proteins.
- vi. Scaling-up of cultures.

Suggested Readings

Selected articles from journals.

ABT 706

TRANSGENIC ANIMAL TECHNOLOGY

2+0

Objective

Understanding the latest developments in transgenic technology.

Theory

UNIT I

Concept of transgenics, techniques of gene transfer, microinjection of recombinant DNA into fertilized eggs/stem cells, transfection of DNA totipotent keratocarcinoma cells, electroporation, gene transfer into cultured cells.

UNIT II

Suitable promoters for expression of transgenes, eukaryotic expression vectors, detection of transgenes in the new born.

UNIT III

Principles of animal cloning, application of transgenic and cloning technologies for improvement of livestock. Transgenic animals as bioreactors.

UNIT IV

Social, ethical, religious, environmental and other regulatory issues related to transgenic animal technology.

Suggested Readings

Selected articles from journals.

ANIMAL BIOTECHNOLOGY

List of Journals

- ❖ Animal Biotechnology
- ❖ Animal Genetics
- ❖ Animal Reproduction
- ❖ Cellular and Molecular Probe
- ❖ Current Science
- ❖ Genome Research
- ❖ Indian journal of Microbiology
- ❖ Journal of Clinical Microbiology
- ❖ Journal of Dairy Science
- ❖ Journal of Reproduction and Fertility
- ❖ Methods in Virus Research
- ❖ Nature
- ❖ Nature Biotechnology
- ❖ Nature Genetics
- ❖ Nucleic Acid Research
- ❖ PNAS
- ❖ Reproduction in Domestic Animals
- ❖ Science
- ❖ Theriogenology
- ❖ Trends in Biotechnology
- ❖ Trends in Genetics
- ❖ Viral Research

e-Resources

- ❖ www.cls.casa.colostate.edu/TransgenicCrops/teacherlinks
- ❖ www.hpc.unm.edu/~aroberts/main/top5%25.htm
- ❖ www.isaaa.org
- ❖ www.ciat.cgiar.org/biotechnology/cbn/gines_mera_fund.htm
- ❖ www.scidev.net/en/agriculture-and-environment/agri-biotech/links/publications-and-information-services
- ❖ www.biotechinstitute.org/programs/t_leader_program.html
- ❖ www.sci-ed-ga.org/modules/dna/analogies.html
- ❖ www.accessexcellence.org/AE/AEPC/WWC/1993
- ❖ www.atschool.eduweb.co.uk/trinity/bio2.html
- ❖ www.pub.ac.za/resources/teach.html
- ❖ www.bio-link.org/biomaterial.htm
- ❖ www.biotechnology.gov.au/index.cfm?event=object.showContent&objectID=B35A914C-DE3D-1A59-79F89FAA26F54E44
- ❖ www.monsanto.com/products/techandsafety/technicalpubs/eduwebsites.asp
- ❖ www.ejbiotechnology.info/content/vol5/issue3/teaching/01/index.html
- ❖ www.ncbiotech.org/resource_center/for_educators/online_teaching_resources.html
- ❖ www.ias.ac.in/currsci/dec252006/1594
- ❖ www.cccoe.k12.ca.us/stsvcs/newteacher/rop/curr_rop_links2.html
- ❖ www.scielo.cl/scielo.php?pid=S0717-34582003000100004&script=sci_arttext
- ❖ www.sunysb.edu/ligase/Forstudents/BiotechTeachingCenter/biotechcenter.html

- ❖ www.ca.uky.edu/agc/pubs/brei/brei3tg/brei3tg.htm
- ❖ www.aggie-horticulture.tamu.edu/tisscult/biotech/biotechteach.html
- ❖ www.ejbiotechnology.info/content/vol6/issue2/issues/2/index.html
- ❖ <http://science.nhmccd.edu/biol/biolint.htm#dna>
- ❖ <http://nhscience.lonestar.edu/biol/biolint.htm>
- ❖ www.ingentaconnect.com/content/tandf/tsed/2000/00000022/00000009/art00007
- ❖ www.buildingbiotechnology.com/free.php
- ❖ www.biotechnologist2020.com/2008/04/teaching-jobs-in-bioinformatics.html
- ❖ www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ613711
- ❖ www.uq.edu.au/teaching-learning/index.html?page=61920
- ❖ www.nature.com/nbt/journal/v18/n9/full/nbt0900_913b.html
- ❖ www.fotodyne.com/literature/datasheets/E10700
- ❖ www.biotethics.org/conferences/maastricht/partecipants.html
- ❖ www.brookes.ac.uk/studying/courses/postgraduate/2008/biotech
- ❖ www.bioweb.usc.edu/courses/2003-spring/documents/bisc406-notes_011603
- ❖ www.gen.ufl.edu/~chyn/age2062/lect/lect_09/lect_09.htm
- ❖ www.bioinformaticscourses.com/BIOL358/lectures.html
- ❖ www.isis.vt.edu/~nstone/LifeSci/lect5.html
- ❖ www.nwo.nl/nwohome.nsf/pages/NWOA_6Y2LGH_Eng
- ❖ www.soi.wide.ad.jp/class/20040016
- ❖ www.sciencetech.technomuses.ca/english/schoolzone/biotech.cfm
- ❖ www.freevideolectures.com/biotech.html
- ❖ www.gen.ufl.edu/~chyn/age4660/lect/lect_07/lect_07.htm
- ❖ www.web.mit.edu/cheme/news/frontiers_2005.html

Suggested Broad Topics for Master's and Doctoral Research

- ❖ Development of Vaccines against emerging pathogens
- ❖ Nucleic acid based diagnostics
- ❖ Molecular animal forensics
- ❖ Whole genome analysis of animal viruses
- ❖ Embryo manipulation
- ❖ Animal genomics
- ❖ Reproductive biotechnology
- ❖ Conservation of endangered animal species
- ❖ Animal breed characterization
- ❖ Genomic Diversity of animal viruses
- ❖ Mapping of disease resistance genes in livestock
- ❖ Proteomics

BIOINFORMATICS

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
BIF 501*	INTRODUCTION TO BIOINFORMATICS	2+1
BIF 502*	ADVANCED BIOINFORMATICS	2+1
BIF 503*	TECHNIQUES IN BIOINFORMATICS	0+2
BIF 504**†	BIOLOGICAL CHEMISTRY	3+0
BIF 505**†	STATISTICS FOR BIOINFORMATICS	2+1
BIF 506	CONCEPTS IN COMPUTING	2+2
BIF 507**†	PROGRAMMING LANGUAGES FOR BIOINFORMATICS	2+2
BIF 508**†	BASIC MOLECULAR BIOLOGY	3+0
BIF 509**†	MATHEMATICS FOR BIOINFORMATICS	2+0
BIF 510**	GENETICS & IMMUNOLOGY	3+0
BIF 511	INTRODUCTION TO DATABASE SYSTEMS	2+1
BIF 512	COMPUTATIONAL & SYSTEM BIOLOGY	2+2
BIF 513	BIOMOLECULAR SEQUENCE ANALYSIS	1+1
BIF 514**†	DYNAMIC WEB-DESIGN	1+2
BIF 515	BIOLOGICAL DATABANKS & DATA MINING	1+2
BIF 516	MOLECULAR MODELLING & DRUG DESIGN	2+2
BIF 517	COMPARATIVE AND FUNCTIONAL GENOMICS	2+1
BIF 518	PHARMACOGENOMICS & IPR	2+1
BIF 591	MASTER'S SEMINAR	1+0
BIF 599	MASTER'S RESEARCH	20

* To be offered to the students other than those of M.Sc. Bioinformatics

** May be taken as Minor/Supporting course

† To be offered from respective departments. The syllabi are attached for reference only. Actual contents may be seen from the corresponding department(s).

Theory

UNIT I

The molecular logic of living organisms; Cells and composition of living matter; Carbohydrates: monosaccharides, oligosaccharides, polysaccharides, proteoglycans and glycoproteins; Lipids: fatty acids, acylglycerols, phospholipids, sphingolipids, cholesterol and membranes.

UNIT II

Structure and function of Proteins and nucleic acids; Enzymes: details of enzyme nomenclature and classification; units of enzyme activity; coenzymes and metal cofactors; temperature and pH effects; Michaelis-Menten kinetics; Inhibitors and activators; active site and catalytic mechanisms; covalent and noncovalent regulations; isoenzymes.

UNIT III

Organization of metabolic systems: enzyme chains, multienzyme complexes and multifunctional enzymes; anaplerotic sequences and amphibolic pathways; pacemaker enzymes and feedback control of metabolic pathways; shuttle pathways; energy charge.

UNIT IV

Oxidation of glucose in cells: high energy bond, glycolysis, citric acid cycle and oxidative phosphorylation, metabolism of lipids, proteins and nucleic acids, signal transduction.

Suggested Readings

Geoffrey LZ, Michael Gregory E & Sitz T. 1997. *Biochemistry*. McGraw-Hill.

Nelson DL, Cox MM & Ocorr MOK. 2005. *Lehninger's Biochemistry*. WH Freeman & Co.

Voet D & Voet JG. 1997. *Biochemistry*. John Wiley & Sons.

BIF 505

STATISTICS FOR BIOINFORMATICS

2+1

Objective

To understand the basic principles of statistics and mathematics and their applications in relation to Biological system.

Theory

UNIT I

Introduction to Statistical Bioinformatics, Principles of sampling from a population; Random sampling

UNIT II

Frequency distributions: Graphical representations and Descriptive measures; Standard Probability Distributions; Correlation and regression analysis.

UNIT III

Hypothesis testing; Markov Models, Cluster Analysis: Hierarchical and Non-Hierarchical methods.

UNIT IV

Phylogenetic Analysis Tools: Maximum Likelihood, Parsimony methods.

Practical

- i. Computational exercises on Random Sampling
- ii. Construction and representation of frequency distributions
- iii. Descriptive measures
- iv. Probability distribution.

Theory

UNIT I

Programming in C: Pointers, pointers to functions, macro programming in C, graphs, data structure - linked list, stack, queue, binary trees, threaded binary trees.

UNIT II

File and exception handling in C, Programming in Visual Basic: Introduction to Application Development using Visual Basic; Working with Code and Forms.

UNIT III

Variables, Procedures and Controlling Program Executor; Standard Controls; Data Access Using Data Control; Connecting to Database using VB.

UNIT IV

Introduction to JAVA, variables, constants, control structures, input output, classes. Jar and Java applets.

Practical

- i. Programming in C and Visual basic with special reference to database linking.
- ii. Small Java applets

Suggested Readings

Brian WK & Ritchie DM. 1988. *C Programming Language*. Prentice Hall.
Kanetkar. 2002. *Let us C*. BPB Publications.
Microsoft Developers Network (MSDN Digital Library).2006. Microsoft.

BIF 508

BASIC MOLECULAR BIOLOGY

3+0

Objective

To understand the basic concepts of molecular biology in order to relate to the structure and functions of biomolecules and to have an insight of chemical aspects of life.

Theory

UNIT I

Nucleic acids as hereditary material, Genome organization in prokaryotes and eukaryotes.

UNIT II

DNA replication, semi-conservative model, mechanism of replication in *E. coli*, differences in pro- and eukaryotic DNA replication.

UNIT II

Reverse transcription, Transcription in pro- and eukaryotes, post-transcriptional changes; Ribozymes, anti-sense RNA, micro-RNAs

UNIT IV

Genetic code and translation; differences in translation process in pro-and eukaryotes; Gene regulation in prokaryotes and eukaryotes.

Suggested Readings

Gupta PK. 2003. *Cell and Molecular Biology*. 2nd Ed. Rastogi Publications.
Lodish H. 2003. *Molecular Cell Biology*. 5th Ed. W.H. Freeman & Co.
Zhang MQ & Jiang T. 2002. *Current Topics in Computational Molecular Biology*. MIT Press.

UNIT II

Anatomy of DNA: A, B, Z DNA, DNA bending etc.; RNA structure; Structure of Ribosome; Principles of Protein Folding; Structural data banks - Protein Data Bank, Cambridge small molecular crystal structure data bank.

UNIT III

Methods for Prediction of Secondary and Tertiary structures of Proteins, DNA, RNA, Fold recognition, *Ab initio* methods for structure prediction; Homology modeling, Methods for comparison of 3D structures of proteins.

UNIT IV

Molecular interactions of Protein – Protein with special reference to signal transduction and antigen-antibody interaction, Protein - DNA, Protein - carbohydrate, DNA - small molecules. System modeling and metabolomics – concepts and principles.

Practical

- i. Usage of softwares for above topics
- ii. Molecular Visualization tools: RasMol, QMol, Swiss PDB, Pymol
- iii. Biomolecular Interaction Databases: BIND, DIP;
- iv. Structure Similarity Search Tools: CN3D, Vast Search

Suggested Readings

Fall CP. 2002. *Computational Cell Biology*. Springer.
Tsai CS. 2003. *Computational Biochemistry*. John Wiley & Sons.
Waterman MS. 1995. *Introduction to Computational Biology: Maps, Sequences and Genomes*. CRC Press.

BIF 513 BIOMOLECULAR SEQUENCE ANALYSIS 1+1

Objective

To understand the local and multiple alignment concepts and to carry out multiple sequence alignment.

Theory

UNIT I

Analysis of protein and nucleic acid sequences, multiple alignment programs,

UNIT II

Development of programs for analysis of nucleic acid sequences, Use of EMBOSS package.

UNIT III

Phylogenetic analysis – Elements of phylogenetic models, tree interpretation, tree data analysis, alignment – building data model.

UNIT IV

Extraction of phylogenetics data sets, Distance and character based methods.

Practical

- i. EMBOSS
- ii. File Format Converter Tools: BABEL, ReadSeq
- iii. Phylogenetic Analysis Tools: Phylip, NTSYS, PAUP
- iv. CLUSTALW/CLUSTALX.

Suggested Readings

Baxevanis AD & Ouellette BFF. 2001. *Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins*. Wiley Interscience.

UNIT II

AIDS Virus sequence data bank, rRNA data bank, Protein sequence data banks: NBRF-PIR, SWISSPROT, Signal peptide data bank; Database Similarity Searches.

UNIT III

BLAST, FASTA, PSI-BLAST algorithms; Pair wise sequence alignment - NEEDLEMAN and Wunsch, Smith Waterman algorithms; Multiple sequence alignments - CLUSTAL, Patterns, motifs and Profiles in sequences.

UNIT IV

Derivation and searching; Derived Databases of patterns, motifs and profiles: Prosite, Blocks, Prints-S, Pfam, etc.; Primer Design.

Practical

- i. Gene Information Resources
- ii. Protein Information Resources
- iii. Structural Databases
- iv. Sequence Analysis and Database Similarity Search Tools: BLAST, PHI-BLAST, PSI-BLAST, FASTA, EMBOSS, CLUSTAL, TCOFFEE
- v. Use of similarity, homology and alignment tools.

Suggested Readings

Letovsky S. (Ed).1999. *Bioinformatics: Databases and Systems*. Kluwer.

LeÛn D & Markel S. 2003. *Sequence Analysis in a Nutshell: A Guide to Common Tools and Databases*. O'Reilly.

NCBI(www.ncbi.nlm.nih.gov).

PUBMED (www.pubmedcentral.nih.gov) and database web-sites.

BIF 516 MOLECULAR MODELLING AND DRUG DESIGN 2+2

Objective

To understand the Modelling of small molecules; to understand the computational chemistry principles and to familiarize the role of computers in drug-discovery process.

Theory

UNIT I

Concepts of Molecular Modelling, Molecular structure and internal energy, Application of molecular graphics,

UNIT II

Energy minimization of small molecules, Use of Force Fields and MM methods, Local and global energy minima. Techniques in MD and Monte Carlo. Simulation for conformational analysis, *Ab initio*, DFT and semi-empirical methods.

UNIT III

Design of ligands, Drug-receptor interactions, Classical SAR/QSAR, Docking of Molecules;

UNIT IV

Role of computers in chemical research; Structure representation, SMILES; Chemical Databases, 2D and 3D structures, reaction databases, search techniques, similarity searches; Chemoinformatics tools for drug discovery.

Practical

- i. Modelling Tools: MODELLER, Geno3D
- ii. Docking Tools: Chimera, Dock, MOE, AutoDock Tools, GRAMM, Hex, ArgusLab;
- iii. 3D-Structure Optimization Tools: CHEMSKETCH, CHEM 3D, ISIS Draw, CHEMDRAW

Suggested Readings

- Bunin BA. 2006. *Chemoinformatics: Theory, Practice and Products*. Springer.
- Gasteiger J & Engel T. 2003. *Chemoinformatics: A Textbook*. Wiley-VCH.
- Hinchliffe A. 2003. *Molecular Modelling for Beginners*. John Wiley & Sons.
- Leach AR. 1996. *Molecular Modelling: Principles and Applications*. Longman.

BIF 517 COMPARATIVE AND FUNCTIONAL GENOMICS 2+1**Objective**

To understand the genomic and proteomic concepts and to learn the usage of various algorithms and programmes in analysis of genomic and proteomic data.

TheoryUNIT I

A brief account of recombinant DNA technology, PCR and molecular marker techniques. *Genomics* - Whole genome analysis, Comparative and functional genomics,

UNIT II

Pathway analysis, Repeat analysis, Human genetic disorders, Candidate gene identification, Linkage analysis, Genotyping analysis.

UNIT III

Concepts of Pharmacogenomics *Proteomics* - Introduction to basic Proteomics technology, Bio-informatics in Proteomics, Gene to Protein Function: a Roundtrip,

UNIT IV

Analysis of Proteomes, Analysis of 2-D gels, Protein to Disease and *vice versa*, Human Genome and science after Genome era. SAGE.

Practical

- i. Gene Prediction Tools: GENSCAN, GRAIL, FGENESH
- ii. NCBI Genomic Resources
- iii. Proteomics Tools: EXPASY, CDART

Suggested Readings

- Azuaje F & Dopazo J. 2005. *Data Analysis and Visualization in Genomics and Proteomics*. John Wiley & Sons.
- Jollès P & Jörnvall H. 2000. *Proteomics in Functional Genomics: Protein Structure Analysis*. Birkhäuser.

BIF 518 PHARMACOGENOMICS & IPR 2+1**Objective**

To understand the translation of Bioinformatics into commercial gains; to familiarize the concepts of microarray – data acquisition and analysis and

learn the IPR issues in Biological sciences with special emphasis on bioinformatics.

Theory

UNIT I

Bioinformatics companies, Genomes, transcriptomes and proteomes – their applications in medicine and agriculture, disease monitoring, profile for therapeutic molecular targeting.

UNIT II

Diagnostic drug discovery and genomics. Pharmacogenomics and its application. SNPs and their applications. Microarray and genome wide expression analysis: Introduction to basic microarray technology, Bioinformatics in microarrays, Getting started – target selection.

UNIT III

Customised microarray design, Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, Public Microarray data resources.

UNIT IV

Patenting and data generation from patent literature for commercial benefits. IPR, and bioinformatics. Bioinformatics patents.

Practical

- i. Microarray Analysis Tools: MAGICTool
- ii. Stanford Microarray Database
- iii. Gene Expression Omnibus
- iv. Creation of an On-line company.

Suggested Readings

- Blalock EM. 2003. *A Beginner's Guide to Microarrays*. Springer.
- Catania M. 2006. *An A-Z Guide to Pharmacogenomics*. American Association for Clinical Chemistry.
- Chakraborty C & Bhattachary A. 2005. *Pharmacogenomics*. Biotech Books.
- Stekel D. 2003. *Microarray Bioinformatics*. Cambridge University Press.

BIOINFORMATICS

List of Journals

- ❖ Bioinformatics - Oxford University Press
- ❖ BMC Bioinformatics - BioMed Central
- ❖ Briefings in Bioinformatics - Oxford University Press
- ❖ Briefings in Functional Genomics and Proteomics - Oxford University Press
- ❖ Computers in Biology and Medicine – Elsevier
- ❖ Journal of Bioinformatics and Computational Biology (JBCB) – World Scientific Publishers
- ❖ Journal of Biomedical Informatics – Elsevier
- ❖ Journal of Computational Biology - Mary Ann Liebert, Inc. publishers
- ❖ Journal of Molecular Modelling – Springer
- ❖ Nucleic Acids Research – Oxford Press
- ❖ Protein Engineering, Design and Selection (*PEDS*) – Oxford Press

e-Resources

- ❖ Bioinformatics.Org: The Open-Access Institute - <http://bioinformatics.org/>
- ❖ European Molecular Biology Network - <http://www.embnet.org/>
- ❖ European Bioinformatics Institute -<http://www.ebi.ac.uk/>
- ❖ The European Molecular Biology Laboratory - <http://www.embl.org/>
- ❖ International Society for Computational Biology - <http://www.iscb.org/>
- ❖ National Center for Biotechnology Information - <http://www.ncbi.nlm.nih.gov/>
- ❖ ExPASy Proteomics Server - <http://us.expasy.org/>
- ❖ Mouse Genome Informatics - <http://www.informatics.jax.org/>
- ❖ Center for Molecular Modeling - <http://cmm.info.nih.gov/modeling/>
- ❖ RCSB PDB - <http://www.rcsb.org/pdb>
- ❖ Bioinformatics resources - http://www.biochem.ucl.ac.uk/bsm/BCSB/bioinfo_resources/bioinform_res.htm
- ❖ South African National Bioinformatics Institute - <http://www.sanbi.ac.za/>
- ❖ Swiss Institute of Bioinformatics - <http://www.isb-sib.ch/>
- ❖ Protein Structure Prediction Center - <http://predictioncenter.llnl.gov/>
- ❖ Programs for Genomic Applications -<http://www.nhlbi.nih.gov/resources/pgs/>
- ❖ Computational Molecular Biology At NIH - <http://molbio.info.nih.gov/molbio/>
- ❖ Gene Ontology Home - <http://www.geneontology.org/>
- ❖ All About The Human Genome Project (HGP) - <http://www.genome.gov/>
- ❖ UCSC Genome Browser - <http://genome.ucsc.edu/>

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.;

commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article. **Communication Skills** - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
 Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
 Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
 James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
 Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
 Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
 Richard WS. 1969. *Technical Writing*. Barnes & Noble.
 Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
 Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
 Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503
(e-Course)

**INTELLECTUAL PROPERTY AND ITS
MANAGEMENT IN AGRICULTURE**

1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

- Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS 1+0 **(e-Course) AND RURAL DEVELOPMENT PROGRAMMES**

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
- Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
- Singh K.. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

PGS 506
(e-Course)

DISASTER MANAGEMENT

1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water

pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

BSMA Committee on Biotechnology & Bioinformatics

(Plant Biotechnology/Animal Biotechnology/Bioinformatics)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR
dated January 14, 2008)

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Dr. H.S. Chawla Professor	Department of Plant Breeding, GBPUAT, Pantnagar	Plant Biotech
Dr. R.G. Saini Retired Professor	Dept. Biotech., Genetics & Plant Breeding, PAU, Ludhiana	Plant Biotech
Dr. D.R. Sharma Director of Research	Dr. Y.S. Parmar University of Horticulture & Forestry, Solan	Plant Biotech
Dr. K. Kumanan Professor & Head	Department of Animal Biotechnology, TANUVASU, Chennai	Animal Biotechnology
Dr. Sudhir Kumar Associate Professor	Bioinformatics Section, CCS HAU, Hisar	Bioinformatics
Dr. Anant Rai Head	Division of Animal Biotech. IVRI, Izatnagar	Animal Biotechnology
Dr. Gaya Prasad Professor Member Secretary	Dept. Animal Biotech. CCS HAU, Hisar	Animal Biotechnology

**NEW AND RESTRUCTURED
POST-GRADUATE CURRICULA & SYLLABI**

Statistical Sciences

Statistics/Agricultural Statistics
Bio-Statistics
Computer Application



**Education Division
Indian Council of Agricultural Research
New Delhi**

January 2009

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PREAMBLE

The origin of the discipline of Agricultural Statistics can be traced back to 1930 when the then Imperial Council of Agricultural Research decided setting up a Statistical Section to assist the State Departments of Agriculture and Animal Husbandry in planning their experiments and analysis of data. The activities of this section increased rapidly and acquired International recognition as a centre for research and training in the field of Agricultural Statistics. Training programmes were started in this discipline in 1945. This activity resulted in the conversion of this section to a full-fledged Institute named as Institute of Agricultural Research Statistics (IARS) where subsequently the M.Sc. and Ph.D. degree courses in Agricultural Statistics were started in 1964 in collaboration with Indian Agricultural Research Institute (IARI). With the strengthening of NARS through more SAUs and ICAR Institutes, the demand for trained and qualified manpower in Agricultural Statistics increased rapidly which resulted in starting of M.Sc. and Ph. D. degree courses in Agricultural Statistics in many other State Agricultural Universities (SAUs) and Deemed-to-be Universities (DUs). Throughout the growth of this discipline, the main emphasis was to develop trained manpower in the country in the field of Agricultural Statistics and later on in the field of Computer Application so as to meet the challenges of agricultural research in the newer emerging areas. These disciplines have now become an integrated component of agricultural research and help in making agricultural research globally acceptable.

Bio-Statistics has also emerged as an important branch of statistical sciences and it helps strengthening research in the disciplines of biology, genetics, animal sciences, veterinary sciences, clinical trials and livestock. The problems of the animal / veterinary sciences are altogether different from those of agricultural sciences because in these sciences there would always be a scarcity of resources and the experimentation would be of a longer duration. Therefore, the students doing their M.Sc. in Bio-Statistics are trained in statistics with emphasis on Bio-statistical techniques. The courses covered in this discipline also cater to the requirements of the biologists and are so designed that they learn the statistical techniques needed to carry out analysis of their data. As such, while designing curricula in bio-statistics, in particular for veterinary sciences, due care has to be taken to cover all statistical techniques required especially for life sciences. Currently M.Sc. in bio-statistics is being offered at Indian Veterinary Research Institute, Izatnagar.

Some of courses of bio-statistics are also offered in the curriculum of Agricultural Statistics/Statistics in SAUs and DUs.

Use of computers in agricultural research began more than three decades ago. Initially the electronic data processing requirements of agricultural research workers and students in the NARS were catered by Indian Agricultural Statistics Research Institute (IASRI). Late sixties and seventies saw statisticians - programmers at IASRI shouldering the onerous responsibility of training agricultural research workers in the use of computers. Around the same time a course on Computer Programming was introduced and offered in the curriculum of M.Sc. and Ph.D. students of PG School of IARI and subsequently at many other SAUs. Seventies witnessed an increase in the computing facilities in NARS; there was a great demand for qualified and trained manpower to manage these facilities. During mid eighties, M.Sc. Course in Computer Application in Agriculture was introduced in the PG programme of IARI. During this time the computing environment started witnessing changes and Mainframe computers were getting replaced by PCs. Concepts like LAN, WAN, Information Technology (IT), Databases, Information Systems, etc., all became bywords among agricultural research workers. PG Programme in Computer Science/Application was also introduced in other SAUs. Computer Application became an important discipline in agricultural research and as such this discipline was introduced in the Agricultural Research Service of the ICAR in 1985. In the present day world the role of Information Technology has become very important. Together with the discipline of Statistics, it does wonders in agricultural research. The newer areas of research like genomics, geoinformatics, market intelligence, quality management depend very heavily on Statistics and Information Technology. For outreaching the research in the labs to the farmers, information technology plays a vital role. Advisory and consultancy, distance learning, etc. have become possible through IT only. Data warehouses and data mining are the orders of the day.

In view of the importance of Statistical Sciences, it is important that the course curricula framed to generate trained manpower in the country are dynamic in nature and undergo changes over regular period of time interval so as to accommodate and modernize the curricula. Accordingly a national level core group was constituted to revise the syllabi of agricultural sciences so as to cater to the requirements of the present day world. A Broad Subject Matter Area (BSMA) Committee for statistical sciences was constituted to look into the revision of the course curricula of the disciplines of Statistics / Agricultural statistics, Bio-statistics, Computer Application.

A meeting of the BSMA committee was held on 28 April 2008 at IASRI, New Delhi to initiate the process of course curricula revision. The need for revision of the curricula was discussed. It was felt that the revised curricula should include all the necessary courses required to be studied by M.Sc. and Ph.D. students so as to prepare them to undertake research in the newer emerging areas. This would ensure that the curricula is competitive at both National and International level. Further, the course curricula should be such that it enhances the job opportunities for the students and helps them fetch good jobs in the private sector as well. It was also felt that the curricula should be so framed that it includes the courses on newer areas of research. The committee members were then assigned the responsibility of restructuring the course curricula. Thereafter another meeting of the BSMA committee was held on 26-27 May 2008 in which the revised course curricula was discussed. The committee was enlarged by inviting some experienced faculty members so as to take advantage of their experience. It was felt that the number of courses should be reduced but the course contents should be competitive at both National and International level. Several new courses were introduced. There was a general feeling that due emphasis should be laid on the courses on “time series analysis” and “regression analysis”. Courses on “statistical computing” and “bioinformatics” were also introduced keeping in mind the job perspectives of the students. A workshop was organized on 28 May 2008 in which senior faculty members from Indian Statistical Institute, Delhi; University of Delhi; PAU, Ludhiana; CCS HAU, Hisar; College of Agriculture, Dharwad; GKVK, UAS, Bangalore; NDUAT, Faizabad; Institute of Agricultural Sciences, BHU, Varanasi; NCERT, Delhi; DRDO, Delhi; NCIPM, Delhi; IISS, Bhopal etc. were invited. The revised course curricula were presented during the workshop and the suggestions were invited from a broad spectrum of experts.

A major recommendation from the workshop was that the major courses should be divided into core and optional courses for all M.Sc. programmes. However, for Ph.D. programme, there should be no core course. There was also a feeling that course on optimization techniques may be continued with some revision but new courses on statistical ecology, demography, biostatistics and actuarial statistics should be introduced. It was also decided that the courses on “Planning experiments and surveys including official statistics” and “System analysis and design” may be dropped from the curricula and suitable changes made in the course on “Software Engineering”.

The course outline also introduces new courses on regression analysis and time series analysis. These courses assume importance in the newer environment of open economy. Keeping pace with the newer areas of research in agricultural sciences, new courses on Bio-statistics and Bioinformatics have been introduced. A new course on Statistical Ecology has been introduced keeping in view the importance of ecology in the present day world. Similarly, another new course on actuarial statistics has been introduced in view of the importance of insurance.

The course outline lays emphasis on statistical computing and simulation techniques. This would enable students to use software packages for data analysis and also interpretation of results. This exposure would enhance further the job prospects of the students.

V. K. Gupta
BSMAC (Statistical Sciences)

ACKNOWLEDGEMENTS

On behalf of the Broad Subject Matter Area (BSMA) Committee on Statistical Sciences and on my own personal behalf I wish to place on record my deepest sense of gratitude to Dr. JC Katyal, Chairman, National Core Group and Vice Chancellor, CCS HAU, Hisar for entrusting us with the responsibility to undertake this challenging but noble cause of revising the course curricula of all the disciplines in Statistical Sciences. This was a herculean task but the leadership of Dr. Katyal, his fresh and fragrant ideas, and his knowledge and wisdom made the job easy for the committee. I would also like to articulate my feelings of indebtedness towards Dr. RK Mittal, ADG (EQR), Education Division, ICAR in particular, and for the Education Division, ICAR, in general, for providing necessary guidance from time to time and for also extending fullest support in successfully completing this exercise.

I gratefully acknowledge the full support received from Dr. SD Sharma, Former Director, IASRI, New Delhi, during course of preparation of this report. The logistic support provided by Dr. Sharma and his dedicated team at IASRI for holding the meetings of the BSMA committee and the workshop is duly acknowledged.

I have no words to express my most sincere and heartfelt gratefulness to Dr. BS Kulkarni, Dr. M Gopala Rao, Dr. HL Sharma, Dr. DK Jain, Dr. VK Bhatia and Dr. LS Kaushik, members of the BSMA Committee, whose unflinching efforts have culminated in the preparation of this report. The help received from Dr. PK Malhotra, Dr. Rajender Parsad and Dr. Prajneshu is praise worthy and I would like to express my highest appreciation of their efforts in this formidable work. The help received from Dr. B Singh, who looked into the syllabi of Bio-Statistics courses, is held in high esteem. I would also like to express my sincere thanks to all the participants of the workshop whose valuable suggestions have helped in shaping the course curricula. I would like to make a special mention of Dr. Alope Dey who chaired the Workshop and also gave valuable suggestions which led to considerable improvements in the contents of the report.

The whole exercise started with a rough draft of course curricula prepared by the faculty of Mathematics and Statistics, and Computer Centre, CCS HAU, Hisar for which the BSMA Committee would like to convey its thankfulness to the entire faculty of the concerned Departments. Their help is also duly acknowledged. Another very important base material for revising the course curricula was the syllabi of the PG Courses of IARI, provided by IASRI and also the syllabi of the previous BSMA Committee prepared during 2001. The draft on the syllabi was also prepared by various members of the Committee. I very sincerely appreciate the help received from one and all which helped lay the foundation of the success of this phenomenal task.

Lastly, but most importantly, I would articulate my feelings for one and would like to reiterate the fact that it has been indeed a great pleasure working with everyone in the committee as well as outside the committee.

EXECUTIVE SUMMARY

The discipline of Statistical Sciences includes in its gamete subjects like Statistics / Agricultural Statistics, Bio-statistics, Computer Application, etc. These subjects have wide applicability in the disciplines of physical, social, agricultural, animal, biological, medical sciences, etc. Statistical sciences form the backbone of agricultural research and are an integrated component of agricultural research. It is, therefore, of paramount importance that the education in statistical sciences is of high academic standards so as to produce trained human resource in the country to meet the challenges of agricultural research in newer areas and also to help make the agricultural research globally competitive. The course curricula in the discipline of agricultural sciences should be dynamic in nature and also should be competitive at both national and international level. A number of State Agricultural Universities (SAUs) and Deemed-to-be Universities (DUs) under the Indian Council of Agricultural Research (ICAR) have introduced M.Sc. programmes in Statistical Sciences. The revision of curricula and syllabi has been undertaken by the SAUs and DUs from time to time on need basis.

In order to meet the requirements of teaching in the changing scenario, particularly in view of the open economy, ICAR constituted a Broad Subject Matter Area (BSMA) Committee on statistical sciences covering three PG Programmes *viz.*, (a) Statistics / Agricultural Statistics, (b) Bio-Statistics and (c) Computer Application so as to revise the course curricula to meet the demands of agricultural research in newer emerging areas. The underlying concept while revising the curricula was that the number of courses and the course contents should be such that it covers all the necessary courses required to be studied by an M.Sc. and a Ph.D. student and the student gets prepared for undertaking research independently. This would ensure that the curricula is competitive at both national and international level. Further, the course curricula should be such that it enhances the job opportunities for the students and helps them to fetch good jobs in the private sector as well. The course curriculum divides the major courses into core and optional courses for all M.Sc. programmes. However, for Ph.D. programme in Agricultural Statistics, there are no core courses. The existing syllabi have been revised and the number of courses have been reduced by combining several courses. The course contents, however, have not been sacrificed. The major changes that have taken place are the following:

Statistics/Agricultural Statistics

Ph. D. Programme

- A new curricula comprising of 15 courses has been framed.
- These new courses have been so framed as to initiate the students to conduct research in these areas and to expose them to their applications to agricultural sciences.

M. Sc. Programme

- New courses on “Regression Analysis,” “Time Series Analysis,” “Bioinformatics,” “Statistical Quality Control,” “Optimization Techniques,” “Demography,” “Statistical Methods for Life Sciences,” “Actuarial Statistics” and “Statistical Ecology” have been introduced.
- Course on “Data Analysis in Agriculture” has been restructured as “Statistical Computing.”
- The courses on “Official Statistics,” “Stochastic Processes” and “Non-linear Statistical Modeling” have been dropped.
- The course on “Mathematical Methods” has been divided into two courses by strengthening the course content as “Mathematical Methods – I” and “Mathematical Methods –II.”
- Six new courses on “Mathematical Methods in Applied Sciences,” “Statistical Methods for Applied Sciences,” “Experimental Designs,” “Sampling Techniques,” “Applied Regression Analysis” and “Data Analysis Using Statistical Packages” have been introduced for students of agricultural sciences discipline.

Bio- Statistics

M. Sc. Programme

- The course on “Mathematical Methods” has been divided into two courses by strengthening the course content as “Mathematical Methods – I” and “Mathematical Methods –II.”
- The course on “Non-linear Statistical Modeling” has been dropped.
- Six new courses on “Mathematical Methods Useful for Applied Sciences,” “Statistical Methods for Applied Sciences,” “Experimental Designs,” “Sampling Techniques,” “Applied Regression Analysis” and “Data Analysis Using Statistical Packages” have been introduced for students of animal sciences discipline.

Computer Application

M. Sc. Programme

- The course on “Discrete Mathematics” has been restructured and renamed as “Mathematical Foundations in Computer Science”.
- Course on “System Analysis and Design” has been dropped from the curricula. The course on “Software Engineering” has been modified accordingly.
- Course on “Data and File Structures” has been dropped and the course content has been included in the existing course on “Design and Analysis of Algorithms” that has been renamed as “Data Structures and Algorithms.”
- Courses on “Data Analysis Using Statistical Software” and “Management Information System” have been dropped.
- Course on “Recent Trends and Emerging Programming Paradigms” has been restructured as “Web Technologies and Applications” and made a core course.
- New courses on “Bioinformatics Computing,” “Soft Computing” and “Information Security” have been introduced.
- New courses on “Computers Fundamentals and Programming” and “Introduction to Networking and Internet Applications” have been introduced for students of agricultural sciences discipline.

ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level. A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
- Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	36	18
Minor	09	08
Supporting	05	05
Seminar	01	02
Research	10	45
Total Credits	61	78
Compulsory Non Credit Courses	See relevant section	

Major subject: The subject (department) in which the students takes admission.

Minor subject: The subject closely related to students major subject (e.g., if the major subject is Entomology, the appropriate minor subjects should be Plant Pathology & Nematology).

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's programme. Ph. D. students may be exempted from these courses if already studied during Master's degree.

STATISTICS / AGRICULTURAL STATISTICS

Course Structure – at a Glance

1. Service Courses (For M.Sc. and Ph.D. programs of other disciplines)

CODE	COURSE TITLE	CREDITS
STAT 501	MATHEMATICAL METHODS FOR APPLIED SCIENCES	2+0
STAT 511	STATISTICAL METHODS FOR APPLIED SCIENCES	3+1
STAT 512	EXPERIMENTAL DESIGNS	2+1
STAT 513	SAMPLING TECHNIQUES	2+1
STAT 521	APPLIED REGRESSION ANALYSIS	2+1
STAT 531	DATA ANALYSIS USING STATISTICAL PACKAGES	2+1

2. M. Sc. (Statistics / Agricultural Statistics)

STAT 551	MATHEMATICAL METHODS - I	3+0
STAT 552	MATHEMATICAL METHODS - II	2+0
STAT 560	PROBABILITY THEORY	2+0
STAT 561	STATISTICAL METHODS	2+1
STAT 562	STATISTICAL INFERENCE	2+1
STAT 563	MULTIVARIATE ANALYSIS	2+1
STAT 564	DESIGN OF EXPERIMENTS	2+1
STAT 565	SAMPLING TECHNIQUES	2+1
STAT 566	STATISTICAL GENETICS	2+1
STAT 567	REGRESSION ANALYSIS	1+1
STAT 568	STATISTICAL COMPUTING	1+1
STAT 569	TIME SERIES ANALYSIS	1+1
STAT 570	ACTUARIAL STATISTICS	2+0
STAT 571	BIOINFORMATICS	2+0
STAT 572	ECONOMETRICS	2+0
STAT 573	STATISTICAL QUALITY CONTROL	2+0
STAT 574	OPTIMIZATION TECHNIQUES	1+1
STAT 575	DEMOGRAPHY	2+0
STAT 576	STATISTICAL METHODS FOR LIFE SCIENCES	2+0
STAT 577	STATISTICAL ECOLOGY	2+0
STAT 591	MASTER'S SEMINAR	1+0
STAT 599	MASTER'S RESEARCH	10+0

NOTE:

1. STAT 551 and STAT 552 are supporting courses. These are compulsory for all the students of Statistics / Agricultural Statistics.
2. STAT 560 - STAT 569 are core courses to be taken by all the students of Statistics / Agricultural Statistics.
3. STAT 591 and STAT 599 are compulsory for all the students of Statistics / Agricultural Statistics.
4. A student has to take a minimum of 36 credits course work, excluding the supporting courses, seminar and research.

3. Ph. D. (Statistics / Agricultural Statistics)

STAT 601	ADVANCED STATISTICAL COMPUTING	2+1
STAT 602	SIMULATION TECHNIQUES	1+1
STAT 611	ADVANCED STATISTICAL METHODS	2+0
STAT 612	ADVANCED STATISTICAL INFERENCE	3+0
STAT 613	ADVANCED DESIGN OF EXPERIMENTS	2+0
STAT 614	ADVANCED SAMPLING TECHNIQUES	2+0
STAT 615	ADVANCED STATISTICAL GENETICS	2+0
STAT 616	STATISTICAL MODELING	1+1
STAT 617	ADVANCED TIME SERIES ANALYSIS	2+0
STAT 618	STOCHASTIC PROCESSES	2+0
STAT 619	SURVIVAL ANALYSIS	2+0
STAT 620	ADVANCED BIOINFORMATICS	2+0
STAT 621	ADVANCED ECONOMETRICS	2+0
STAT 651	RECENT ADVANCES IN THE FIELD OF SPECIALIZATION	1+0
STAT 691	DOCTORAL SEMINAR I	1+0
STAT 692	DOCTORAL SEMINAR II	1+0
STAT 699	DOCTORAL RESEARCH	45+0

NOTE:

1. STAT 601 and STAT 602 are supporting courses. These are compulsory for all the students of Statistics / Agricultural Statistics.
2. STAT 691, STAT 692, STAT 651 and STAT 699 are compulsory for all the students of Statistics / Agricultural Statistics.
3. A student has to take a minimum of 18 credits course work, excluding the supporting courses, seminar and research.
4. A student has to take two seminars.

STATISTICS / AGRICULTURAL STATISTICS

Course Contents

STAT 501/ **MATHEMATICAL METHODS FOR** **2+0**
BST 501 **APPLIED SCIENCES**

Objective

This course is meant for students who do not have sufficient background of Mathematics. The students would be exposed to elementary mathematics that would prepare them to study their main courses that involve knowledge of Mathematics. The students would get an exposure to differentiation, integration and differential equation.

Theory

UNIT I

Variables and functions; limit and continuity. Specific functions. Differentiation: theorems of differentiation, differentiation of logarithmic, trigonometric, exponential and inverse functions, function of a function, derivative of higher order, partial derivatives. Application of derivatives in agricultural research; determination of points of inflexion, maxima and minima in optimization, etc.

UNIT II

Integration as a reverse process of differentiation, methods of integration, reduction formulae, definite integral; Applications of integration in agricultural research with special reference to economics and genetics, engineering, etc.

UNIT III

Vectors and vector spaces, Matrices, notations and operations, laws of matrix algebra; transpose and inverse of matrix; Eigen values and eigen vectors. Determinants - evaluation and properties of determinants, application of determinants and matrices in solution of equation for economic analysis.

UNIT IV

Set theory-set operations, finite and infinite sets, operations of set, function defined in terms of sets.

Suggested Readings

Harville DA. 1997. *Matrix Algebra from a Statistician's Perspective*. Springer.

Hohn FE. 1973. *Elementary Matrix Algebra*. Macmillan.

Searle SR. 1982. *Matrix Algebra Useful for Statistics*. John Wiley.

Stewart J. 2007. *Calculus*. Thompson.

Thomas GB. Jr. & Finney RL. 1996. *Calculus*. 9th Ed. Pearson Edu.

STAT 511 / **STATISTICAL METHODS FOR** **3+1**
BST 511 **APPLIED SCIENCES**

Objective

This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and

interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Classification, tabulation and graphical representation of data. Box-plot, Descriptive statistics. Exploratory data analysis; Theory of probability. Random variable and mathematical expectation.

UNIT II

Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Large sample theory.

UNIT III

Introduction to theory of estimation and confidence-intervals. Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination. Polynomial regression models and their fitting.

Probit regression analysis by least squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.

UNIT IV

Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

UNIT V

Introduction to multivariate analytical tools- Hotelling's T^2 Tests of hypothesis about the mean vector of a multinormal population. Classificatory problems and discriminant function, D^2 -statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.

Practical

Exploratory data analysis, Box-Cox plots; Fitting of distributions \sim Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions \sim chi square, t and F ; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Non-parametric tests.

Suggested Readings

Anderson TW. 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley.

Dillon WR & Goldstein M. 1984. *Multivariate Analysis - Methods and*

Applications. John Wiley.
 Goon AM, Gupta MK & Dasgupta B. 1977. *An Outline of Statistical Theory*. Vol. I. The World Press.
 Goon AM, Gupta MK & Dasgupta B. 1983. *Fundamentals of Statistics*. Vol. I. The World Press.
 Hoel PG. 1971. *Introduction to Mathematical Statistics*. John Wiley.
 Hogg RV & Craig TT. 1978. *Introduction to Mathematical Statistics*. Macmillan.
 Morrison DF. 1976. *Multivariate Statistical Methods*. McGraw Hill.
 Siegel S, Johan N & Casellan Jr. 1956. *Non-parametric Tests for Behavior Sciences*. John Wiley.
 Learning Statistics: <http://freestatistics.altervista.org/en/learning.php>.
 Electronic Statistics Text Book:
<http://www.statsoft.com/textbook/stathome.html>.

**STAT 512 /
 BST 512**

EXPERIMENTAL DESIGNS

2+1

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

UNIT II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design - concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

Practical

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD; Analysis of

factorial experiments without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces.

Suggested Readings

Cochran WG & Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
Federer WT. 1985. *Experimental Designs*. MacMillan.
Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
Nigam AK & Gupta VK. 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.
Pearce SC. 1983. *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley.
Design Resources Server: www.iasri.res.in/design.

**STAT 513/
BST 513**

SAMPLING TECHNIQUES

2+1

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. The students would be exposed to elementary sampling techniques. It would help them in understanding the concepts involved in planning and designing their surveys, presentation of survey data analysis of survey data and presentation of results. This course would be especially important to the students of social sciences.

Theory

UNIT I

Concept of sampling, sample survey vs complete enumeration, planning of sample survey, sampling from a finite population.

UNIT II

Simple random sampling, sampling for proportion, determination of sample size; inverse sampling, Stratified sampling.

UNIT III

Cluster sampling, PPS sampling, Multi-stage sampling, double sampling, systematic sampling; Use of auxiliary information at estimation as well as selection stages.

UNIT IV

Ratio and regression estimators. Construction and analysis of survey designs, sampling and non-sampling errors; Preparation of questionnaire Non-sampling errors.

Practical

Random sampling ~ use of random number tables, concepts of unbiasedness, variance, etc.; simple random sampling, determination of sample size; Exercises on inverse sampling, stratified sampling, cluster sampling and systematic sampling; Estimation using ratio and regression estimators; Estimation using multistage design, double sampling and PPS sampling.

Suggested Readings

Cochran WG. 1977. *Sampling Techniques*. John Wiley.
Murthy MN. 1977. *Sampling Theory and Methods*. 2nd Ed. Statistical Publ. Soc., Calcutta.
Singh D, Singh P & Kumar P. 1982. *Handbook on Sampling Methods*.

IASRI Publ.

Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984. *Sampling Theory of Surveys with Applications*. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.

**STAT 521/
BST 521**

APPLIED REGRESSION ANALYSIS

2+1

Objective

This course is meant for students of all disciplines including agricultural and animal sciences. The students would be exposed to the concepts of correlation and regression. Emphasis will be laid on diagnostic measures such as autocorrelation, multicollinearity and heteroscedasticity. This course would prepare students to handle their data for analysis and interpretation.

Theory

UNIT I

Introduction to correlation analysis and its measures; Correlation from grouped data, Biserial correlation, Rank correlation; Testing of population correlation coefficients; Multiple and partial correlation coefficients and their testing.

UNIT II

Problem of correlated errors; Auto correlation; Durbin Watson Statistics; Removal of auto correlation by transformation; Analysis of collinear data; Detection and correction of multicollinearity; Regression analysis; Method of least squares for curve fitting; Testing of regression coefficients; Multiple and partial regressions.

UNIT III

Examining the multiple regression equation; Concept of weighted least squares; regression equation on grouped data; Various methods of selecting the best regression equation; regression approach applied to analysis of variance in one way classification.

UNIT IV

Heteroscedastic models, Concept of nonlinear regression and fitting of quadratic, exponential and power curves; Economic and optimal dose, Orthogonal polynomial.

Practical

Correlation coefficient, various types of correlation coefficients, partial and multiple, testing of hypotheses; Multiple linear regression analysis, partial regression coefficients, testing of hypotheses, residuals and their applications in outlier detection; Handling of correlated errors, multicollinearity; Fitting of quadratic, exponential and power curves, fitting of orthogonal polynomials.

Suggested Readings

Draper NR & Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.

Ezekiel M. 1963. *Methods of Correlation and Regression Analysis*. John Wiley.

Kleinbaum DG, Kupper LL, Muller KE & Nizam A. 1998. *Applied Regression Analysis and Multivariable Methods*. Duxbury Press.

Koutsoyiannis A. 1978. *Theory of Econometrics*. MacMillan.

Kutner MH, Nachtsheim CJ & Neter J. 2004. *Applied Linear Regression Models*. 4th Ed. With Student CD. McGraw Hill.

**STAT 531/
BST 531**

**DATA ANALYSIS USING
STATISTICAL PACKAGES**

2+1

Objective

This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students an hands on experience in the analysis of their research data. This course is useful to all disciplines.

Theory

UNIT I

Use of Software packages for: Summarization and tabulation of data; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

UNIT II

Fitting and testing the goodness of fit of discrete and continuous probability distributions; Testing of hypothesis based on large sample test statistics; Testing of hypothesis using chi-square, t and F statistics.

UNIT III

Concept of analysis of variance and covariance of data for single factor, multi-factor, one-way and multi-classified experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

UNIT IV

Analysis of mixed models; Estimation of variance components; Testing the significance of contrasts; Correlation and regression including multiple regression.

UNIT V

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Time series data; Spatial analysis; Neural networks.

Practical

Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data. Robust Estimation, Testing linearity and normality assumption, Estimation of trimmed means etc., Cross tabulation of data including its statistics, cell display and table format and means for different sub-classifications; Fitting and testing the goodness of fit of probability distributions; Testing the hypothesis for one sample t -test, two sample t -test, paired t -test, test for large samples - Chi-squares test, F test, One way analysis of variance, contrast and its testing, pairwise comparisons; Multiway classified analysis of variance - cross-classification, nested classification, factorial set up, fixed effect models, random effect models, mixed effect models, estimation of variance components; Generalized linear models - analysis of unbalanced data sets, testing and significance of contrasts, Estimation of variance components in unbalanced data sets - maximum likelihood, ANOVA, REML, MINQUE; Bivariate and partial correlation, Distances - to obtain a distance matrix, dissimilarity measures, similarity measures; Linear regression, Multiple regression, Regression plots, Variable selection, Regression statistics, Fitting of growth models - curve estimation models,

examination of residuals; Discriminant analysis - fitting of discriminant functions, identification of important variables, Factor analysis. Principal component analysis - obtaining principal component, spectral composition; Analysis of time series data - fitting of ARIMA models, working out moving averages. Spatial analysis; Neural networks.

Suggested Readings

- Anderson CW & Loynes RM. 1987. *The Teaching of Practical Statistics*. John Wiley.
- Atkinson AC. 1985. *Plots Transformations and Regression*. Oxford University Press.
- Chambers JM, Cleveland WS, Kleiner B & Tukey PA. 1983. *Graphical Methods for Data Analysis*. Wadsworth, Belmont, California.
- Chatfield C & Collins AJ. 1980. *Introduction to Multivariate Analysis*. Chapman & Hall.
- Chatfield C. 1983. *Statistics for Technology*. 3rd Ed. Chapman & Hall.
- Chatfield C. 1995. *Problem Solving: A Statistician's Guide*. Chapman & Hall.
- Cleveland WS. 1985. *The Elements of Graphing Data*. Wadsworth, Belmont, California.
- Ehrenberg ASC. 1982. *A Primer in Data Reduction*. John Wiley.
- Erickson BH & Nosanchuk TA. 1992. *Understanding Data*. 2nd Ed. Open University Press, Milton Keynes.
- Snell EJ & Simpson HR. 1991. *Applied Statistics: A Handbook of GENSTAT Analyses*. Chapman & Hall.
- Sprent P. 1993. *Applied Non-parametric Statistical Methods*. 2nd Ed. Chapman & Hall.
- Tufte ER. 1983. *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, Conn.
- Velleman PF & Hoaglin DC. 1981. *Application, Basics and Computing of Exploratory Data Analysis*. Duxbury Press.
- Weisberg S. 1985. *Applied Linear Regression*. John Wiley.
- Wetherill GB. 1982. *Elementary Statistical Methods*. Chapman & Hall.
- Wetherill GB. 1986. *Regression Analysis with Applications*. Chapman & Hall.
- Learning Statistics: <http://freestatistics.altervista.org/en/learning.php>.
- Free Statistical Softwares: <http://freestatistics.altervista.org/en/stat.php>.
- Statistics Glossary http://www.cas.lancs.ac.uk/glossary_v1.1/main.html.
- Course on Experimental design:
<http://www.stat.sc.edu/~grego/courses/stat706/>.
- Design Resources Server: www.iasri.res.in/design.
- Analysis of Data: Design Resources Server.
<http://www.iasri.res.in/design/Analysis%20of%20data/Analysis%20of%20Data.html>.

**STAT 551/
BST 551**

MATHEMATICAL METHODS – I

3+0

Objective

This course lays the foundation of all other courses of Statistics / Agricultural Statistics discipline by preparing them to understand the importance of mathematical methods in research. The students would be

exposed to the basic mathematical tools of real analysis, calculus, differential equations and numerical analysis. This would prepare them to study their main courses that involve knowledge of Mathematics.

Theory

UNIT I

Real Analysis: Convergence and divergence of infinite series, use of comparison tests -D'Alembert's Ratio - test, Cauchy's nth root test, Raabe's test, Kummer's test, Gauss test. Absolute and conditional convergence. Riemann integration, concept of Lebesgue integration, power series, Fourier, Laplace and Laplace -Steiltjes' transformation, multiple integrals.

UNIT II

Calculus: Limit and continuity, differentiation of functions, successive differentiation, partial differentiation, mean value theorems, Taylor and Maclaurin's series. Application of derivatives, L'hospital's rule. Integration of rational, irrational and trigonometric functions. Application of integration.

UNIT III

Differential equation: Differential equations of first order, linear differential equations of higher order with constant coefficient.

UNIT IV

Numerical Analysis: Simple interpolation, Divided differences, Numerical differentiation and integration.

Suggested Readings

- Bartle RG. 1976. *Elements of Real Analysis*. John Wiley.
Chatterjee SK. 1970. *Mathematical Analysis*. Oxford & IBH.
Gibson GA. 1954. *Advanced Calculus*. Macmillan.
Henrice P. 1964. *Elements of Numerical Analysis*. John Wiley.
Hildebrand FB. 1956. *Introduction to Numerical Analysis*. Tata McGraw Hill.
Priestley HA. 1985. *Complex Analysis*. Clarenton Press.
Rudin W. 1985. *Principles of Mathematical Analysis*. McGraw Hill.
Sauer T. 2006. *Numerical Analysis With CD-Rom*. Addison Wesley.
Scarborough JB. 1976. *Numerical Mathematical Analysis*. Oxford & IBH.
Stewart J. 2007. *Calculus*. Thompson.
Thomas GB Jr. & Finney RL. 1996. *Calculus*. 9th Ed. Pearson Edu.

**STAT 552/
BST 552**

MATHEMATICAL METHODS – II

2+0

Objective

This is another course that supports all other courses in Statistics / Agricultural Statistics. The students would be exposed to the advances in Linear Algebra and Matrix theory. This would prepare them to study their main courses that involve knowledge of Linear Algebra and Matrix Algebra.

Theory

UNIT I

Linear Algebra: Group, ring, field and vector spaces, Sub-spaces, basis, Gram Schmidt's orthogonalization, Galois field - Fermat's theorem and

primitive elements. Linear transformations. Graph theory: Concepts and applications

UNIT II

Matrix Algebra: Basic terminology, linear independence and dependence of vectors. Row and column spaces, Echelon form. Determinants, rank and inverse of matrices. Special matrices – idempotent, symmetric, orthogonal. Eigen values and eigen vectors. Spectral decomposition of matrices

UNIT III

Unitary, Similar, Hadamard, Circulant, Helmert's matrices. Kronecker and Hadamard product of matrices, Kronecker sum of matrices. Sub-matrices and partitioned matrices, Permutation matrices, full rank factorization, Gramian root of a symmetric matrix. Solutions of linear equations, Equations having many solutions.

UNIT IV

Generalized inverses, Moore-Penrose inverse, Applications of g-inverse. Spectral decomposition of matrices, Inverse and Generalized inverse of partitioned matrices, Differentiation and integration of matrices, Quadratic forms.

Suggested Readings

- Aschbacher M. 2000. *Finite Group Theory*. Cambridge University Press.
Deo N. 1984. *Graph Theory with Application to Engineering and Computer Science*. Prentice Hall of India.
Gentle JE. 2007. *Matrix Algebra: Theory, Computations and Applications in Statistics*. Springer.
Graybill FE. 1961. *Introduction to Matrices with Applications in Statistics*. Wadsworth Publ.
Hadley G. 1969. *Linear Algebra*. Addison Wesley.
Harville DA. 1997. *Matrix Algebra from a Statistician's Perspective*. Springer.
Rao CR. 1965. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.
Robinson DJS. 1991. *A Course in Linear Algebra with Applications*. World Scientific.
Searle SR. 1982. *Matrix Algebra Useful for Statistics*. John Wiley.
Seber GAF. 2008. *A Matrix Handbook for Statisticians*. John Wiley.

**STAT 560/
BST 560**

PROBABILITY THEORY

2+0

Objective

This is a fundamental course in Statistics. This course lays the foundation of probability theory, random variable, probability distribution, mathematical expectation, etc. which forms the basis of basic statistics. The students are also exposed to law of large numbers and central limit theorem. The students also get introduced to stochastic processes.

Theory

UNIT I

Basic concepts of probability. Elements of measure theory: class of sets, field, sigma field, minimal sigma field, Borel sigma field in R, measure, probability measure. Axiomatic approach to probability. Properties of probability based on axiomatic definition. Addition and multiplication

theorems. Conditional probability and independence of events. Bayes theorem.

UNIT II

Random variables: definition of random variable, discrete and continuous, functions of random variables. Probability mass function and Probability density function, Distribution function and its properties. Notion of bivariate random variables, bivariate distribution function and its properties. Joint, marginal and conditional distributions. Independence of random variables. Transformation of random variables (two dimensional case only).

Mathematical expectation: Mathematical expectation of functions of a random variable. Raw and central moments and their relation, covariance, skewness and kurtosis. Addition and multiplication theorems of expectation. Definition of moment generating function, cumulating generating function, probability generating function and statements of their properties.

UNIT III

Conditional expectation and conditional variance. Characteristic function and its properties. Inversion and uniqueness theorems. Functions, which cannot be characteristic functions.

Chebyshev, Markov, Cauchy-Schwartz, Jensen, Liapounov, holder's and Minkowsky's inequalities. Sequence of random variables and modes of convergence (convergence in distribution, in probability, almost surely, and quadratic mean) and their interrelations. Statement of Slutsky's theorem. Borel –Cantelli lemma and Borel 0-1 law.

UNIT IV

Laws of large numbers: WLLN, Bernoulli and Kintchin's WLLN. Kolmogorov inequality, Kolmogorov's SLLNs.

Central Limit theorems: Demoviere- Laplace CLT, Lindberg – Levy CLT, Liapounov CLT, Statement of Lindeberg-Feller CLT and simple applications. Definition of quantiles and statement of asymptotic distribution of sample quantiles.

UNIT V

Classification of Stochastic Processes, Examples. Markov Chain and classification of states of Markov Chain.

Suggested Readings

- Ash RB. 2000. *Probability and Measure Theory*. 2nd Ed. Academic Press.
- Billingsley P. 1986. *Probability and Measure*. 2nd Ed. John Wiley.
- Capinski M & Zastawniah. 2001. *Probability Through Problems*. Springer.
- Dudewicz EJ & Mishra SN. 1988. *Modern Mathematical Statistics*. John Wiley.
- Feller W. 1972. *An Introduction to Probability Theory and its Applications*. Vols. I., II. John Wiley.
- Loeve M. 1978. *Probability Theory*. 4th Ed. Springer.
- Marek F. 1963. *Probability Theory and Mathematical Statistics*. John Wiley.
- Rohatgi VK & Saleh AK Md. E. 2005. *An Introduction to Probability and Statistics*. 2nd Ed. John Wiley.

Objective

This course lays the foundation of probability distributions and sampling distributions and their application which forms the basis of Statistical Inference. Together with probability theory, this course is fundamental to the discipline of Statistics. The students are also exposed to correlation and regression, and order statistics and their distributions. Categorical data analysis is also covered in this course.

Theory

UNIT I

Descriptive statistics: probability distributions: Discrete probability distributions ~ Bernoulli, Binomial, Poisson, Negative-binomial, Geometric and Hyper Geometric, uniform, multinomial ~ Properties of these distributions and real life examples. Continuous probability distributions ~ rectangular, exponential, Cauchy, normal, gamma, beta of two kinds, Weibull, lognormal, logistic, Pareto. Properties of these distributions. Probability distributions of functions of random variables.

UNIT II

Concepts of compound, truncated and mixture distributions (definitions and examples). Pearsonian curves and its various types. Sampling distributions of sample mean and sample variance from Normal population, central and non-central chi-Square, t and F distributions, their properties and inter relationships.

UNIT III

Concepts of random vectors, moments and their distributions. Bivariate Normal distribution - marginal and conditional distributions. Distribution of quadratic forms. Cochran theorem. Correlation, rank correlation, correlation ratio and intra-class correlation. Regression analysis, partial and multiple correlation and regression.

UNIT IV

Sampling distribution of correlation coefficient, regression coefficient, correlation ratio, intra class correlation coefficient. Categorical data analysis - loglinear models, Association between attributes. Variance Stabilizing Transformations.

UNIT V

Order statistics, distribution of r -th order statistics, joint distribution of several order statistics and their functions, marginal distributions of order statistics, distribution of range, median, etc.

Practical

Fitting of discrete distributions and test for goodness of fit; Fitting of continuous distributions and test for goodness of fit; Fitting of truncated distribution; Computation of simple, multiple and partial correlation coefficient, correlation ratio and intra-class correlation; Regression coefficients and regression equations; Fitting of Pearsonian curves; Analysis of association between attributes, categorical data and log-linear models.

Suggested Readings

Agresti A. 2002. *Categorical Data Analysis*. 2nd Ed. John Wiley.

- Arnold BC, Balakrishnan N & Nagaraja HN. 1992. *A First Course in Order Statistics*. John Wiley.
- David HA & Nagaraja HN. 2003. *Order Statistics*. 3rd Ed. John Wiley.
- Dudewicz EJ & Mishra SN. 1988. *Modern Mathematical Statistics*. John Wiley.
- Huber PJ. 1981. *Robust Statistics*. John Wiley.
- Johnson NL, Kotz S & Balakrishnan N. 2000. *Continuous Univariate Distributions*. John Wiley.
- Johnson NL, Kotz S & Balakrishnan N. 2000. *Discrete Univariate Distributions*. John Wiley.
- Marek F. 1963. *Probability Theory and Mathematical Statistics*. John Wiley.
- Rao CR. 1965. *Linear Statistical Inference and its Applications*. John Wiley.
- Rohatgi VK & Saleh AK Md. E. 2005. *An Introduction to Probability and Statistics*. 2nd Ed. John Wiley.

**STAT 562/
BST 562**

STATISTICAL INFERENCE

2+1

Objective

This course lays the foundation of Statistical Inference. The students would be taught the problems related to point and confidence interval estimation and testing of hypothesis. They would also be given the concepts of nonparametric and sequential test procedures and elements of decision theory.

Theory

UNIT I

Concepts of point estimation: MSE, unbiasedness, consistency, efficiency and sufficiency. Statement of Neyman's Factorization theorem with applications. MVUE, Rao-Blackwell theorem, completeness, Lehmann-Scheffe theorem. Fisher information, Cramer-Rao lower bound and its applications.

UNIT II

Moments, minimum chi-square, least square and maximum likelihood methods of estimation and statements of their properties. Interval estimation-Confidence level, CI using pivots and shortest length CI. CI for the parameters of Normal, Exponential, Binomial and Poisson distributions.

UNIT III

Fundamental notions of hypothesis testing-statistical hypothesis, statistical test, critical region, types of errors, test function, randomized and non-randomized tests, level of significance, power function, most powerful tests: Neyman-Pearson fundamental lemma, MLR families and UMP tests for one parameter exponential families. Concepts of consistency, unbiasedness and invariance of tests. Likelihood Ratio tests, statement of asymptotic properties of LR tests with applications (including homogeneity of means and variances).Relation between confidence interval estimation and testing of hypothesis.

UNIT IV

Notions of sequential vs fixed sample size techniques. Wald's SPRT for testing simple null hypothesis vs simple alternative. Termination property

of SPRT, SPRT for Binomial, Poisson, Normal and Exponential distributions. Concepts of loss, risk and decision functions, admissible and optimal decision functions, estimation and testing viewed as decision problems, conjugate families, Bayes and Minimax decision functions with applications to estimation with quadratic loss.

UNIT V

Non-parametric tests: Sign test, Wilcoxon signed rank test, Runs test for randomness, Kolmogorov – Smirnov test for goodness of fit, Median test and Wilcoxon-Mann-Whitney U-test. Chi-square test for goodness of fit and test for independence of attributes. Kruskal –Wallis and Friedman’s tests. Spearman’s rank correlation and Kendall’s Tau tests for independence.

Practical

Methods of estimation - Maximum Likelihood, Minimum χ^2 and Moments; Confidence Interval Estimation; MP and UMP tests; Large Sample tests; Non-parametric tests, Sequential Probability Ratio Test; Decision functions.

Suggested Readings

- Box GEP & Tiao GC. 1992. *Bayesian Inference in Statistical Analysis*. John Wiley.
- Casela G & Berger RL. 2001. *Statistical Inference*. Duxbury Thompson Learning.
- Christensen R. 1990. *Log Linear Models*. Springer.
- Conover WJ. 1980. *Practical Nonparametric Statistics*. John Wiley.
- Dudewicz EJ & Mishra SN. 1988. *Modern Mathematical Statistics*. John Wiley.
- Gibbons JD. 1985. *Non Parametric Statistical Inference*. 2nd Ed. Marcel Dekker.
- Kiefer JC. 1987. *Introduction to Statistical Inference*. Springer.
- Lehmann EL. 1986. *Testing Statistical Hypotheses*. John Wiley.
- Lehmann EL. 1986. *Theory of Point Estimation*. John Wiley.
- Randles RH & Wolfe DS. 1979. *Introduction to the Theory of Nonparametric Statistics*. John Wiley.
- Rao CR. 1973. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.
- Rohatgi VK & Saleh AK. Md. E. 2005. *An Introduction to Probability and Statistics*. 2nd Ed. John Wiley.
- Rohtagi VK. 1984. *Statistical Inference*. John Wiley
- Sidney S & Castellan NJ Jr. 1988. *Non Parametric Statistical Methods for Behavioral Sciences*. McGraw Hill.
- Wald A. 2004. *Sequential Analysis*. Dover Publ.

**STAT 563 /
BST 563**

MULTIVARIATE ANALYSIS

2+1

Objective

This course lays the foundation of Multivariate data analysis. Most of the data sets in agricultural sciences are multivariate in nature. The exposure provided to multivariate data structure, multinomial and multivariate normal distribution, estimation and testing of parameters, various data

reduction methods would help the students in having a better understanding of agricultural research data, its presentation and analysis.

Theory

UNIT I

Concept of random vector, its expectation and Variance-Covariance matrix. Marginal and joint distributions. Conditional distributions and Independence of random vectors. Multinomial distribution. Multivariate Normal distribution, marginal and conditional distributions. Sample mean vector and its distribution. Maximum likelihood estimates of mean vector and dispersion matrix. Tests of hypothesis about mean vector.

UNIT II

Wishart distribution and its simple properties. Hotelling's T^2 and Mahalanobis D^2 statistics. Null distribution of Hotelling's T^2 . Rao's U statistics and its distribution.

Wilks' λ criterion and statement of its properties. Concepts of discriminant analysis, computation of linear discriminant function, classification between k (≥ 2) multivariate normal populations based on LDF and Mahalanobis D^2 .

UNIT III

Principal Component Analysis, factor analysis (simple and multi factor models). Canonical variables and canonical correlations. Cluster analysis, similarities and dissimilarities, Hierarchical clustering. Single and Complete linkage methods.

UNIT IV

Path analysis and computation of path coefficients, introduction to multidimensional scaling, some theoretical results, similarities, metric and non metric scaling methods. Concepts of analysis of categorical data.

Practical

Maximum likelihood estimates of mean-vector and dispersion matrix; Testing of hypothesis on mean vectors of multivariate normal populations; Cluster analysis, Discriminant function, Canonical correlation, Principal component analysis, Factor analysis; Multivariate analysis of variance and covariance, multidimensional scaling.

Suggested Readings

- Anderson TW. 1984. *An Introduction to Multivariate Statistical Analysis*. 2nd Ed. John Wiley.
- Arnold SF. 1981. *The Theory of Linear Models and Multivariate Analysis*. John Wiley.
- Giri NC. 1977. *Multivariate Statistical Inference*. Academic Press.
- Johnson RA & Wichern DW. 1988. *Applied Multivariate Statistical Analysis*. Prentice Hall.
- Kshirsagar AM. 1972. *Multivariate Analysis*. Marcel Dekker.
- Muirhead RJ. 1982. *Aspects of Multivariate Statistical Theory*. John Wiley.
- Rao CR. 1973. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.
- Rencher AC. 2002. *Methods of Multivariate Analysis*. 2nd Ed. John Wiley.
- Srivastava MS & Khatri CG. 1979. *An Introduction to Multivariate Statistics*. North Holland.

Objective

Design of Experiments provides the statistical tools to get maximum information from least amount of resources. This course is meant to expose the students to the basic principles of design of experiments. The students would also be provided with mathematical background of various basic designs involving one-way and two way elimination of heterogeneity and their characterization properties. This course would also prepare the students in deriving the expressions for analysis of experimental data.

Theory

UNIT I

Elements of linear estimation, Gauss Markoff Theorem, relationship between BLUEs and linear zero-functions. Aitken's transformation, test of hypothesis, analysis of variance, partitioning of degrees of freedom.

UNIT II

Orthogonality, contrasts, mutually orthogonal contrasts, analysis of covariance; Basic principles of design of experiments, uniformity trials, size and shape of plots and blocks.

UNIT III

Basic designs - completely randomized design, randomized complete block design and Latin square design; orthogonal Latin squares, mutually orthogonal Latin squares (MOLS), Youden square designs, Graeco Latin squares.

UNIT IV

Balanced incomplete block (BIB) designs – general properties and analysis without and with recovery of intra block information, construction of BIB designs. Partially balanced incomplete block designs with two associate classes - properties, analysis and construction, Lattice designs, alpha designs, cyclic designs, augmented designs, general analysis of block designs.

UNIT V

Factorial experiments, confounding in symmetrical factorial experiments (2^n and 3^n series), partial and total confounding, fractional factorials, asymmetrical factorials.

UNIT VI

Designs for fitting response surface; Cross-over designs. Missing plot technique; Split plot and Strip plot design; Groups of experiments; Sampling in field experiments.

Practical

Determination of size and shape of plots and blocks from uniformity trials data; Analysis of data generated from completely randomized design, randomized complete block design; Latin square design, Youden square design; Analysis of data generated from a BIB design, lattice design, PBIB designs; 2^n , 3^n factorial experiments without and with confounding; Split and strip plot designs, repeated measurement design; Missing plot techniques, Analysis of covariance; Analysis of Groups of experiments, Analysis of clinical trial experiments. Sampling in field experiments.

Suggested Readings

- Chakrabarti MC. 1962. *Mathematics of Design and Analysis of Experiments*. Asia Publ. House.
- Cochran WG & Cox DR. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Dey A & Mukerjee R. 1999. *Fractional Factorial Plans*. John Wiley.
- Dey A 1986. *Theory of Block Designs*. Wiley Eastern.
- Hall M Jr. 1986. *Combinatorial Theory*. John Wiley.
- John JA & Quenouille MH. 1977. *Experiments: Design and Analysis*. Charles & Griffin.
- Kemphorne, O. 1976. *Design and Analysis of Experiments*. John Wiley.
- Khuri AI & Cornell JA. 1996. *Response Surface Designs and Analysis*. 2nd Ed. Marcel Dekker.
- Kshirsagar AM 1983. *A Course in Linear Models*. Marcel Dekker.
- Montgomery DC. 2005. *Design and Analysis of Experiments*. John Wiley.
- Raghavarao D. 1971. *Construction and Combinatorial Problems in Design of Experiments*. John Wiley.
- Searle SR. 1971. *Linear Models*. John Wiley.
- Street AP & Street DJ. 1987. *Combinatorics of Experimental Designs*. Oxford Science Publ.
- Design Resources Server. *Indian Agricultural Statistics Research Institute(ICAR), New Delhi-110012, India*. www.iasri.res.in/design.

STAT 565 /
BST 565

SAMPLING TECHNIQUES

2+1

Objective

This course is meant to expose the students to the techniques of drawing representative samples from various populations and then preparing them on the mathematical formulations of estimating the population parameters based on the sample data. The students would also be exposed to the real life applications of sampling techniques and estimation of parameters.

Theory

UNIT I

Sample survey vs complete survey, probability sampling, sample space, sampling design, sampling strategy; Inverse sampling; Determination of sample size; Confidence-interval; Simple random sampling, Estimation of population proportion, Stratified random sampling, Number of strata and optimum points of stratification.

UNIT II

Ratio and regression methods of estimation, Cluster sampling, Systematic sampling, Multistage sampling with equal probability, Separate and combined ratio estimator, Double sampling, Successive sampling –two occasions.

UNIT III

Non-sampling errors – sources and classification, Non-response in surveys, Imputation methods, Randomized response techniques, Response errors – interpenetrating sub-sampling.

UNIT IV

Sampling with varying probabilities with and without replacement, PPS sampling, Cumulative method and Lahiri's method of selection, Horvitz-

Thompson estimator, Ordered and unordered estimators, Sampling strategies due to Midzuno-Sen and Rao-Hartley-Cochran. Inclusion probability proportional to size sampling, PPS systematic sampling, Multistage sampling with unequal probabilities, Self weighting design PPS sampling.

UNIT V

Unbiased ratio and regression type estimators, Multivariate ratio and regression type of estimators, Design effect, Bernoulli and Poisson sampling.

Practical

Determination of sample size and selection of sample; Simple random sampling, Inverse sampling, Stratified random sampling, Cluster sampling, systematic sampling; Ratio and regression methods of estimation; Double sampling, multi-stage sampling, Imputation methods; Randomized response techniques; Sampling with varying probabilities.

Suggested Readings

- Cassel CM, Sarndal CE & Wretman JH. 1977. *Foundations of Inference in Survey Sampling*. John Wiley.
- Chaudhari A & Stenger H. 2005. *Survey Sampling Theory and Methods*. 2nd Ed. Chapman & Hall.
- Chaudhari A & Voss JWE. 1988. *Unified Theory and Strategies of Survey Sampling*. North Holland.
- Cochran WG. 1977. *Sampling Techniques*. John Wiley.
- Hedayat AS & Sinha BK. 1991. *Design and Inference in Finite Population Sampling*. John Wiley.
- Kish L. 1965. *Survey Sampling*. John Wiley.
- Murthy MN. 1977. *Sampling Theory and Methods*. 2nd Ed. Statistical Publ. Society, Calcutta.
- Raj D & Chandhok P. 1998. *Sample Survey Theory*. Narosa Publ.
- Sarndal CE, Swensson B & Wretman J. 1992. *Models Assisted Survey Sampling*. Springer.
- Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984. *Sampling Theory of Surveys with Applications*. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.
- Thompson SK. 2000. *Sampling*. John Wiley.

**STAT 566 /
BST 566**

STATISTICAL GENETICS

2+1

Objective

This course is meant to prepare the students in applications of statistics in quantitative genetics and breeding. The students would be exposed to the physical basis of inheritance, detection and estimation of linkage, estimation of genetic parameters and development of selection indices.

Theory

UNIT I

Physical basis of inheritance. Analysis of segregation, detection and estimation of linkage for qualitative characters. Amount of information about linkage, combined estimation, disturbed segregation.

UNIT II

Gene and genotypic frequencies, Random mating and Hardy -Weinberg law, Application and extension of the equilibrium law, Fisher's fundamental theorem of natural selection. Disequilibrium due to linkage for two pairs of genes, sex-linked genes, Theory of path coefficients.

UNIT III

Concepts of inbreeding, Regular system of inbreeding. Forces affecting gene frequency - selection, mutation and migration, equilibrium between forces in large populations, Random genetic drift, Effect of finite population size.

UNIT IV

Polygenic system for quantitative characters, concepts of breeding value and dominance deviation. Genetic variance and its partitioning, Effect of inbreeding on quantitative characters, Multiple allelism in continuous variation, Sex-linked genes, Maternal effects - estimation of their contribution.

UNIT V

Correlations between relatives, Heritability, Repeatability and Genetic correlation. Response due to selection, Selection index and its applications in plants and animals improvement programmes, Correlated response to selection.

UNIT VI

Restricted selection index. Variance component approach and linear regression approach for the analysis of GE interactions. Measurement of stability and adaptability for genotypes. Concepts of general and specific combining ability. Diallel and partial diallel crosses - construction and analysis.

Practical

Test for the single factor segregation ratios, homogeneity of the families with regard to single factor segregation; Detection and estimation of linkage parameter by different procedures; Estimation of genotypic and gene frequency from a given data. Hardy-Weinberg law; Estimation of changes in gene frequency due to systematic forces, inbreeding coefficient, genetic components of variation, heritability and repeatability coefficient, genetic correlation coefficient; Examination of effect of linkage, epistasis and inbreeding on mean and variance of metric traits; Mating designs; Construction of selection index including phenotypic index, restricted selection index. Correlated response to selection.

Suggested Readings

- Bailey NTJ. 1961. *The Mathematical Theory of Genetic Linkage*. Clarendon Press.
- Balding DJ, Bishop M & Cannings C. 2001. *Hand Book of Statistical Genetics*. John Wiley.
- Crow JF & Kimura M. 1970. *An Introduction of Population Genetics Theory*. Harper & Row.
- Dahlberg G. 1948. *Mathematical Methods for Population Genetics*. Inter Science Publ.
- East EM & Jones DF. 1919. *Inbreeding and Outbreeding*. J B Lippincott.
- Ewens WJ. 1979. *Mathematics of Population Genetics*. Springer.
- Falconer DS. 1985. *Introduction to Quantitative Genetics*. ELBL.

- Fisher RA. 1949. *The Theory of Inbreeding*. Oliver & Boyd.
- Fisher RA. 1950. *Statistical Methods for Research Workers*. Oliver & Boyd.
- Fisher RA. 1958. *The Genetical Theory of Natural Selection*. Dover Publ.
- Kempthorne O. 1957. *An Introduction to Genetic Statistics*. The Iowa State Univ. Press.
- Lerner IM. 1950. *Population Genetics and Animal Improvement*. Cambridge Univ. Press.
- Lerner IM. 1954. *Genetic Homeostasis*. Oliver & Boyd.
- Lerner IM. 1958. *The Genetic Theory of Selection*. John Wiley.
- Li CC. 1982. *Population Genetics*. The University of Chicago Press.
- Mather K & Jinks JL. 1977. *Introduction to Biometrical Genetics*. Chapman & Hall.
- Mather K & Jinks JL. 1982. *Biometrical Genetics*. Chapman & Hall.
- Mather K. 1949. *Biometrical Genetics*. Methuen.
- Mather K. 1951. *The Measurement of Linkage in Heredity*. Methuen.
- Narain P. 1990. *Statistical Genetics*. Wiley Eastern.

**STAT 567 /
BST 567**

REGRESSION ANALYSIS

1+1

Objective

This course is meant to prepare the students in linear and non-linear regression methods useful for statistical data analysis. They would also be provided a mathematical foundation behind these techniques and their applications in agricultural data.

Theory

UNIT I

Simple and Multiple linear regressions: Least squares fit, Properties and examples. Polynomial regression: Use of orthogonal polynomials.

UNIT II

Assumptions of regression; diagnostics and transformations; Examination of residuals ~ Studentized residuals, applications of residuals in detecting outliers, identification of influential observations. Lack of fit, Pure error. Testing homoscedasticity and normality of errors, Durbin-Watson test. Use of R^2 for examining goodness of fit.

UNIT III

Concepts of Least median of squares and its applications; Concept of multicollinearity, Analysis of multiple regression models, estimation and testing of regression parameters, sub-hypothesis testing, restricted estimation.

UNIT IV

Weighted least squares method: Properties, and examples. Box-Cox family of transformations. Use of dummy variables, Selection of variables: Forward selection, Backward elimination. Stepwise and Stagewise regressions.

UNIT V

Introduction to non-linear models, nonlinear estimation: Least squares for nonlinear models.

Practical

Multiple regression fitting with three and four independent variables; Estimation of residuals, their applications in outlier detection, distribution of residuals; Test of homoscedasticity, and normality, Box-Cox transformation; Restricted estimation of parameters in the model, hypothesis testing, Step wise regression analysis; Least median of squares norm, Orthogonal polynomial fitting.

Suggested Readings

- Barnett V & Lewis T. 1984. *Outliers in Statistical Data*. John Wiley.
- Belsley DA, Kuh E & Welsch RE. 2004. *Regression Diagnostics- Identifying Influential Data and Sources of Collinearity*. John Wiley.
- Chatterjee S, Hadi A & Price B. 1999. *Regression Analysis by Examples*. John Wiley.
- Draper NR & Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.
- McCullagh P & Nelder JA. 1999. *Generalized Linear Models*. 2nd Ed. Chapman & Hall.
- Montgomery DC, Peck EA & Vining GG. 2003. *Introduction to Linear Regression Analysis*. 3rd Ed. John Wiley.
- Rao CR. 1973. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.

**STAT 568/
BST 568**

STATISTICAL COMPUTING

1+1

Objective

This course is meant for exposing the students in the concepts of computational techniques. Various statistical packages would be used for teaching the concepts of computational techniques.

Theory

UNIT I

Introduction to statistical packages and computing: data types and structures, pattern recognition, classification, association rules, graphical methods. Data analysis principles and practice

UNIT II

ANOVA, regression and categorical data methods; model formulation, fitting, diagnostics and validation; Matrix computations in linear models. Analysis of discrete data.

UNIT III

Numerical linear algebra, numerical optimization, graphical techniques, numerical approximations, numerical integration and Monte Carlo methods.

UNIT IV

Spatial statistics; spatial sampling; hierarchical modeling. Analysis of cohort studies, case-control studies and randomized clinical trials, techniques in the analysis of survival data and longitudinal studies, Approaches to handling missing data, and meta-analysis.

Practical

Data management, Graphical representation of data, Descriptive statistics; General linear models ~ fitting and analysis of residuals, outlier detection;

Categorical data analysis, analysis of discrete data, analysis of binary data; Numerical algorithms; Spatial modeling, cohort studies; Clinical trials, analysis of survival data; Handling missing data.

Suggested Readings

- Agresti A. 2002. *Categorical Data Analysis*. 2nd Ed. John Wiley.
- Everitt BS & Dunn G. 1991. *Advanced Multivariate Data Analysis*. 2nd Ed. Arnold.
- Geisser S. 1993. *Predictive Inference: An Introduction*. Chapman & Hall.
- Gelman A & Hill J. 2006. *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge Univ. Press.
- Gentle JE, Härdle W & Mori Y. 2004. *Handbook of Computational Statistics - Concepts and Methods*. Springer.
- Han J & Kamber M. 2000. *Data Mining: Concepts and Techniques*. Morgan.
- Hastie T, Tibshirani R & Friedman R. 2001. *The Elements of Statistical Learning: Data Mining, Inference and Prediction*. Springer.
- Kennedy WJ & Gentle JE. 1980. *Statistical Computing*. Marcel Dekker.
- Miller RG Jr. 1986. *Beyond ANOVA, Basics of Applied Statistics*. John Wiley.
- Rajaraman V. 1993. *Computer Oriented Numerical Methods*. Prentice-Hall.
- Ross S. 2000. *Introduction to Probability Models*. Academic Press.
- Ryan BF & Joiner BL. 1994. *MINITAB Handbook*. 3rd Ed. Duxbury Press.
- Simonoff JS. 1996. *Smoothing Methods in Statistics*. Springer.
- Snell EJ. 1987. *Applied Statistics: A Handbook of BMDP Analyses*. Chapman & Hall.
- Thisted RA. 1988. *Elements of Statistical Computing*. Chapman & Hall.
- Venables WN & Ripley BD. 1999. *Modern Applied Statistics With S-Plus*. 3rd Ed. Springer.

STAT 569

TIME SERIES ANALYSIS

1+1

Objective

This course is meant to teach the students the concepts involved in time series data. They would also be exposed to components of time series, stationary models and forecasting/ projecting the future scenarios based on time series data. It would also help them in understanding the concepts involved in time series data presentation, analysis and interpretation.

Theory

UNIT I

Components of a time-series. Autocorrelation and Partial autocorrelation functions, Correlogram and periodogram analysis.

UNIT II

Linear stationary models: Autoregressive, Moving average and Mixed processes. Linear non-stationary models: Autoregressive integrated moving average processes.

UNIT III

Forecasting: Minimum mean square forecasts and their properties, Calculating and updating forecasts.

UNIT IV

Model identification: Objectives, Techniques, and Initial estimates. Model estimation: Likelihood function, Sum of squares function, Least squares

estimates. Seasonal models. Intervention analysis models and Outlier detection.

Practical

Time series analysis, autocorrelations, correlogram and periodogram; Linear stationary model; Linear non-stationary model; Model identification and model estimation; Intervention analysis and outliers detection.

Suggested Readings

Box GEP, Jenkins GM & Reinsel GC. 2007. *Time Series Analysis: Forecasting and Control*. 3rd Ed. Pearson Edu.

Brockwell PJ & Davis RA. 2002. *Introduction to Time Series and Forecasting*. 2nd Ed. Springer.

Chatterjee S, Hadi A & Price B.1999. *Regression Analysis by Examples*. John Wiley.

Draper NR & Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.

Johnston J. 1984. *Econometric Methods*. McGraw Hill.

Judge GG, Hill RC, Griffiths WE, Lutkepohl H & Lee TC. 1988. *Introduction to the Theory and Practice of Econometrics*. 2nd Ed. John Wiley.

Montgomery DC & Johnson LA. 1976. *Forecasting and Time Series Analysis*. McGraw Hill.

Shumway RH & Stoffer DS. 2006. *Time Series Analysis and its Applications: With R Examples*. 2nd Ed. Springer.

**STAT 570 /
BST 570**

ACTUARIAL STATISTICS

2+0

Objective

This course is meant to expose to the students to the statistical techniques such as probability models, life tables, insurance and annuities. The students would also be exposed top practical applications of these techniques in computation of premiums that include expenses, general expenses, types of expenses and per policy expenses.

Theory

UNIT I

Insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality.

UNIT II

Life table and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

UNIT III

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions evaluation for special mortality laws. Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations.

UNIT IV

Distribution of aggregate claims, compound Poisson distribution and its applications.

UNIT V

Principles of compound interest: Nominal and effective rates of interest and discount, force of interest and discount, compound interest, accumulation factor, continuous compounding.

UNIT VI

Insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, deferred insurance and varying benefit insurance, recursions, commutation functions.

UNIT VII

Life annuities: Single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, commutation functions, varying annuities, recursions, complete annuities-immediate and apportionable annuities-due.

UNIT VIII

Net premiums: Continuous and discrete premiums, true monthly payment premiums, apportionable premiums, commutation functions, accumulation type benefits. Payment premiums, apportionable premiums, commutation functions, accumulation type benefits. Net premium reserves: Continuous and discrete net premium reserve, reserves on a semi-continuous basis, reserves based on true monthly premiums, reserves on an apportionable or discounted continuous basis, reserves at fractional durations, allocations of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.

UNIT IX

Some practical considerations: Premiums that include expenses-general expenses types of expenses, per policy expenses. Claim amount distributions, approximating the individual model, stop-loss insurance.

Suggested Readings

- Atkinson ME & Dickson DCM. 2000. *An Introduction to Actuarial Studies*. Elgar Publ.
- Bedford T & Cooke R. 2001. *Probabilistic Risk Analysis*. Cambridge.
- Booth PM, Chadburn RG, Cooper DR, Haberman S & James DE. 1999. *Modern Actuarial Theory and Practice*. Chapman & Hall.
- Borowiak Dale S. 2003. *Financial and Actuarial Statistics: An Introduction*. 2003. Marcel Dekker.
- Bowers NL, Gerber HU, Hickman JC, Jones DA & Nesbitt CJ. 1997. *Actuarial Mathematics*. 2nd Ed. Society of Actuaries, Ithaca, Illinois.
- Daykin CD, Pentikainen T & Pesonen M. 1994. *Practical Risk Theory for Actuaries*. Chapman & Hall.
- Klugman SA, Panjer HH, Willmotand GE & Venter GG. 1998. *Loss Models: From data to Decisions*. John Wiley.
- Medina PK & Merino S. 2003. *Mathematical Finance and Probability: A Discrete Introduction*. Basel, Birkhauser.
- Neill A. 1977. *Life Contingencies*. Butterworth-Heinemann.
- Rolski T, Schmidli H, Schmidt V & Teugels J. 1998. *Stochastic Processes for Insurance and Finance*. John Wiley.
- Rotar VI. 2006. *Actuarial Models. The Mathematics of Insurance*. Chapman & Hall/CRC.
- Spurgeon ET. 1972. *Life Contingencies*. Cambridge Univ. Press.

Objective

Bioinformatics is a new emerging area. It is an integration of Statistics, Computer applications and Biology. The trained manpower in the area of Bioinformatics is required for meeting the new challenges in teaching and research in the discipline of Agricultural Sciences. This course is meant to train the students on concepts of basic biology, statistical techniques and computational techniques for understanding bioinformatics principals.

TheoryUNIT I

Basic Biology: Cell, genes, gene structures, gene expression and regulation, Molecular tools, nucleotides, nucleic acids, markers, proteins and enzymes, bioenergetics, single nucleotide polymorphism, expressed sequence tag. Structural and functional genomics: Organization and structure of genomes, genome mapping, assembling of physical maps, strategies and techniques for genome sequencing and analysis.

UNIT II

Computing techniques: OS and Programming Languages – *Linux, perl, bioperl, cgi, MySQL, phpMyAdmin*; Coding for browsing biological databases on web, parsing & annotation of genomic sequences; Database designing; Computer networks – Internet, World wide web, Web browsers – EMBnet, NCBI; Databases on public domain pertaining to Nucleic acid sequences, protein sequences, SNPs, etc.; Searching sequence databases, Structural databases.

UNIT III

Statistical Techniques: MANOVA, Cluster analysis, Discriminant analysis, Principal component analysis, Principal coordinate analysis, Multidimensional scaling; Multiple regression analysis; Likelihood approach in estimation and testing; Resampling techniques – Bootstrapping and Jack-knifing; Hidden Markov Models; Bayesian estimation and Gibbs sampling;

UNIT IV

Tools for Bioinformatics: DNA Sequence Analysis – Features of DNA sequence analysis, Approaches to EST analysis; Pairwise alignment techniques: Comparing two sequences, PAM and BLOSUM, Global alignment (The Needleman and Wunsch algorithm), Local Alignment (The Smith-Waterman algorithm), Dynamic programming, Pairwise database searching; Sequence analysis– BLAST and other related tools, Multiple alignment and database search using motif models, ClustalW, Phylogeny; Databases on SNPs; EM algorithm and other methods to discover common motifs in biosequences; Gene prediction based on Neural Networks, Genetic algorithms, Hidden Markov models. Computational analysis of protein sequence, structure and function; Design and Analysis of microarray experiments.

Suggested Readings

- Baldi P & Brunak S. 2001. *Bioinformatics: The Machine Learning Approach*. 2nd Ed. (Adaptive Computation and Machine Learning). MIT Press.
- Baxevanis AD & Francis BF. (Eds.). 2004. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. John Wiley.

- Bergeron BP. 2002. *Bioinformatics Computing*. Prentice Hall.
- Duda RO, Hart PE & Stork DG. 1999. *Pattern Classification*. John Wiley.
- Ewens WJ & Grant GR. 2001. *Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology and Health)*. Springer.
- Hunt S & Livesy F. (Eds.). 2000. *Functional Genomics: A Practical Approach (The Practical Approach Series, 235)*. Oxford Univ. Press.
- Jones NC & Pevzner PA. 2004. *An Introduction to Bioinformatics Algorithms*. MIT Press.
- Koski T & Koskinen T. 2001. *Hidden Markov Models for Bioinformatics*. Kluwer.
- Krane DE & Raymer ML. 2002. *Fundamental Concepts of Bio-informatics*. Benjamin / Cummings.
- Krawetz SA & Womble DD. 2003. *Introduction to Bioinformatics: A Theoretical and Practical Approach*. Humana Press.
- Lesk AM. 2002. *Introduction to Bio-informatics*. Oxford Univ. Press.
- Percus JK. 2001. *Mathematics of Genome Analysis*. Cambridge Univ. Press.
- Sorensen D & Gianola D. 2002. *Likelihood, Bayesian and MCMC Methods in Genetics*. Springer.
- Tisdall JD. 2001. *Mastering Perl for Bioinformatics*. O'Reilly & Associates.
- Tisdall JD. 2003. *Beginning Perl for Bioinformatics*. O'Reilly & Associates.
- Wang JTL, Zaki MJ, Toivonen HTT & Shasha D. 2004. *Data Mining in Bioinformatics*. Springer.
- Wu CH & McLarty JW. 2000. *Neural Networks and Genome Informatics*. Elsevier.
- Wunschiers R. 2004. *Computational Biology Unix/Linux, Data Processing and Programming*. Springer.

STAT 572

ECONOMETRICS

2+0

Objective

This course is meant for training the students in econometric methods and their applications in agriculture. This course would enable the students in understanding the economic phenomena through statistical tools and economics principles.

Theory

UNIT I

Representation of Economic phenomenon, relationship among economic variables, linear and non linear economic models, single equation general linear regression model, basic assumptions, Ordinary least squares method of estimation for simple and multiple regression models; summary statistics correlation matrix, co-efficient of multiple determination, standard errors of estimated parameters, tests of significance and confidence interval estimation. BLUE properties of Least Squares estimates. Chow test, test of improvement of fit through additional regressors. Maximum likelihood estimation.

UNIT II

Heteroscedasticity, Auto-correlation, Durbin Watson test, Multicollinearity. Stochastic regressors, Errors in variables, Use of instrumental variables in regression analysis. Dummy Variables. Distributed Lag models: Koyck's Geometric Lag scheme, Adaptive Expectation and Partial Adjustment Mode, Rational Expectation Models and test for rationality.

UNIT III

Simultaneous equation model: Basic rationale, Consequences of simultaneous relations, Identification problem, Conditions of Identification, Indirect Least Squares, Two-stage least squares, K-class estimators, Limited Information and Full Information Maximum Likelihood Methods, Three stage least squares, Generalized least squares, Recursive models, SURE Models. Mixed Estimation Methods, use of instrumental variables, pooling of cross-section and time series data, Principal Component Methods.

UNIT IV

Problem and Construction of index numbers and their tests; fixed and chain based index numbers; Construction of cost of living index number.

UNIT V

Demand analysis – Demand and Supply Curves; Determination of demand curves from market data. Engel's Law and the Engel's Curves, Income distribution and method of its estimation, Pareto's Curve, Income inequality measures.

Suggested Readings

- Croxtan FE & Cowden DJ. 1979. *Applied General Statistics*. Prentice Hall of India.
- Johnston J. 1984. *Econometric Methods*. McGraw Hill.
- Judge GC, Hill RC, Griffiths WE, Lutkepohl H & Lee TC. 1988. *Introduction to the Theory and Practice of Econometrics*. 2nd Ed. John Wiley.
- Kmenta J. 1986. *Elements of Econometrics*. 2nd Ed. University of Michigan Press.
- Koop G. 2007. *Introduction to Econometrics*. John Wiley.
- Maddala GS. 2001. *Introduction to Econometrics*. 3rd Ed. John Wiley.
- Pindyck RS & Rubinfeld DL. 1998. *Econometric Models and Economic Forecasts*. 4th Ed. McGraw Hill.
- Verbeek M. 2008. *A Guide to Modern Econometrics*. 3rd Ed. John Wiley.

STAT 573

STATISTICAL QUALITY CONTROL

2+0

Objective

This course is meant for exposing the students to the concepts of Statistical Quality Control and their applications in agribusiness and agro-processing industries. This course would enable the students to have an idea about the statistical techniques used in quality control. students who do not have sufficient background of Statistical Methods.

Theory

UNIT I

Introduction to Statistical Quality Control; Control Charts for Variables – Mean, Standard deviation and Range charts; Statistical basis; Rational subgroups.

UNIT II

Control charts for attributes- ‘np’, ‘p’ and ‘c’ charts.

UNIT III

Fundamental concepts of acceptance, sampling plans, single, double and sequential sampling plans for attributes inspection.

UNIT IV

Sampling inspection tables for selection of single and double sampling plans.

Suggested Readings

Cowden DJ. 1957. *Statistical Methods in Quality Control*. Prentice Hall of India.

Dodge HF & Romig HG. 1959. *Sampling Inspection Tables*. John Wiley.

Duncan A.J. 1986. *Quality Control and Industrial Statistics*. 5th Ed. Irwin Book Co.

Grant EL & Leavenworth RS. 1996. *Statistical Quality Control*. 7th Ed. McGraw Hill.

Montgomery DC. 2005. *Introduction to Statistical Quality Control*. 5th Ed. John Wiley.

Wetherhil G.B. 1977. *Sampling Inspection and Quality Control*. Halsted Press.

**STAT 574/
BST 574**

OPTIMIZATION TECHNIQUES

1+1

Objective

This course is meant for exposing the students to the mathematical details of the techniques for obtaining optimum solutions under constraints for desired output. They will be taught numerical methods of optimization, linear programming techniques, non-linear programming and multiple objective programming. Students will also be exposed to practical applications of these techniques.

Theory

UNIT I

Classical Optimization Techniques: Necessary Conditions for an Extremum. Constrained Optimization: Lagrange Multipliers, Statistical Applications. Optimization and Inequalities. Classical Inequalities, like Cauchy-Schwarz Inequality, Jensen Inequality and Markov Inequality.

UNIT II

Numerical Methods of Optimization: Numerical Evaluation of Roots of Equations, Direct Search Methods, Sequential Search Methods -- Fibonacci Search Method. Random Search Method – Method of Hooke and Jeeves, Simplex Search Method. Gradient Methods, like Newton’s Method, and Method of Steepest Ascent. Nonlinear Regression and Other Statistical Algorithms, like Expectation – Maximization Algorithm.

UNIT III

Linear programming Techniques – Simplex Method, Karmarkar's Algorithm, Duality and Sensitivity Analysis. Zero-sum Two-person Finite Games and Linear Programming. Integer Programming. Statistical Applications.

UNIT IV

Nonlinear Programming and its Examples. Kuhn-Tucker Conditions. Quadratic Programming. Convex Programming. Basics of Stochastic Programming. Applications. Elements of Multiple Objective Programming. Dynamic Programming, Optimal Control Theory – Pontryagin's Maximum Principle, Time-Optimal Control Problems.

Practical

Problems based on classical optimization techniques; Problems based on optimization techniques with constraints; Minimization problems using numerical methods; Linear programming (LP) problems through graphical method; LP problem by Simplex method; LP problem using simplex method (Two-phase method); LP problem using primal and dual method; Sensitivity analysis for LP problem; LP problem using Karmarkar's method; Problems based on Quadratic programming; Problems based on Integer programming; Problems based on Dynamic programming; Problems based on Pontryagin's Maximum Principle.

Suggested Readings

- Rao SS. 2007. *Engineering Optimization: Theory and Practice*. 3rd Ed. New Age.
- Rustagi JS. 1994. *Optimization Techniques in Statistics*. Academic Press.
- Taha HA. 2007. *Operations Research: Introduction with CD*. 8th Ed. Pearson Edu.
- Zeleny M. 1974. *Linear Multiobjective Programming*. Springer.

STAT 575

DEMOGRAPHY

2+0

Objective

This course is meant for training the students in measures of demographic indices, estimation procedures of demographic parameters. Students would also be exposed to population projection techniques and principles involved in bioassays.

Theory

UNIT I

Introduction to vital statistics, crude and standard mortality and morbidity rates, Estimation of mortality, Measures of fertility and mortality, period and cohort measures.

UNIT II

Life tables and their applications, methods of construction of abridged life tables, Increment-Decrement Life Tables.

UNIT III

Stationary and stable populations, Migration and immigration. Application of stable population theory to estimate vital rates, migration and its estimation. Demographic relations in Nonstable populations. Measurement of population growth, Lotka's model(deterministic) and intrinsic rate of growth, Measures of mortality and morbidity, Period and

UNIT IV

Principle of biological assays, parallel line and slope ratio assays, choice of doses and efficiency in assays quantal responses, probit and logit transformations, epidemiological models.

Suggested Readings

- Cox DR. 1957. *Demography*. Cambridge Univ. Press.
Finney DJ. 1981. *Statistical Methods in Biological Assays*. Charles Griffin.
Fleiss JL. 1981. *Statistical Methods for Rates and Proportions*. John Wiley.
Lawless JF. 1982. *Statistical Models and Methods for Lifetime Data*. John Wiley.
MacMahon B & Pugh TF. 1970. *Epidemiology- Principles and Methods*. Little Brown, Boston.
Mann NR, Schafer RE & Singpurwalla ND. 1974. *Methods for Statistical Analysis of Reliability and Life Data*. John Wiley.
Newell C. 1988. *Methods and Models in Demography*. Guilford Publ.
Preston S, Heuveline P & Guillot M. 2001. *Demography: Measuring and Modeling Population Processes*. Blackwell Publ.
Rowland DT. 2004. *Demographic Methods and Concepts*. Oxford Press.
Siegel JS & Swanson DA. 2004. *The Methods and Material of Demography*. 2nd Ed. Elsevier.
Woolson FR. 1987. *Statistical Methods for the Analysis of Biomedical Data*. John Wiley.

STAT 576

STATISTICAL METHODS FOR LIFE SCIENCES

2+0

Objective

This course focuses on statistical methods for discrete data collected in public health, clinical and biological studies including survival analysis. This would enable the students to understand the principles of different statistical techniques useful in public health and clinical studies conducted.

Theory

UNIT I

Proportions and counts, contingency tables, logistic regression models, Poisson regression and log-linear models, models for polytomous data and generalized linear models.

UNIT II

Computing techniques, numerical methods, simulation and general implementation of biostatistical analysis techniques with emphasis on data applications. Analysis of survival time data using parametric and non-parametric models, hypothesis testing, and methods for analyzing censored (partially observed) data with covariates. Topics include marginal estimation of a survival function, estimation of a generalized multivariate linear regression model (allowing missing covariates and/or outcomes).

UNIT III

Proportional Hazard model: Methods of estimation, estimation of survival functions, time-dependent covariates, estimation of a multiplicative intensity model (such as Cox proportional hazards model) and estimation of causal parameters assuming marginal structural models.

UNIT IV

General theory for developing locally efficient estimators of the parameters of interest in censored data models. Rank tests with censored data. Computing techniques, numerical methods, simulation and general implementation of biostatistical analysis techniques with emphasis on data applications.

UNIT V

Newton, scoring, and EM algorithms for maximization; smoothing methods; bootstrapping; trees and neural networks; clustering; isotonic regression; Markov chain Monte Carlo methods.

Suggested Readings

- Biswas S. 1995. *Applied Stochastic Processes. A Biostatistical and Population Oriented Approach*. Wiley Eastern Ltd.
- Collett D. 2003. *Modeling Survival Data in Medical Research*. Chapman & Hall.
- Cox DR & Oakes D. 1984. *Analysis of Survival Data*. Chapman & Hall.
- Hosmer DW Jr. & Lemeshow S. 1999. *Applied Survival Analysis: Regression Modeling or Time to Event*. John Wiley.
- Klein JP & Moeschberger ML. 2003. *Survival Analysis: Techniques for Censored and Truncated Data*. Springer.
- Kleinbaum DG & Klein M 2005. *Survival Analysis. A Self Learning Text*. Springer.
- Kleinbaum DG & Klein M. 2005. *Logistic Regression*. 2nd Ed. Springer.
- Lee ET. 1992. *Statistical Methods for Survival Data Analysis*. John Wiley.
- Miller RG. 1981. *Survival Analysis*. John Wiley.
- Therneau TM & Grambsch PM. 2000. *Modeling Survival Data: Extending the Cox Model*. Springer.

STAT 577

STATISTICAL ECOLOGY

2+0

Objective

This course is meant for exposing the students to the importance and use of statistical methods in collections of ecological data, species-abundance relations, community classification and community interpretation.

Theory

UNIT I

Ecological data, Ecological sampling; Spatial pattern analysis: Distribution methods, Quadrant-variance methods, Distance methods.

UNIT II

Species-abundance relations: Distribution models, Diversity indices; Species affinity: Niche-overlap indices, interspecific association, interspecific covariation.

UNIT III

Community classification: Resemblance functions, Association analysis, Cluster analysis; Community Ordination: Polar Ordination, Principal Component Analysis, Correspondence analysis, Nonlinear ordination.

UNIT IV

Community interpretation: Classification Interpretation and Ordination Interpretation.

Suggested Readings

- Pielou EC. 1970. *An introduction to Mathematical Ecology*. John Wiley.

- Reynolds JF & Ludwig JA. 1988. *Statistical Ecology: A Primer on Methods and Computing*. John Wiley.
- Young LJ, Young JH & Young J. 1998. *Statistical Ecology: A Population Perspective*. Kluwer.

STAT 601 ADVANCED STATISTICAL COMPUTING 2+1

Objective

This is an advanced course in Statistical Computing that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences and use of statistical packages.

Theory

UNIT I

Measures of association. Structural models for discrete data in two or more dimensions.

Estimation in complete tables. Goodness of fit, choice of a model. Generalized Linear Model for discrete data, Poisson and Logistic regression models. Log-linear models.

UNIT II

Elements of inference for cross-classification tables. Models for nominal and ordinal response.

UNIT III

Computational problems and techniques for robust linear regression, nonlinear and generalized linear regression problem, tree-structured regression and classification, cluster analysis, smoothing and function estimation, robust multivariate analysis.

UNIT IV

Analysis of incomplete data: EM algorithm, single and multiple imputations. Markov Chain, Monte Carlo and annealing techniques, Neural Networks, Association Rules and learning algorithms.

UNIT V

Linear mixed effects models, generalized linear models for correlated data (including generalized estimating equations), computational issues and methods for fitting models, and dropout or other missing data.

UNIT VI

Multivariate tests of linear hypotheses, multiple comparisons, confidence regions, prediction intervals, statistical power, transformations and diagnostics, growth curve models, dose-response models.

Practical

Analysis of qualitative data; Generalized linear for correlated data; Generalized linear models for discrete data; Robust methods of estimation and testing of non-normal data; Robust multivariate analysis; Cluster analysis; Analysis of Incomplete data; Classification and prediction using artificial neural networks; Markov Chain; Analysis of data having random effects using Linear mixed effects models; Analysis of data with missing observations; Applications of multiple comparison procedures; Building Simultaneous confidence intervals; Fitting of growth curve models to growth data; Fitting of dose-response curves and estimation of parameters.

Suggested Readings

- Everitt BS & Dunn G. 1991. *Advanced Multivariate Data Analysis*. 2nd Ed. Arnold.
- Geisser S. 1993. *Predictive Inference: An Introduction*. Chapman & Hall.
- Gentle JE, Härdle W & Mori Y. 2004. *Handbook of Computational Statistics -Concepts and Methods*. Springer.
- Han J & Kamber M. 2000. *Data Mining: Concepts and Techniques*. Morgan.
- Hastie T, Tibshirani R & Friedman R. 2001. *The Elements of Statistical Learning: Data Mining, Inference and Prediction*. Springer.
- Kennedy WJ & Gentle JE. 1980. *Statistical Computing*. Marcel Dekker.
- Miller RG Jr. 1986. *Beyond ANOVA, Basics of Applied Statistics*. John Wiley.
- Rajaraman V. 1993. *Computer Oriented Numerical Methods*. Prentice-Hall.
- Robert CP & Casella G. 2004. *Monte Carlo Statistical Methods*. 2nd Ed. Springer.
- Ross S. 2000. *Introduction to Probability Models*. Academic Press.
- Simonoff JS. 1996. *Smoothing Methods in Statistics*. Springer.
- Thisted RA. 1988. *Elements of Statistical Computing*. Chapman & Hall.
- Venables WN & Ripley BD. 1999. *Modern Applied Statistics With S-Plus*. 3rd Ed. Springer.
- Free Statistical Softwares: <http://freestatistics.altervista.org/en/stat.php>.
- Design Resources Server: www.iasri.res.in.
- SAS Online Doc 9.1.3:
<http://support.sas.com/onlinedoc/913/docMainpage.jsp>

STAT 602

SIMULATION TECHNIQUES

1+1

Objective

This course is meant for students who have a good knowledge in Statistical Inference and Statistical Computing. This course would prepare students for undertaking research in the area of simulation techniques and their applications to agricultural sciences.

Theory

UNIT I

Review of simulation methods; Implementation of simulation methods - for various probability models, and resampling methods: theory and application of the jackknife and the bootstrap.

UNIT II

Randomization tests, analysis using computer software packages. Simulating multivariate distributions, MCMC methods and Gibbs sampler.

UNIT III

Correlograms, periodograms, fast Fourier transforms, power spectra, cross-spectra, coherences, ARMA and transfer-function models, spectral-domain regression. Simulated data sets to be analyzed using popular computer software packages

UNIT IV

Stochastic simulation: Markov Chain, Monte Carlo, Gibbs' sampling, Hastings-Metropolis algorithms, critical slowing-down and remedies, auxiliary variables, simulated tempering, reversible- jump MCMC and multi-grid methods.

Practical

Simulation from various probability models; Resampling methods, jackknife and the bootstrap; Randomization tests; Simulating multivariate distributions, MCMC methods and Gibbs sampler; Correlograms, periodograms, fast Fourier transforms, power spectra, cross-spectra, coherences; ARMA and transfer-function models, spectral-domain regression; Simulated data sets to be analyzed using popular computer software packages; Markov Chain, Monte Carlo, Gibbs' sampling; Reversible- jump MCMC and multi-grid methods.

Suggested Readings

- Averill ML, Kelton D. 2005. *Simulation, Modeling and Analysis*. Tata McGraw Hill.
- Balakrishnan N, Melas VB & Ermakov S. (Ed.). 2000. *Advances in Stochastic Simulation Methods*. Basel-Birkhauser.
- Banks J. (Ed.). 1998. *Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice*. John Wiley.
- Bratley P, Fox BL & Schrage LE. 1987. *A Guide to Simulation*. Springer.
- Davison AC & Hinkley DV. 2003. *Bootstrap Methods and their Application*. Cambridge Univ. Press.
- Gamerman D, Lopes HF & Lopes HF. 2006. *Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference*. CRC Press.
- Gardner FM & Baker JD. 1997. *Simulation Techniques Set*. John Wiley.
- Gentle JE. 2005. *Random Number Generation and Monte Carlo Methods*. Springer.
- Janacek G & Louise S. 1993. *Time Series: Forecasting, Simulation, Applications*. Ellis Horwood Series in Mathematics and Its Applications.
- Kleijnen J & Groenendaal WV. 1992. *Simulation: A Statistical Perspective*. John Wiley.
- Kleijnen J. 1974 (Part I), 1975 (Part II). *Statistical Techniques in Simulation*. Marcel Dekker.
- Law A & Kelton D. 2000. *Simulation Modeling and Analysis*. McGraw Hill.
- Press WH, Flannery BP, Tenkolsky SA & Vetterling WT. 1986. *Numerical Recipes*. Cambridge Univ. Press.
- Ripley BD. 1987. *Stochastic Simulation*. John Wiley.
- Ross SM. 1997. *Simulation*. John Wiley.

STAT 611

ADVANCED STATISTICAL METHODS

2+0

Objective

This is an advanced course in Statistical Methods that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

UNIT I

Ridge regression: Basic form, Use as a selection procedure. Robust regression: Least absolute deviations regression, M-estimators, Least median of squares regression. Nonparametric regression.

UNIT II

Introduction to the theory and applications of generalized linear models, fixed effects, random effects and mixed effects models, estimation of variance components from unbalanced data. Unified theory of least - squares, MINQUE, MIVQUE, REML.

UNIT III

Quasi-likelihoods, and generalized estimating equations - logistic regression, over-dispersion, Poisson regression, log-linear models, conditional likelihoods, generalized mixed models, and regression diagnostics. Theory of statistical methods for analyzing categorical data by means of linear models; multifactor and multi-response situations; interpretation of interactions.

UNIT IV

Fitting of a generalized linear model, mixed model and variance components estimation, MINQUE, MIVQUE, REML.

UNIT V

Fitting of Logistic regression, Poisson regression, ridge regression, robust regression, non-parametric regression.

Suggested Readings

Chatterjee S, Hadi A & Price B.1999. *Regression Analysis by Examples*. John Wiley.

Draper NR & Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.

Rao CR. 1965. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.

Searle SR, Casella G & McCulloch CE. 1992. *Variance Components*. John Wiley.

Searle SR. 1971. *Linear Models*. John Wiley.

STAT 612

ADVANCED STATISTICAL INFERENCE

3+0

Objective

This course aims at describing the advanced level topics in statistical methods and statistical inference. This course would prepare students to have a strong base in basic statistics that would help them in undertake basic and applied research in Statistics.

Theory

UNIT I

Robust estimation and robust tests, Robustness, M-estimates. L-estimates, asymptotic techniques, Bayesian inference. Detection and handling of outliers in statistical data.

UNIT II

Loglinear models, saturated models, hierarchical models, Analysis of multi - dimensional contingency tables. Non-parametric maximum likelihood estimation.

UNIT III

Density Estimation: Density Estimation in the Exploration and Presentation of Data. Survey of existing methods. The Kernel method for Univariate Data: Rosenblatts naïve estimator, its bias and variance. Consistency of general Kernel estimators, MSE and IMSE. Asymptotic

normality of Kernel estimates of density. Estimation of distribution by method of kernels.

UNIT IV

Consistency and asymptotic normality (CAN) of real and vector parameters. Invariance of consistency under continuous transformation. Invariance of CAN estimators under differentiable transformations, generation of CAN estimators using central limit theorem. Exponential class of densities and multinomial distribution, Cramer-Huzurbazar theorem, method of scoring.

UNIT V

Efficiency: asymptotic relative efficiency and Pitman's theorem. Concepts and examples of Bahadur efficiency and Hodges-Lehmann's efficiency with examples. The concepts of Rao's second order efficiency and Hodges-Lehmann's Deficiency with examples. Rank tests, permutation tests, asymptotic theory of rank tests under null and alternative (contiguous) hypotheses.

UNIT VI

Inference on Markov Chains: Maximum likelihood estimation and testing of Transition Probability Matrix of a Markov Chain, testing for order of a Markov chain, estimation of functions of transition probabilities.

UNIT VII

Concept of loss, risk and decision functions, admissible and optimal decision functions, a-priori and posteriori distributions, conjugate families. Bayes and Minimax decision rules and some basic results on them. Estimation and testing viewed as cases of decision problems. Bayes and Minimax decision functions with applications to estimation with quadratic loss function. Concept of Bayesian sequential analysis. Bayes sequential decision rule. The SPRT as a Bayes procedure. Minimax sequential procedure.

UNIT VIII

U-Statistics: definitions of estimable parametric function, kernel, symmetric kernel and U-statistics. Variance and covariance of U-statistics. Hoeffding's decomposition of U-statistics –examples. U-statistics based on sampling from finite populations and weighted U-statistics with examples. Some convergence results on U-statistics. Asymptotic normality of U-statistics with examples.

UNIT IX

Resampling Plans : Estimation of standard and biased deviation of point estimator by the Jackknife, the Bootstrap, the Infinitesimal Jackknife, the Delta and the Influence function methods. Estimation of excess error in regression by cross validation, the Jackknife and Bootstrap methods. Nonparametric confidence interval for the median by the Percentile method.

Suggested Readings

- Casela G & Berger RL. 2001. *Statistical Inference*. Duxbury Thompson Learning.
- Daniel W.1990. *Applied Nonparametric Statistics*. Houghton Mifflin, Boston.
- DeGroot MH. 1970. *Optimal Statistical Decisions*. McGraw Hill.

- Efron B & Tibshirani RJ. 1993. *An Introduction to Bootstrap*. Chapman Hall/CRC.
- Ferguson TS. 1967. *Mathematical Statistics, A Decision Theoretic Approach*. Academic Press.
- Gibbons JD & Chakraborty S. 1992. *Non-parametric Statistical Inference*. Marcel Dekker.
- Gray HL & Schucany WR. 1972. *The Generalized Jackknife Statistics*. Marcel Dekker.
- Kale BK. 1999. *A First Course on Parametric Inference*. Narosa Publ.
- Prakasa Rao BLS. 1983. *Nonparametric Functional Estimation*. Academic Press.
- Rao CR. 1965. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.
- Silverman BW. 1986. *Density Estimation for Statistics and Data Analysis*. Chapman & Hall.
- Silvey SD. 1975. *Statistical Inference*. Chapman & Hall.
- Tapia RA & Thompson JR. 1978. *Nonparametric Probability Density Estimation*. Johns Hopkins Univ. Press.
- Tiku ML, TanWY & Balakrishnana N. 1986. *Robust Inference*. Marcel Dekker.
- Wald A. 2004. *Sequential Analysis*. Dover Publ.
- Wasserman L. 2006. *All of Nonparametric Statistics*. Springer.

STAT 613

ADVANCED DESIGN OF EXPERIMENTS

2+0

Objective

This is an advanced course in Design of Experiments that aims at describing some advanced level topics for students who wish to pursue research in Design of Experiments. This course prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

UNIT I

General properties and analysis of block designs. Balancing criteria. m -associate PBIB designs, and their association schemes including lattice designs - properties and construction, Designs for test treatment – control(s) comparisons; Nested block designs, Mating designs.

UNIT II

General properties and analysis of two-way heterogeneity designs, Youden type designs, generalized Youden designs, Pseudo Youden designs. Structurally Incomplete block designs, Designs for two sets of treatments.

UNIT III

Balanced factorial experiments - characterization and analysis (symmetrical and asymmetrical factorials). Factorial experiments with extra treatment(s). Orthogonal arrays, Mixed orthogonal arrays, balanced arrays, Fractional replication, Regular and irregular fractions.

UNIT IV

Response surface designs - Symmetrical and asymmetrical factorials, Response optimization and slope estimation, Blocking. Canonical analysis and ridge analysis. Experiments with mixtures: design and analysis. Experiments with qualitative cum quantitative factors.

UNIT V

Optimality criteria and optimality of designs, robustness of designs against loss of data, outliers, etc. Diagnostics in design of experiments.

Suggested Readings

- Chakraborti MC. 1962. *Mathematics of Design and Analysis of Experiments*. Asia Publ. House.
- Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Dey A & Mukerjee R. 1999. *Fractional Factorial Plans*. John Wiley.
- Dey A 1986. *Theory of Block Designs*. Wiley Eastern.
- Hall M Jr. 1986. *Combinatorial Theory*. John Wiley.
- Hedayat AS, Sloane NJA & Stufken J. 1999. *Orthogonal Arrays: Theory and Applications*. Springer.
- John JA & Quenouille MH. 1977. *Experiments: Design and Analysis*. Charles & Griffin.
- Khuri AI & Cornell JA. 1996. *Response Surface Designs and Analysis*. 2nd Ed. Marcel Dekker.
- Montgomery DC. 2005. *Design and Analysis of Experiments*. John Wiley.
- Ogawa J. 1974. *Statistical Theory of the Analysis of Experimental Designs*. Marcel Dekker.
- Parsad R, Gupta VK, Batra PK, Satpati SK & Biswas P. 2007. *Monograph on α -designs*. IASRI, New Delhi.
- Raghavarao D. 1971. *Construction and Combinatorial Problems in Design of Experiments*. John Wiley.
- Shah KR & Sinha BK. 1989. *Theory of Optimal Designs. Lecture notes in Statistics*. Vol. 54. Springer.
- Street AP & Street DJ. 1987. *Combinatorics of Experimental Designs*. Oxford Science Publ.
- Design Resources Server: www.iasri.res.in.

STAT 614 ADVANCED SAMPLING TECHNIQUES 2+0

Objective

This is an advanced course in Sampling Techniques that aims at describing some advanced level topics for students who wish to pursue research in Sampling Techniques. This course prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to Statistical System in the country.

Theory

UNIT I

Controlled selection. Two way stratification, collapsed strata. Systematic sampling in two dimensions. Use of combinatorics in controlled selection. Integration of surveys - Lahiri and Keyfitz's procedures.

UNIT II

Variance estimation in complex surveys. Taylor's series linearisation, balanced repeated replication, Jackknife and bootstrap methods.

UNIT III

Unified theory of sampling from finite populations. UMV - Non-existence theorem and existence theorem under restricted conditions. Concept of sufficiency and likelihood in survey sampling. Admissibility and hyper-admissibility.

UNIT IV

Inference under super population models - concept of designs and model unbiasedness, prediction approach. Regression analysis and categorical data analysis with data from complex surveys. Domain estimation. Small area estimation.

UNIT V

Stochastic parameter models, Bayes' linear predictor, Bayesian models with multi-stage sampling. Measurement error and small area estimation, Time series approach in survey sampling. Dynamic Bayesian prediction, Kalman filter, Empirical and Hierarchical Bayes predictors, Robust linear prediction, Bayesian robustness.

Suggested Readings

- Berger JO. 1993. *Statistical Decision Theory and Bayesian Analysis*. Springer.
- Bolfarine H & Zacks S. 1992. *Prediction Theory for Finite Population Sampling*. Springer.
- Cassel CM, Sarndal CE & Wretman JH. 1977. *Foundations of Inference in Survey Sampling*. John Wiley.
- Des Raj & Chandhok P. 1998. *Sample Survey Theory*. Narosa Publ. House.
- Ghosh M & Meeden G. 1997. *Bayesian Method for Finite Population Sampling. Monograph on Statistics and Applied Probability*. Chapman & Hall.
- Mukhopadhyay P. 1998. *Theory and Methods of Survey Sampling*. Prentice Hall of India.
- Rao JNK. 2003. *Small Area Estimation*. John Wiley.
- Sarndal CE, Swensson B & Wretman JH. 1992. *Model Assisted Survey Sampling*. Springer.

STAT 615

ADVANCED STATISTICAL GENETICS

2+0

Objective

This is an advanced course in Statistical Genetics that aims at describing some advanced level topics for students who wish to pursue research in Statistical Genetics. This course prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject in plant and animal breeding.

Theory

UNIT I

Hardy-Weinberg law with multiple allelic systems, auto-tetraploids and self-sterility alleles. Complex cases of selection with two or more loci.

UNIT II

Different approaches to study inbreeding process, methods of path coefficient, probability and generation matrix. Fisher's approach to inbreeding. Stochastic process of gene frequency change, transition matrix approach using finite Markov chains, diffusion approximation, Steady decay and distribution of gene frequency, Probability of fixation of a gene, Conditional process - Markov chains and diffusion approaches, Distribution of time until fixation, random fluctuations in selection intensity, stationary distribution of gene frequency. Effective population size.

UNIT III

Prediction and estimation of genetic merit. Best linear unbiased prediction, Use of mixed model methodology in analysis of animal and plant breeding experiments. Newer reproductive technology and its effect in genetic evaluation of individual merit. Estimation of genetic parameters - problems relating to computational aspects of genetic variance components, parameter estimation in variance component models for binary response data.

UNIT IV

Identification of genes with large effects, Use of molecular markers (RFLP, PCR-AFLP, RAPD and SSR), Gene mapping and Quantitative trait loci. Molecular manipulation for genetic variability.

UNIT V

Survival analysis and concept of censored observation in animal breeding. Phylogeny and analysis of molecular variance.

Suggested Readings

- Crow JF & Kimura M. 1970. *An Introduction of Population Genetics Theory*. Harper & Row.
- Ewens WJ. 1979. *Mathematical Population Genetics*. Springer.
- Falconer DS. 1985. *Introduction to Quantitative Genetics*. ELBL.
- Fisher RA. 1949. *The Theory of Inbreeding*. Oliver & Boyd.
- Fisher RA. 1958. *The Genetical Theory of Natural Selection*. Dover Publ.
- Haldane JBS. 1932. *The Causes of Evolution*. Harper & Bros.
- Kempthorne O. 1957. *An Introduction to Genetic Statistics*. The Iowa State Univ. Press.
- Lerner IM. 1950. *Population Genetics and Animal Improvement*. Cambridge Univ. Press.
- Lerner IM. 1958. *The Genetic Theory of Selection*. John Wiley.
- Li CC. 1982. *Population Genetics*. The University of Chicago Press.
- Mather K & Jinks JL. 1982. *Biometrical Genetics*. Chapman & Hall.
- Mather K. 1951. *The Measurement of Linkage in Heredity*. Methuen.
- Nagilaki T. 1992. *Introduction to Theoretical Population Genetics*. Springer.
- Narain P. 1990. *Statistical Genetics*. Wiley Eastern.

STAT 616

STATISTICAL MODELING

1+1

Objective

This is an advanced course in Statistical Methods that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in the area of empirical and mechanistic models and nonlinear estimation and the replications in different disciplines of agricultural sciences.

Theory

UNIT I

Empirical and mechanistic models. Nonlinear growth models like monomolecular, logistic, Gompertz, Richards. Applications in agriculture and fisheries.

UNIT II

Nonlinear estimation: Least squares for nonlinear models, Methods for estimation of parameters like Linearization, Steepest, and Levenberg-Marquardt's Reparameterization.

UNIT III

Two-species systems. Lotka-Volterra, Leslie-Gower and Holling-Tanner non-linear prey-predator models. Volterra's principle and its applications. Gause competition model.

UNIT IV

Compartmental modelling - First and second order input-output systems, Dynamics of a multivariable system.

Practical

Fitting of mechanistic non-linear models; Application of Schaefer and Fox non-linear models; Fitting of compartmental models.

Suggested Readings

- Draper NR & Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.
- Efromovich S. 1999. *Nonparametric Curve Estimation*. Springer.
- Fan J & Yao Q. 2003. *Nonlinear Time Series-Nonparametric and Parametric Methods*. Springer.
- France J & Thornley JHM. 1984. *Mathematical Models in Agriculture*. Butterworths.
- Harvey AC. 1996. *Forecasting, Structural Time Series Models and the Kalman Filter*. Cambridge Univ. Press.
- Ratkowsky DA. 1983. *Nonlinear Regression Modelling: A Unified Practical Approach*. Marcel Dekker.
- Ratkowsky DA. 1990. *Handbook of Nonlinear Regression Models*. Marcel Dekker.
- Seber GAF & Wild CJ. 1989. *Non-linear Regression*. John Wiley.
- Silverman BW. 1986. *Density Estimation for Statistics and Data Analysis*. Chapman & Hall.

STAT 617

ADVANCED TIME SERIES ANALYSIS

2+0

Objective

This is an advanced course in Time Series Analysis that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

UNIT I

Multivariate time series: modelling the mean, stationary VAR models: properties, estimation, analysis and forecasting, VAR models with elements of nonlinearity, Non-stationary multivariate time series: spurious regression, co-integration, common trends.

UNIT II

Volatility: Modelling the variance, The class of ARCH models: properties, estimation, analysis and forecasting, stochastic volatility, realized volatility, Extensions: IGARCH, ARCH-t, ARCD, Multivariate GARCH, Time-varying risk and ARCH-in-mean.

UNIT III

Structural time-series modelling: State space models, Kalman filter. Local level model, Local linear trend model, Seasonal models, Cyclical models. Nonlinear time-series models: Parametric and nonparametric approaches. Autoregressive conditional heteroscedastic model and its extensions. Threshold and Functional coefficient autoregressive models.

UNIT IV

Non-linear programming, Kuhn-Tucker sufficient conditions, Elements of multiple objective programming, Dynamic Programming, Optimal control theory - Pontryagin's maximum principle, Time-optimal control problems.

Suggested Readings

- Box GEP, Jenkins GM & Reinsel GC. 2008. *Time Series Analysis: Forecasting and Control*. 3rd Ed. John Wiley.
- Brockwell PJ & Davis RA. 1991. *Time Series: Theory and Methods*. 2nd Ed. Springer.
- Chatfield C. 2004. *The Analysis of Time Series: An Introduction*. 6th Ed. Chapman & Hall/CRC.
- Tong H. 1995. *Nonlinear Time Series: A Dynamical System Approach*. Oxford Univ. Press.

STAT 618

STOCHASTIC PROCESSES

2+0

Objective

This is a course on Stochastic Processes that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

UNIT I

Introduction to stochastic process - classification according to state space and time domain. Finite and countable state Markov chains; time-homogeneity; Chapman-Kolmogorov equations, marginal distribution and finite dimensional distributions. Classification of Markov chain. Canonical form of transition probability matrix of a Markov chain. Fundamental matrix; probabilities of absorption from transient states into recurrent classes in a finite Markov chain, mean time for absorption. Ergodic state and Ergodic chain. Stationary distribution of a Markov chain, existence and evaluation of stationary distribution. Random walk and gamblers ruin problem.

UNIT II

Discrete state continuous time Markov process: Kolmogorov difference – differential equations. Birth and death process, pure birth process (Yule-Furry process). Immigration-Emigration process. Linear growth process, pure death process.

UNIT III

Renewal process: renewal process when time is discrete and continuous. Renewal function and renewal density. Statements of Elementary renewal theorem and Key renewal theorem.

UNIT IV

Stochastic process in biological sciences: Markov models in population genetics, compartmental analysis. Simple deterministic and stochastic epidemic model. General epidemic models-Karmack and McKendrick's threshold theorem. Recurrent epidemics.

UNIT V

Elements of queueing process; the queueing model M/M/1: steady state behaviors. Birth and death process in queueing theory- Multi channel models. Net work of Markovian queueing system.

UNIT VI

Branching process: Galton-Watson branching process. Mean and variance of size of nth generation, probability of ultimate extinction of a branching process. Fundamental theorem of branching process and applications.

UNIT VII

Wiener process- Wiener process as a limit of random walk. First passage time for Wiener process. Kolmogorov backward and forward diffusion equations and their applications.

Suggested Readings

- Adke SR & Manjunath SM. 1984. *Finite Markov Processes*. John Wiley.
- Bailey NTJ. 1964. *Elements of Stochastic Processes with Applications to the Natural Sciences*. Wiley Eastern.
- Bartlett MS. 1955. *Introduction to Stochastic Processes*. Cambridge Univ. Press.
- Basawa IV & Prakasa Rao BLS. 1980. *Statistical Inference for Stochastic Processes*. Academic Press.
- Bharucha-Reid AT. 1960. *Elements of the Theory of Markov Processes and their Applications*. McGraw Hill.
- Bhat BR. 2000. *Stochastic Models; Analysis and Applications*. New Age.
- Cox DR & Miller HD. 1965. *The Theory of Stochastic Processes*. Methuen.
- Draper NR & Smith H. 1981. *Applied Regression Analysis*. Wiley Eastern.
- France J & Thornley JHM. 1984. *Mathematical Models in Agriculture*. Butterworths.
- Karlin S & Taylor H.M. 1975. *A First Course in Stochastic Processes*. Vol. I. Academic Press.
- Lawler GF. 1995. *Introduction to Stochastic Processes*. Chapman & Hall.
- Medhi J. 2001. *Stochastic Processes*. 2nd Ed. Wiley Eastern.
- Parzen E. 1962. *Stochastic Processes*. Holden-Day.
- Prabhu NU. 1965. *Stochastic Processes*. Macmillan.
- Prakasa Rao BLS & Bhat BR. 1996. *Stochastic Processes and Statistical Inference*. New Age.
- Ratkowsky DA. 1983. *Nonlinear Regression Modelling: a Unified Practical Approach*. Marcel Dekker.
- Ratkowsky DA. 1990. *Handbook of Nonlinear Regression Models*. Marcel Dekker.
- Seber GAF & Wild CJ. 1989. *Non-linear Regression*. John Wiley.

Objective

The course deals with the study of demographic profiles and survival times. In-depth statistical properties and analysis is an important component of this course.

TheoryUNIT I

Measures of Mortality and Morbidity: Ratios and proportions, rates of continuous process, rates of repetitive events, crude birth rate, Mortality measures used in vital statistics relationships between crude and age specific rates, standardized mortality ratios, evaluation of person-year of exposed to risk in long term studies, prevalence and incidence of a disease, relative risk and odds ratio.

Survival Distribution: Survival functions, hazard rate, hazard function, review of survival distributions: exponential, Weibull, Gamma, Rayleigh, Pareto, Lognormal~ IFR and TFRA, Gompertz and Makeham. Gompertz and logistic distributions. Parametric (m.l.e) estimation. Types of Censoring: Type I, Type II, random and other types of censoring, right and left truncated distributions. Expectation and variance of future life time, series and parallel system of failures.

Life Tables: Fundamental and construction.

UNIT II

Complete Mortality data, Estimation of Survival Function : Empirical survival function, estimation of survival function from grouped mortality data, joint distribution of the number of deaths, distribution of the estimation P_i covariance of estimate, estimation of curves of deaths and central death rate and force of mortality rate.

Incomplete Mortality data (non-parametric models): Actuarial method, m.l.e method, moment and reduced sample method of estimation and their comparison. Product limit (Kaplan-Meier) method and cumulative hazard function (CHF) of estimation of survival function.

UNIT III

Fitting Parametric Survival Distribution : Special form of survival function cumulative hazard function (CHF) plots, Nelson's method of ungrouped data, construction of the likelihood function for survival data, least squares fitting, fitting a Gompertz distribution to grouped data.

Some tests of Goodness of fit: Graphical, Kolmogorov-Smirnov statistics for complete, censored and truncated data, Chi-Square test and Anderson-Darling A^2 -statistics.

Comparison of Mortality Experiences: Comparison of two life tables, some distribution-free methods (two samples) for ungrouped data, Two samples Kolmogorov-Smirnov test, Wilcoxon test for complete data and modified Wilcoxon test for incomplete data. Gilbert and Gehan's test, mean and variance of Wilcoxon statistics, generalization of Gehan's test. Testing for Consistent Differences in Mortality : Mantel-Haenszel and log rank test. Generalized Mantel-Haenszel test (k-sample).

UNIT IV

Concomitant Variables: General parametric model for hazard function with observed concomitant variables. Additive and multiplicative models of hazard rate functions. Estimating multiplicative models, selection of

concomitant variables. Logistic linear model, Concomitant Variable regarded as random variable. Age of onset distributions: Models of onset distributions and their estimation.

Gompertz distribution, parallel system and Weibull distribution, Fatal short models of failure. Two component series system.

Suggested Readings

Anderson B. 1990. *Methodological Errors in Medical Research*. Blackwell.

Armitage P & Berry G. 1987. *Statistical Methods in Medical Research*. Blackwell.

Collett D. 2003. *Modeling Survival Data in Medical Research*. Chapman & Hall.

Cox DR & Oakes D. 1984. *Analysis of Survival Data*. Chapman & Hall.

Elandt-Johnson RC & Johnson NL. 1980. *Survival Models and Data Analysis*. John Wiley.

Everitt BS & Dunn G. 1998. *Statistical Analysis of Medical Data*. Arnold.

Hosmer DW Jr. & Lemeshow S. 1999. *Applied Survival Analysis: Regression Modeling or Time to Event*. John Wiley.

Kalbfleisch JD & Prentice. RL 2002. *The Statistical Analysis of Failure Time Data*. John Wiley.

Klein JP & Moeschberger ML. 2003. *Survival Analysis: Techniques for Censored and Truncated Data*. Springer.

Kleinbaum DG & Klein M. 2002. *Logistic Regression*. Springer.

Kleinbaum DG & Klein M. 2005. *Survival Analysis*. Springer.

Lawless JF. 2003. *Statistical Models and Methods for Lifetime Data*. 2nd Ed. John Wiley.

Lee ET. 1980. *Statistical Methods for Survival Data Analysis*. Lifetime Learning Publ.

STAT 620

ADVANCED BIOINFORMATICS

2+0

Objective

This is a course on Bioinformatics that aims at exposing the students to some advanced statistical and computational techniques related to bioinformatics. This course would prepare the students in understanding bioinformatics principles and their applications.

Theory

UNIT I

Genomic databases and analysis of high-throughput data sets, sequence annotation, ESTs, SNPs. BLAST and related sequence comparison methods. EM algorithm and other statistical methods to discover common motifs in biosequences. Multiple alignment and database search using motif models, ClustalW and others. Concepts in phylogeny. Gene prediction based on codons, Decision trees, Classificatory analysis, Neural Networks, Genetic algorithms, Pattern recognition, Hidden Markov models.

UNIT II

Computational analysis of protein sequence, structure and function. Expression profiling by microarray/gene chip, proteomics etc., Multiple alignment of protein sequences, Modelling and prediction of structure of proteins, Designer proteins, Drug designing.

UNIT III

Analysis of one DNA sequence (Modeling signals in DNA; Analysis of patterns; Overlaps and Generalizations), Analysis of multiple DNA or protein sequences (Alignment algorithms – Gapped global comparisons and Dynamic programming; use of linear gap models; protein sequences and substitution matrices – BLOSUM, PAM; Multiple sequences), BLAST (Comparison of two aligned sequences – Parameter calculation; Choice of a score; Bounds for P-value; Normalized and Bit scores, Karlin – Altschul sum statistic; comparison of two unaligned sequences; Minimum significance Lengths).

UNIT IV

Markov chains (MC with no absorbing states; Higher order Markov dependence; patterns in sequences; Markov chain Monte Carlo – Hastings-Metropolis algorithm, Gibbs sampling, Simulated Annealing; MC with absorbing States, Continuous-Time Markov chains) Hidden Markov Models (Forward and Backward algorithm; Viterbi algorithms; Estimation algorithm;

UNIT V

Modeling protein families; Multiple sequence alignments; Pfam; Gene finding), Computationally intensive methods (Classical estimation methods; Bootstrap estimation and Confidence Intervals; Hypothesis testing; Multiple Hypothesis testing), Evolutionary models (Models of Nucleotide substitution; Discrete time models – The Jukes-Cantor Model, The Kimura Model, The Felsenstein Model; Continuous-time models),

UNIT VI

Phylogenetic tree estimation (Distances; Tree reconstruction – Ultrametric and Neighbor-Joining cases; Surrogate distances; Tree reconstruction; Parsimony and Maximum Likelihood; Modeling, Estimation and Hypothesis Testing;) Neural Networks (Universal Approximation Properties; Priors and Likelihoods, Learning Algorithms – Backpropagation; Sequence encoding and output interpretation; Prediction of Protein Secondary Structure; Prediction of Signal Peptides and their cleavage sites; Application for DNA and RNA Nucleotide Sequences), Analysis of SNPs and Haplotypes.

Suggested Readings

- Baldi P & Brunak S. 2001. *Bioinformatics: The Machine Learning Approach*. MIT Press.
- Baxevanis AD & Francis BF. (Eds.). 2004. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. John Wiley.
- Duda RO, Hart PE & Stork DG. 1999. *Pattern Classification*. John Wiley.
- Ewens WJ & Grant GR. 2001. *Statistical Methods in Bioinformatics*. Springer.
- Jones NC & Pevzner PA. 2004. *Introduction to Bioinformatics Algorithms*. The MIT Press.
- Koskinen T. 2001. *Hidden Markov Models for Bioinformatics*. Kluwer.
- Krane DE & Raymer ML. 2002. *Fundamental Concepts of Bio-informatics*. Benjamin / Cummings.
- Krawetz SA & Womble DD. 2003. *Introduction to Bioinformatics: A Theoretical and Practical Approach*. Humana Press.
- Lesk AM. 2002. *Introduction to Bio-informatics*. Oxford Univ. Press.

- Linder E & Seefeld K. 2005. *R for Bioinformatics*. O'Reilly & Associates.
- Percus JK. 2001. *Mathematics of Genome Analysis*. Cambridge Univ. Press.
- Sorensen D & Gianola D. 2002. *Likelihood, Bayesian and MCMC Methods in Genetics*. Springer.
- Tisdall JD. 2001. *Mastering Perl for Bioinformatics*. O'Reilly & Associates.
- Wang JTL, Zaki MJ, Toivonen HTT & Shasha D. 2004. *Data Mining in Bioinformatics*. Springer.
- Wu CH & McLarty JW. 2000. *Neural Networks and Genome Informatics*. Elsevier.
- Wunschiers R. 2004. *Computational Biology Unix/Linux, Data Processing and Programming*. Springer.
- Yang MCC. 2000. *Introduction to Statistical Methods in Modern Genetics*. Taylor & Francis.

STAT 621 ADVANCED ECONOMETRICS 2+0

Objective

This is a course on Econometrics aims at exposing the students to some advanced level econometric methods and their applications to agricultural situations.

Theory

UNIT I

Quantile regression, binary quantile regression, extreme values, copula, loss functions, Point and interval forecasting, unconditional and conditional forecasting, forecasting with serially correlated errors, bootstrap: asymptotic expansion, bootstrap consistency, asymptotic refinement, recent developments for dependent time series

UNIT II

Multivariate time series: modelling the mean, stationary VAR models: properties, estimation, analysis and forecasting, VAR models with elements of nonlinearity, Non-stationary multivariate time series: spurious regression, co-integration, common trends; Volatility: Modelling the variance, The class of ARCH models: properties, estimation, analysis and forecasting, stochastic volatility, realized volatility.

UNIT III

Basic Concepts of Bayesian Inference, Probability and Inference, Posterior Distributions and Inference, Prior Distributions. The Bayesian linear model and autoregressive (AR) processes; Model selection with marginal likelihoods and fractional priors, Comparison of Bayesian Methods with Classical approaches, Bayes risk and their applications, and Sample Selection Monte Carlo integration, importance sampling and Gibbs sampling, The Regression Model with General Error Covariance Matrix, Qualitative Choice Models, Bayesian information criterion (BIC), Markov Chain Monte Carlo (MCMC) Model Composition and stochastic search variable selection, BUGS [Bayesian Inference Using Gibbs Sampling] , BUCC [Bayesian Analysis, Computation and Communication].

Suggested Readings

- Banerjee A, Dolado J, Galbraith J & Hendry DF. 1993. *Co-integration, Error Correction, and the Econometric Analysis of Nonstationary Data*. Oxford Univ. Press.
- Bauwens L, Lubrano M & Richard JF. 1999. *Bayesian Inference in Dynamics of Econometric Models*. Oxford Univ. Press.
- Carlin BP & Louis TA. 1996. *Bayes and Empirical Bayes Methods for Data Analysis*. Chapman & Hall.
- Gilks WR, Richardson S & Spiegelhalter D. 1996. *MCMC in Practice*. Chapman & Hall.
- Greenberg E. 2008. *Introduction to Bayesian Econometrics*. Cambridge Univ. Press.
- Hamilton JD. 1994. *Time Series Analysis*. Princeton Univ. Press.
- Judge GG, Griffith WE, Hill RC, Lee CH & Lutkepohl H. 1985. *The Theory and Practice of Econometrics*. 2nd Ed. John Wiley.
- Koop G, Poirier D & Tobias J. 2007. *Bayesian Econometric Methods*. Cambridge Univ. Press.
- Koop G. 2003. *Bayesian Econometrics*. John Wiley.
- Lancaster A. 2004. *An Introduction to Modern Bayesian Econometrics*. Blackwell.
- Pindyck RS & Rubinfeld DL. 1981. *Econometric Models and Economic Forecasts*. McGraw Hill.

STAT 651

**RECENT ADVANCES IN THE
FIELD OF SPECIALIZATION**

1+0

Objective

To familiarize the students with the recent advances in the areas of their specialization to prepare them for undertaking research.

Theory

Recent advances in the field of specialization - sample surveys / design of experiments / statistical genetics / statistical modeling / econometrics / statistical inference, etc. will be covered by various speakers from the University / Institute as well as from outside the University / Institute in the form of seminar talks.

BIO-STATISTICS
Course Structure – at a Glance

A. Service Courses (For M.Sc. and Ph.D. programs of other disciplines)

CODE	COURSE TITLE	CREDITS
BST/STAT 501	MATHEMATICAL METHODS FOR APPLIED SCIENCES	2+0
BST/STAT 511	STATISTICAL METHODS FOR APPLIED SCIENCES	3+1
BST/STAT 512	EXPERIMENTAL DESIGNS	2+1
BST/STAT 513	SAMPLING TECHNIQUES	2+1
BST/STAT 521	APPLIED REGRESSION ANALYSIS	2+1
BST/STAT 531	DATA ANALYSIS USING STATISTICAL PACKAGES	2+1

B. M.Sc. (Bio-Statistics)

BST 551	MATHEMATICAL METHODS - I	3+0
BST 552	MATHEMATICAL METHODS - II	2+0
BST 560	PROBABILITY THEORY	2+0
BST 561	STATISTICAL METHODS	2+1
BST 562	STATISTICAL INFERENCE	2+1
BST 563	MULTIVARIATE ANALYSIS	2+1
BST 564	DESIGN OF EXPERIMENTS	2+1
BST 565	SAMPLING TECHNIQUES	2+1
BST 566	STATISTICAL GENETICS	2+1
BST 567	REGRESSION ANALYSIS	1+1
BST 568	STATISTICAL COMPUTING	1+1
BST 569	SURVIVAL MODELS IN BIO-STATISTICS	2+1
BST 570	ACTUARIAL STATISTICS	2+0
BST 571	STOCHASTIC PROCESSES	2+0
BST 572	DEMOGRAPHIC TECHNIQUES IN BIO-STATISTICS	2+1
BST 573	ECONOMETRICS AND OPERATIONAL RESEARCH	2+1
BST 574	OPTIMIZATION TECHNIQUES	1+1
BST 591	MASTER'S SEMINAR	1+0
BST 599	MASTER'S RESEARCH	10+0

NOTE:

1. BST 551 and BST 552 are supporting courses. These are compulsory for all the students of Bio-Statistics.
2. BST 560 – BST 569 are core courses to be taken by all the students of Bio-Statistics.
3. BST 591 and BST 599 are compulsory for all the students.
4. A student has to take a minimum of 36 credits course work, excluding the supporting courses, seminar and research.
5. The contents of BST 501 – BST 568, BST 570 and BST 574 are same as the corresponding courses in STAT 501 – STAT 568, STAT 570 and STAT 574.

BIO-STATISTICS

Course Contents

BST 569 **SURVIVAL MODELS IN BIO-STATISTICS** **2+1**

Objective

The course deals with study of survival times and their statistical properties along with the factors affecting them.

Theory

UNIT I

Concept of survival data, definition and associated probability density function, survival function, hazard function, Censoring in survival time.

UNIT II

Estimation of survival function by life table analysis, Kaplan and Meirer Method.

UNIT III

Survival and failure time distributions: family of exponential and Weibul models.

UNIT IV

Analytical and graphical method for choosing best fitted distribution, Parametric and non-parametric tests for comparison of survival functions.

UNIT V

Concomitant variables in lifetime distribution models, Cox-proportional hazard models, Cox-proportional hazard models with time dependent covariates.

Practical

Estimation of survival functions - life table analysis; Kaplan and Meirer Method. Estimation of survival functions in case of censored observations - life table method, Kaplan and Meirer method; Fitting of survival and failure time distributions: family of exponential and Weibul models (For uncensored and censored observations); Regression and Maximum Likelihood Method of fitting and choosing appropriate distribution to the survival times; Graphical method for choosing best fitted distribution, Parametric and Non-Parametric tests for comparison of survival functions; Parametric tests for comparison of survival functions in the presence of censored survival times; Non parametric tests for comparing survival functions in the presence of uncensored survival times; Concomitant variables in lifetime distribution models. Fitting of Cox-proportional hazard models.

Suggested Readings

- Anderson B. 1990. *Methodological Errors in Medical Research*. Blackwell.
- Armitage P & Berry G. 1987. *Statistical Methods in Medical Research*. Blackwell.
- Collett D. 2003. *Modeling Survival Data in Medical Research*. Chapman & Hall.
- Cox DR & Oakes D. 1984. *Analysis of Survival Data*. Chapman & Hall.
- Elandt-Johnson RC & Johnson NL. 1980. *Survival Models and Data Analysis*. John Wiley.
- Everitt BS & Dunn G. 1998. *Statistical Analysis of Medical Data*. Arnold.

- Hosmer DW, Lemeshow S & May S. 2008. *Applied Survival Analysis: Regression Modeling of Time-to-Event Data*. 2nd Ed. John Wiley.
- Klein JP & Moeschberger ML. 2003. *Survival Analysis: Techniques for Censored and Truncated Data*. 2nd Ed. Springer.
- Kleinbaum DG & Klein M. 2002. *Logistic Regression*. Springer.
- Kleinbaum DG & Klein M. 2005. *Survival Analysis. A Self Learning Text*. 2nd Ed. Springer.
- Lee ET & Wang JW. 2003. *Statistical Methods for Survival Data Analysis*. John Wiley.
- Therneau TM & Grambsch PM. 2000. *Modeling Survival Data: Extending the Cox Model*. Springer.

BST 571

STOCHASTIC PROCESSES

2+0

Objective

This is a course which aims at describing basic theory and applications of stochastic process. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

UNIT I

Basics of stochastic processes. Random walk models. Markov chains and their applications. Discrete branching processes.

UNIT II

Markov processes in continuous time: Poisson process, Random-variable technique. Birth and death processes like pure birth process, linear birth and death process, immigration-birth-death process.

UNIT III

Epidemic processes: Simple deterministic and stochastic epidemic model. General epidemic models, Recurrent epidemics.

UNIT IV

Chain binomial models. Diffusion processes. Diffusion limit of a random walk and discrete branching process. Forward and backward Kolmogorov diffusion equations and their applications.

Suggested Readings

- Bartlett MS. 1955. *Introduction to Stochastic Processes*. Cambridge Univ. Press.
- Bharucha-Reid AT. 1960. *Elements of the Theory of Markov Processes and their Applications*. McGraw Hill.
- Bhat UN. 1972. *Elements of Applied Stochastic Processes*. Wiley Eastern.
- Cox DR & Miller HD. 1965. *The Theory of Stochastic Processes*. Methuen.
- Durrett R. 1999. *Essentials of Stochastic Processes*. Springer.
- Lawler GF. 1995. *Introduction to Stochastic Processes*. Chapman & Hall.
- Medhi J. 1982. *Stochastic Processes*. Wiley Eastern.
- Parzen E. 1962. *Stochastic Processes*. Holden-Day.
- Prabhu NU. 1965. *Stochastic Processes*. Macmillan.
- Ross SM. 1996. *Stochastic Processes*. 2nd Ed. John Wiley.
- Taylor HM & Karlin S. 1998. *An Introduction to Stochastic Modeling*. 3rd Ed. Academic Press.

Objective

This course is meant for training the students in measures of demographic indices, estimation procedures of demographic parameters. Students would also be exposed to population projection techniques and principles involved in bioassays.

TheoryUNIT I

Introduction to vital statistics, crude and standard mortality and morbidity rates, Estimation of mortality; Application and methods of constructing life table, abridged life tables; Increment-Decrement Life Tables.

UNIT II

Stationary and stable populations, Stationary and stable populations, Migration and immigration.

Demographic relations in Nonstable populations. Measurement of population growth, Lotka's model(deterministic) and intrinsic rate of growth, Measures of mortality and morbidity, Period and Cohort studies. Population projections

UNIT III

Fertility and reproduction: CBR, GFR, GRR and NRR. Measures of reproduction: total fertility rate, gross reproduction rate, net reproduction rate, replacement index, general fertility models.

UNIT IV

Estimation of median effective doses-their relative potency and standard errors.

UNIT V

Principle of biological assays, parallel line and slope ratio assays, choice of doses and efficiency in assays quantal responses, probit and logit transformations, epidemiological models; Probit analysis, Confounding with natural mortality and methods of its adjustment, Odds-ratio, Mantel-Henszel estimate and its confidence interval, testing of hypothesis in 2x2 and 2xk tables,

Practical

Problems based on estimation of crude and standard mortality and morbidity rates. Construction of life tables; Estimation of CBR, GFR, GRR and NRR; Probit Analysis. Odds-ratio tests, Mantel-Henszel estimate and its confidence interval, testing of hypothesis in 2x2 and 2xk tables. Population projections.

Suggested Readings

- Cox DR. 1957. *Demography*. Cambridge Univ. Press.
 Everitt BS & Dunn G. 1998. *Statistical Analysis of Medical Data*. Arnold.
 Fleiss JL. 1981. *Statistical Methods for Rates and Proportions*. John Wiley.
 Lawless JF. 1982. *Statistical Models and Methods for Lifetime Data*. John Wiley.
 MacMahon B & Pugh TF. 1970. *Epidemiology - Principles and Methods*. Little Brown.
 Mann NR, Schafer RE & Singpurwalla ND. 1974. *Methods for Statistical Analysis of Reliability and Life Data*. John Wiley.

- Miettinen OS. 1985. *Theoretical Epidemiology: Principles of Occurrence Research in Medicine*. John Wiley.
- Newell C. 1988. *Methods and Models in Demography*. Guilford Publ.
- Preston S, Heuveline P & Guillot M. 2001. *Demography: Measuring and Modeling Population Processes*. Blackwell.
- Rowland DT. 2004. *Demographic Methods and Concepts*. Oxford Press.
- Siegel JS & Swanson DA. 2004. *The Methods and Material of Demography*. 2nd Ed. Elsevier.
- Woolson FR. 1987. *Statistical Methods for the Analysis of Biomedical Data*. John Wiley.

BST 573

**ECONOMETRICS AND
OPERATIONAL RESEARCH**

2+1

Objective

This course is meant for training the students in econometric methods, operations research and their applications in agriculture. This course would enable the students in understanding the economic phenomena through statistical tools and economics principles.

Theory

UNIT I

Study of single equation linear regression models, Maximum likelihood and ordinary least squares methods of estimation, Statistical inference in linear regression, Estimation subject to linear restrictions.

UNIT II

Use of dummy variables, Multicollinearity and estimation and testing of hypothesis in linear models not of full rank.

UNIT III

Generalized least squares method of estimation, Seemingly unrelated regressions.

UNIT IV

Heteroscedasticity, Auto - correlation, Distributed lag models. Elements of time-series analysis, Components of time-series.

UNIT V

Measurement of secular trend-Methods of moving averages and curve fitting, Measurement of seasonal fluctuations, Measurement of cyclical fluctuations-Periodogram analysis, Harmonic analysis, Serial correlation and Correlogram.

Practical

Estimation of parameters of linear model through the methods of Ordinary Least Squares (OLS); Test of significance of the estimates; Restricted Ordinary Least Squares Method, Generalized least squares method, Weighted least squares method; Problem on Autocorrelation, Multicollinearity, Dummy variation, Heteroscedasticity; Analysis of time-series data. Serial correlation and Correlogram.

Suggested Readings

- Anderson TW. 1971. *The Statistical Analysis of Time Series*. John Wiley.
- Baltagi BH. 1999. *Econometrics*. Springer.
- Belsley DA, Kuh E & Welsch RE. 1980. *Regression Diagnostics: Identifying Influential Data and Source of Collinearity*. John Wiley.

- Everitt BS. 1987. *Introduction to Optimization Methods and their Application in Statistics*. Chapman & Hall.
- Johnston J. 1984. *Econometric Methods*. McGraw Hill.
- Klein LR. 1975. *A Text Book of Econometrics*. Prentice Hall of India.
- Koutsoyiannis A. 1992. *Theory of Econometrics*. Macmillan.
- Maddala GS. 1977. *Econometrics*. McGraw Hill.
- Rao SS. 1984. *Optimization Theory and Application*. Wiley Eastern.
- Rustagi JS. 1994. *Optimization Techniques in Statistics*. Boston Academic Press.
- Taha HA. 1999. *Operations Research: An Introduction*. Prentice Hall of India.
- Theil H. 1971. *Principles of Econometrics*. John Wiley.
- Zeleny M. 1974. *Linear Multi-objective Programming - Lecture Notes in Economics and Mathematical Systems*. Sr.95. Springer.

COMPUTER APPLICATION

Course Structure – at a Glance

1. Service Courses (For M.Sc. and Ph.D. programs of other disciplines)

CODE	COURSE TITLE	CREDITS
MCA 501	COMPUTERS FUNDAMENTALS AND PROGRAMMING	2+1
MCA 502	INTRODUCTION TO NETWORKING AND INTERNET APPLICATIONS	1+1

2. M. Sc. (Computer Application)

MCA 551	MATHEMATICAL FOUNDATIONS IN COMPUTER SCIENCE	3+0
MCA 552	NUMERICAL ANALYSIS	2+0
MCA 560	COMPUTER ORGANIZATION AND ARCHITECTURE	2+0
MCA 561	FUNDAMENTALS OF COMPUTER PROGRAMMING	2+1
MCA 562	OBJECT ORIENTED ANALYSIS AND DESIGN	2+1
MCA 563	OPERATING SYSTEM	2+1
MCA 564	DATA STRUCTURES AND ALGORITHMS	2+1
MCA 565	COMPILER CONSTRUCTION	2+1
MCA 566	DATA BASE MANAGEMENT SYSTEM	2+1
MCA 567	COMPUTER NETWORKS	2+0
MCA 568	SOFTWARE ENGINEERING	2+0
MCA 569	WEB TECHNOLOGIES AND APPLICATIONS	1+1
MCA 570	INTRODUCTION TO COMPUTER GRAPHICS	1+1
MCA 571	SIMULATION AND MODELING	1+1
MCA 572	GIS AND REMOTE SENSING TECHNIQUES	2+1
MCA 573	DATA WAREHOUSING AND DATA MINING	2+1
MCA 574	MULTIMEDIA AND APPLICATIONS	1+1
MCA 575	ARTIFICIAL INTELLIGENCE	2+1
MCA 576	BIOINFORMATICS COMPUTING	2+1
MCA 577	SOFT COMPUTING	2+0
MCA 578	INFORMATION SECURITY	2+0
MCA 591	MASTER'S SEMINAR	1+0
MCA 599	MASTER'S RESEARCH	10+0

NOTE

1. MCA 551 and MCA 552 are supporting courses. These are compulsory for all the students of Computer Application.
2. MCA 560 - MCA 569 are core courses to be taken by all the students of Computer Application.
3. MCA 591 and MCA 599 are compulsory for all the students.
4. A student has to take a minimum of 36 credits course work, excluding the supporting courses, seminar and research.

COMPUTER APPLICATION **Course Contents**

MCA 501 **COMPUTER FUNDAMENTALS
AND PROGRAMMING** **2+1**

Objective

This course builds an understanding of the structure of computers and how they execute programs, data representation and computer arithmetic. The course is also aimed to develop problem-solving strategies, techniques and skills to help students develop the logic, ability to solve the problems efficiently using C programming.

Theory

UNIT I

Computer Fundamentals - Number systems: decimal, octal, binary and hexadecimal; Representation of integers, fixed and floating point numbers, character representation; ASCII, EBCDIC.

UNIT II

Functional units of computer, I/O devices, primary and secondary memories.

UNIT III

Programming Fundamentals with C - Algorithm, techniques of problem solving, flowcharting, stepwise refinement; Representation of integer, character, real, data types; Constants and variables; Arithmetic expressions, assignment statement, logical expression.

UNIT IV

Sequencing, alteration and iteration; Arrays, string processing.

UNIT V

Sub-programs, recursion, pointers and files.

UNIT VI

Program correctness; Debugging and testing of programs.

Practical

Conversion of different number types; Creation of flow chart, conversion of algorithm/flowchart to program; Mathematical operators, operator precedence; Sequence, control and iteration; Arrays and string processing; Pointers and File processing.

Suggested Readings

- Balaguruswamy E. 1998. *Programming with ANSI C*. Tata McGraw Hill.
- Gottfried B. 1999. *Programming with C, Schaum Outline Series*. Tata McGraw Hill.
- Kanetkar Y. 1999. *Let Us C*. BPB Publ.
- Malvino AP & Brown JA. 1999. *Digital Computer Electronics*. Tata McGraw Hill.
- Mano MM. 1999. *Digital Logic and Computer Design*. Prentice Hall of India.

MCA 502 **INTRODUCTION TO NETWORKING
AND INTERNET APPLICATIONS** **1+1**

Objective

The course is aimed to provide fundamentals of networking and application protocols with the emphasis on developing web based applications.

Theory

UNIT I

Networking fundamentals, types of networking, network topology; Introduction to File Transfer Protocol (FTP), Telnet, Simple Mail Transfer Protocol (SMTP).

UNIT II

World Wide Web (WWW), working with Internet; Web pages, web sites, web servers; Web Applications.

UNIT III

Hyper Text Markup Language (HTML), DHTML, web based application development.

Practical

Network and mail configuration; Using Network Services; Browsing of Internet; Creation of web pages; Creation of websites using HTML and Creation of websites using DHTML.

Suggested Readings

Buyens J. 2002. *Microsoft FrontPage -Inside Out*. Microsoft Press.

Cox V, Wermers L & Reding EE. 2006. *HTML Illustrated Complete*. 3rd Ed. Course Technology.

Niederst J. 2001. *Web Design in a Nutshell*. O'Reilly Media.

Tanenbaum AS. 2003. *Computer Networks*. Prentice Hall of India.

MCA 551

MATHEMATICAL FOUNDATIONS IN COMPUTER SCIENCE

3+0

Objective

This course is designed to give basic foundations in mathematics that are needed to complement and improve the understanding of courses based on algorithm and problem solving.

Theory

UNIT I

Sets: Set theory, subsets, operations on sets, set cardinality and counting.

UNIT II

Functions: Bijective functions, pigeon-hole principle, Boolean functions, permutation functions, Boolean algebra, recursion relations.

UNIT III

Number Theory: Binary arithmetic, exponentiation, induction, sequences, big-oh notation, GCD, Euclidean algorithm, partially ordered sets, congruence and equivalence relation, encryption scheme, Fibonacci sequence, linear homogenous recurrence relations with constant coefficients.

UNIT IV

Graph Theory: Graphs, trees, LAN, Eulerian cycles, Hamiltonian cycles, graph coloring, graph algorithms.

UNIT V

Mathematical Logic: Propositional calculus, proposition, logic connectives and compound statements, conjunction, disjunction, truth tables, duality, tautologies and fallacies.

UNIT VI

Algebraic Systems: Subsemigroups, subgroups and cosets, homomorphisms, application of groups to counting, ring, integral domain and field.

Suggested Readings

- Abertson MO & Hutchinson JP. 1988. *Discrete Mathematics with Algorithms*. John Wiley.
- Deo N. 1984. *Graph Theory with Application to Engineering and Computer Science*. Prentice Hall of India.
- Knuth DE. 1968. *Art of Computer Programming*. Vol. I. *Fundamental Algorithms*. Addison Wesley.
- Tremblay JP & Manohar RP. 1975. *Discrete Mathematical Structures with Applications to Computer Science*. McGraw Hill.

MCA 552

NUMERICAL ANALYSIS

2+0

Objective

The primary objective of the course is to develop the basic understanding of the construction of numerical algorithms, and perhaps more importantly, the applicability and limits of their appropriate use.

Theory

UNIT I

Introduction to complex variables; Basic concepts: Floating point number system, Implication of finite precision, Rounding off errors.

UNIT II

Interpolation: Polynomial interpolation, Inverse interpolation, Spline interpolation; Numerical integration: Trapezoidal rule, Simpson's 1/3rd and 3/8th rules; Ordinary differential equations: Runge-Kutta methods, Predictor - corrector methods.

UNIT III

Linear system of equations: Gaussian's elimination, Operation counts, Implementation including pivoting and scaling, Direct factorization methods, Iterative techniques and their analysis.

UNIT IV

Linear Difference equations; Non-linear equations : Bisection, Newton Raphson, false positions, Secant methods, Iterative methods.

UNIT V

Inverse of Matrices; Computation of eigen values and eigen vectors: Error estimates, the power methods – Jacobi and Householder Method.

UNIT VI

Exposure to mathematical software packages.

Suggested Readings

- Atkinson KE & Han W. 2003. *Elementary Numerical Analysis*. 3rd Ed. John Wiley.
- Atkinson KE. 1978. *An Introduction to Numerical Analysis*. John Wiley.
- Jain MK, Iyengar SRK & Jain RK. 2007. *Numerical Methods for Scientific and Engineering Computation*. 7th Ed. New Age.
- Kennedy WJ & Gentle JE. 1980. *Statistical Computing*. Marcel Dekker.
- Krishnamurthi EV & Sen SK. 1986. *Computer – Based Numerical Algorithms*. East West Publ.
- Yakowitz S & Szidarovszky F. 1986. *An Introduction to Numerical Computation*. MacMillan.

MCA 560

**COMPUTER ORGANIZATION
AND ARCHITECTURE**

2+0

Objective

This course builds an understanding of the structure of computers and how they execute programs. The course introduces data representation, computer arithmetic, and machine instruction set design. It then introduces the common physical components of a computer, their interconnections, and the processes underlying program execution.

Theory

UNIT I

Number systems; Boolean algebra - minimization of Boolean function using Karnaugh Map.

UNIT II

Logic Gates, Combinational circuits – multiplexer, demultiplexer, encoder, decoder; Sequential circuits: Flip-flops, Half and Full adder, Shift register, Counters.

UNIT III

Organization of CPU, Control Unit- Instruction and Execution cycle in CPU, Register Organization, The Instruction Cycle, Instruction Pipelining.

UNIT IV

Memory organization - Internal memory: Semiconductor Main Memory (RAM, ROM, EPROM), Cache Memory, Advanced DRAM Organization; External Memory - Magnetic Disks, RAID, Optical Memory, Magnetic Tape.

UNIT V

Basic structure of computer hardware and system software - Addressing methods and machine programme sequencing; Input-output organizations - accessing I/O devices - direct memory access (DMA) – interrupts.

UNIT VI

Introduction to microprocessors – CISC and RISC Architecture, Study of functional units of microprocessors.

Suggested Readings

- Gear CW. 1974. *Computer Organization and Programming*. McGraw Hill.
Hayes JP. 1988. *Computer Architecture and Organisation*. McGraw Hill.
Malvino AP & Brown JA. 1999. *Digital Computer Electronics*. Tata McGraw Hill.
Mano MM. 1999. *Digital Logic and Computer Design*. Prentice Hall of India.
Mano MM. 2007. *Computer System Architecture*. Prentice Hall of India.
Stallings W. 2006. *Computer Organization and Architecture: Designing for Performance*. Pearson Edu.

MCA 561

**FUNDAMENTALS OF
COMPUTER PROGRAMMING**

2+1

Objective

The course is aimed to develop problem-solving strategies, techniques and skills, to help students develop the logic, ability to solve the problems efficiently using C programming.

Theory

UNIT I

Programming Fundamentals using C- Algorithm development, techniques of problem solving, flowcharting, stepwise refinement.

UNIT II

Structure of program, Data types, Constants, Variables, Expression, Operators.

UNIT III

Basic input/ output and library functions, Control structures, Arrays, String processing, Structure and union.

UNIT IV

Functions, Pointers, Pointer to functions, Function returning pointers, Dynamic memory allocation.

UNIT V

Structured programming concepts; Top down Design, Development of efficient programs.

UNIT VI

File management; Graphics.

Practical

Problems on data types; Input /output statements; Control statements, loops; Arrays, structures/unions; Pointers and string processing; Various operations in file management and Programming for graphics.

Suggested Readings

Balaguruswamy E. 1998. *Programming with ANSI C*. Tata McGraw Hill.

Gottfried B. 1999. *Programming with C, Schaum Outline Series*. Tata McGraw Hill.

Kanetkar Y. 1999. *Exploring C*. BPB Publ.

Kanetkar Y. 1999. *Let Us C*. BPB Publ.

Karnighan BW & Ritchie D. 2000. *The C Programming Language*. Prentice Hall of India.

Sethi R. 1996. *Programming Language Concepts*. Addison Wesley.

Tondo CL & Gimpel SE. 1991. *The C Answer Book*. Prentice Hall of India.

MCA 562

OBJECT ORIENTED ANALYSIS AND DESIGN

2+1

Objective

Object oriented analysis and design has emerged as a new paradigm of analysis and design of the systems. This course is designed to give exposure to basic concepts of object-oriented technology so as to program using object-oriented paradigm.

Theory

UNIT I

Procedural abstraction, command and functional procedures.

UNIT II

Data encapsulation - concepts of modules and interfaces; Data abstraction and types.

UNIT III

Introduction to object orientation; History and evolution of object oriented languages; Object Oriented Programming (OOP) languages (e.g. C++/

JAVA/ C# etc.) - Abstract data types, classes, objects, object/message paradigm.

UNIT IV

Overloading, dynamic binding, parametric polymorphism.

UNIT V

Inheritance: class and object inheritance, inheritance and dynamic binding, multiple inheritance.

UNIT VI

Object oriented software design; Generic and reusable classes.

Practical

Case studies using object oriented analysis and design (OOAD); Creation of classes with features - overloading, inheritance, data abstraction, polymorphism and Implementation of a case study.

Suggested Readings

Arnold K & Gosling J. 1996. *The Java Programming Language. The Java Series*. Addison Wesley.

Bergin J. 1994. *Data Abstraction: The Object-Oriented Approach Using C++*. McGraw Hill.

Holzner S. 1997. *The Visual C++ Programming Language*. Prentice Hall of India.

Johnsonbaugh R & Kalin M. 1995. *Object Oriented Programming in C++*. Prentice Hall.

Khoshafian S & Abnous R. 1995. *Object Orientation Concepts, Languages, Databases, User Interfaces*. John Wiley.

Sengupta S & Korobkin CP. 1994. *C++ Object Oriented Data Structures*. Springer.

Stroustrup B. 1997. *The C++ Programming Language*. Addison Wesley.

Troelsen A. 2005. *Pro C# 2005 and the .NET 2.0 Platform*. 3rd Ed. Apress.

MCA 563

OPERATING SYSTEM

2+1

Objective

The main objective of this course is to provide core knowledge of Operating Systems features, functions and techniques.

Theory

UNIT I

Operating system overview: operating system as an extended machine and resource manager; Operating system classifications; Operating system modes and system calls.

UNIT II

Operating system architecture; Process model, Process synchronization, Concurrent processes, Process scheduling criterion and algorithms.

UNIT III

Problem of mutual exclusion; Deadlock and prevention; Race conditions; Semaphores; Monitors; Process allocation.

UNIT IV

Memory management; Multi-programming with fixed and variable number of tasks; Continuous allocation; Paging, Demand paging, Page fault; Virtual memory; Fragmentation; Segmented memory management, Shared segments; Segmented and demand paged management, Overlays and swapping, Thrashing.

UNIT V

Multi processor system, Master slave scheduling; Homogeneous scheduling; Device management system; Dedicated share and virtual devices; Spooling channels; Multiplexer and selector, control units; Traffic controllers and device handlers.

UNIT VI

Information management memory techniques; Input-Output file protection; Distributed operating system (Course to be taught in accordance to the Unix Operating System).

Practical

Problems using system calls for process management, signaling, file management, directory management, protection; Critical section problem; Solution to mutual exclusion by Peterson method; Producer consumer problem with fatal race conditions; Comparison of various CPU scheduling algorithms and Paging, segmentation and demand paging.

Suggested Readings

- Bach MJ. 1998. *Design of the UNIX Operating System*. Prentice Hall of India.
- Deitel HM. 1990. *An Introduction to Operating System*. Addison Wesley.
- Dhamdhare DM. 2007. *Operating Systems: A Concept Based Approach*. 2nd Ed. Tata McGraw Hill.
- Kernighan BW & Pike R. 1996. *The UNIX Programming Environment*. Prentice Hall of India.
- Peterson J & Silberschatz A. 1991. *Operating System*. Addison Wesley.
- Silberchatz A, Galvin PB & Gagne G. 2001. *Operating system Concepts*. 6th Ed. John Wiley.
- Stallings W. 2006. *Operating Systems: Internals and Design Principals*. 5th Ed.. Prentice Hall of India.
- Tanenbaum AS. 2000. *Modern Operating Systems*. Prentice Hall of India.

MCA 564

DATA STRUCTURES AND ALGORITHMS

2+1

Objective

The learner should be well versed with the various data structures, fundamentals of algorithms, different sorting and searching techniques so as to use them appropriately as per need during development of programs.

Theory

UNIT I

Representation of character, string and their manipulation.

UNIT II

Linear list structure; Stacks; Queues; Heaps.

UNIT III

Sorting algorithms; Searching algorithms.

UNIT IV

Representation and processing of linear linked lists; Multiple linked structures; Sparse arrays.

UNIT V

Tree Structures: Representation of tree structures and different tree traversal algorithms.

UNIT VI

Graph and geometric algorithms.

Practical

Implementation of various types of structures - linked lists, doubly linked lists, circular linked lists, queue, dequeue, stack and tree; String processing; Searching and sorting techniques; Graph and geometric algorithms and Case studies

Suggested Readings

- Aho AV, Hopcroft JE & Ullman JD. 1983. *Data Structures and Algorithms*. Addison Wesley.
- Cormen TH, Leiserson CE, Rivest RL & Stein C. 2006. *Introduction to Algorithms*. Prentice Hall of India.
- Goodrich MT, Tamassia R & Mount D. 2004. *Data Structures and Algorithms in C++*. John Wiley.
- Horowitz E & Sahani S. 1983. *Fundamentals of Data Structures*. Galgotia Publ.
- Kleinberg J & Tardos E. 2006. *Algorithm Design*. Pearson Edu.
- Knuth DE. 1968. *Art of Computer Programming*. Vol. I. *Fundamental Algorithms*. Addison Wesley.
- Knuth DE. 1973. *Art of Computer Programming*. Vol. III. *Sorting and Searching*. Addison Wesley.
- Kruse RL & Ryba AJ. 1998. *Data Structures and Program Design in C++*. Prentice-Hall.
- Langsam Y, Augenstein MJ & Tanenbum AS. 1999. *Data Structures Using C and C++*. Prentice Hall of India.
- Tremblay JP & Sorenson PG. 1976. *An Introduction to Data Structures with Applications*. McGraw Hill.
- Weiss MA. 1994. *Data Structures and Algorithm Analysis in C++*. Benjamin/Cummings.

MCA 565

COMPILER CONSTRUCTION

2+1

Objective

The purpose of the course is to acquaint various phases of compiler writing which will help an application/system programmer working on other projects besides compilers.

Theory

UNIT I

Introduction to Compiler, Compilation Process, Compiler Structure.

UNIT II

Programming Language Grammars, Elements of a Formal Language Grammar, Derivation, Reduction & Syntax Trees, Ambiguity Regular Grammar & Regular Expression – Context Free Grammar.

UNIT III

Introduction to Finite Automata, Deterministic Finite Automata, Non-deterministic Finite Automata.

UNIT IV

Scanning & Parsing Techniques – The Scanner, Regular Grammar and FSA, Top Down Parsing, Parsing Algorithm, Top Down Parsing Without Backtracking, Predictive Parsers, Bottom Up Parsing, Parsing, LR Parsers, Shift Reduce Parsing.

UNIT V

Symbol Table Organization, Memory Allocation – Static & Dynamic Memory Allocation, Compilation Control Transfer, Procedure Calls, Conditional Execution, Iteration Control Construct; Lexical Syntax Errors, Semantic.

UNIT VI

Major Issues In Optimization, Optimizing, Transformations, Local Optimization, Program Flow Analysis, Global Optimization.

Practical

Design of a lexical analyser for regular expression; Design of a finite state machine; Program for - magic squares, context free grammar, shift reduce parsing, operator precedence parsing, recursive decent parsing, predictive parser, simple LR parser and Postfix form for intermediate code.

Suggested Readings

- Aho AV & Ullman JD. 1993. *Principles of Compiler Design Theory*. Narosa.
- Galles G. 2007. *Modern Compiler Design*. Pearson Edu.
- Holab A. 2006. *Compiler Design in C*. Prentice-Hall of India.
- Lewis PM, Rosenkrantz DJ & Stearns RE. 1978. *Compiler Design Theory*. Addison Wesley.
- Tremblay JP & Sorenson PG. 1985. *The Theory and Practice of Compiler Writing*. McGraw Hill.

MCA 566

DATA BASE MANAGEMENT SYSTEM

2+1

Objective

Database systems are backbone of any information system, enterprise resource planning, research activities and other activity that require permanence of data storage. This course provides the basic introduction to database system technologies; design, concurrency, security and backup/recovery issues of database management systems. The major focus in this course is the Relational database model.

Theory

UNIT I

Database system - Operational Data, Characteristics of database approach, architecture.

UNIT II

Overview of DBMS; Data associations - Entities, Attributes and Associations, Relationship among Entities, Representation of Associations and Relationship, Data Model classification.

UNIT III

Entity Relationship model; Relational Data Structure- Relations, Domains and Attributes, Relational Algebra and Operations, Retrieval Operations.

UNIT IV

Relational Database Design - Anomalies in a Database, Normalization Theory, and Normal forms; Query processing.

UNIT V

Distributed Databases- concepts, architecture, design; Structured Query Language (SQL) - Data Definition Language (DDL), Data Manipulation Language (DML).

UNIT VI

PL/SQL - Stored procedure, Database triggers; Relational Data Base Management Package.

Practical

E-R diagram construction; SQL - Command Syntax, Data types, DDL Statements, DML Statements, integrity constraints; Triggers, creating stored procedures/ functions; Normalization of database and Case study on a database design and implementation.

Suggested Readings

- Date CJ. 2000. *Introduction to Database System*. Addison Wesley.
Desai BC. 2000. *Introduction to Database Systems*. Galgotia Publ.
Elmasri & Navathe. 2006. *Fundamentals of Database Systems*. 4th Ed. Addison Wesley.
Garcia-Molina H, Ullman JD & Widom J. 2002. *Database Systems: The Complete Book*. Prentice Hall.
Rob P & Coronel C. 2006. *Database Systems: Design, Implementation and Management*. 7th Ed. Thomson Learning.
Silberschartz A, Korth HF & Sudarshan S. 1997. *Database Systems Concepts*. Tata McGraw Hill.

MCA 567

COMPUTER NETWORKS

2+0

Objective

This course addresses the principles, architectures and protocols that have gone into the development of the Internet and modern networked applications. The course examines network design principles, underlying protocols, technologies and architectures such as naming, data transport, routing and algorithms for networked applications including messaging, encryption and authentication.

Theory

UNIT I

The importance of Networking, Types of Networking, Network Topology, Transmission Media, Data communication: Concepts of data, signal, channel, bandwidth, bit-rate and baud-rate; Maximum data-rate of channel; Analog and digital communications, asynchronous and synchronous transmission.

UNIT II

Network adapters card, Multiplexer (FDM, TDM, STDM), Hub, Repeater. Network References Models: Layered architecture, protocol hierarchies, interface and services.

UNIT III

ISO-OSI references model, TCP/IP reference model; Data link layer function and protocols: Framing, error-control, flow control; sliding window protocol; HDLC, SLIP and PPP protocol.

UNIT IV

Network layer - routing algorithms, congestion control algorithms; Internetworking: bridges and gateway; Transport layer - connection management, addressing; Flow control and buffering, multiplexing.

UNIT V

Session layer – RPC; Presentation layer - abstract syntax notation.

UNIT VI

Application layer - File Transfer Protocol (FTP), Telnet, Simple Mail Transfer Protocol (SMTP); World Wide Web(WWW) - Wide Area Indexed Servers (WAIS), WAP; Network Security; Data compression and cryptography.

Suggested Readings

- Arick MR. 1994. *The TCP/IP Companion - A Guide for Common User*. Shroff Publ.
- Freer J. 1990. *Computer Communication and Networks*. Affiliated East West Press.
- Hayes J. 2001. *Modelling and Analysis of Computer Communication Networks*. Khanna Publ.
- Tanenbaum AS. 2003. *Computer Networks*. Prentice Hall of India.

MCA 568

SOFTWARE ENGINEERING

2+0

Objective

The objective of the course is to make the learner efficiently work as software engineer so as to acquaint them with all the phases of Software Development Life Cycle.

Theory

UNIT I

Software engineering definition; Software Development: Phases, Process models, Project structure, Project team structure, Role of metrics, Measurement, Software quality factors.

UNIT II

Planning and Software Project: Requirement analysis, Cost estimation, Project Scheduling, Quality Assurance Plan, and Project Monitoring Plans, Gantt charts, PERT and CPM.

UNIT III

System Design: Design Objectives, Design Principles, Design Tools, and Techniques, Prototyping.

UNIT IV

Structured Programming Coding: Programming practices, Verification, Monitoring and Control.

UNIT V

Testing: Testing Fundamentals, Functional Testing, Structural Testing, Test Plan activities, Unit testing, Integration Testing.

UNIT VI

Reliability: Concept of Software Reliability, Reliability Models, Limitations of Reliability Models, Software Maintenance. CASE tools.

Suggested Readings

- Aggarwal KK & Singh Y. 2006. *Software Engineering*. 2nd Ed. New Age.
- Awad EM. 1993. *System Analysis and Design*. Galgotia Publ.
- Fairley R. 1999. *Software Engineering Concepts*. Tata McGraw Hill.
- Jalote P. 2005. *An Integrated Approach to Software Engineering*. 3rd Ed. Narosa.
- Kerzner H. 1998. *Project Management: A System Approach to Planning, Scheduling and Controlling*. CBS.
- Mall R. 2006. *Fundamentals of Software Engineering*. 2nd Ed. Prentice-Hall of India.

Pressman RS. 2006. *Software Engineering: A Practitioner's Approach*. 6th Ed. McGraw Hill.
Sommerville I. 2004. *Software Engineering*. 6th Ed. Pearson Edu.

MCA 569 WEB TECHNOLOGIES AND APPLICATIONS 1+1

Objective

The main objective of the course is to introduce the whole range of web technologies. Through the various examples, the course will describe how to design a specific page, dynamic web pages, forms and frames and interaction with a database.

Theory

UNIT I

Survey of contemporary Internet Technologies - Role, use and implementation of current tools.

UNIT II

Application Layer Services and protocols - Domain name services, network management protocol, electronic mail and file transfer protocol.

UNIT III

World Wide Web – Web pages, Web Sites, Web Servers; Intranet and Extranet Concepts; Web Application Architectures.

UNIT IV

Hyper Text Markup Language (HTML); Building static and dynamic web pages.

UNIT V

Scripting Languages - Client side and server side scripting; Interaction with database.

UNIT VI

Latest trends in programming on the emerging technologies relating to web based software development.

Practical

Designing static website with features like tables, hyperlink among pages, pictures, frames and layers; Client side scripting for user interface validation; Server side scripting for database interaction; and Designing of a information system.

Suggested Readings

- Ayers D, Bergsten H, Bogovich M, Diamond J, Ferris M, Fleury M, Halberstadt A, Houle P, Mohseni P, Patzer A, Philips R, Li S, Vedati K, Wilcox M & Zeiger S. 1999. *Professional Java Server Programming*. Wrox Press Ltd.
- Boudreaux 2005. *PHP 5: Your Visual Blueprint for Creating Open Source, Server-side Content*. (Visual Blueprint). Visual.
- Ellis MD. 2007. *ASP.NET AJAX Programming Tricks*. Magma Interactive.
- Esposito D. 2007. *Introducing Microsoft ASP.NET AJAX (Pro - Developer)*. Microsoft Press.
- Evjen B, Hanselman S & Rader D. 2008. *Professional ASP.NET 3.5: In C# and VB (Programmer to Programmer)*. Wrox Press Ltd.
- Haefel-Monson R. 2003. *Enterprise JavaBeans*. O'Reilly & Associates.
- Naughton P & Schildt H. 2001. *The Complete Reference, Java 2*. Tata McGraw Hill.

and structure of real world systems. This course will help in simulation of agricultural research problems and systems.

Theory

UNIT I

Uses and purposes of simulation; Classification of models.

UNIT II

Generation and testing of random numbers.

UNIT III

Simulation of stochastic events and processes, Discrete event simulation.

UNIT IV

Design of simulation experiments. Analysis of data generated by simulation experiments. Verification and validation of simulation models.

UNIT V

Simulation languages.

UNIT VI

Simulation of agricultural problems and systems.

Practical

Generation of random numbers; Testing randomness of generated random numbers; Generation of random variates following Normal, Beta, Gamma, Exponential, Chi-square, Student's-t, F, Weibull, Binomial, Poisson distributions with the given parameters; Discrete event simulation and Simulation from specific models applicable in agriculture.

Suggested Readings

- Averill ML & Kelton D. 2005. *Simulation, Modelling and Analysis*. Tata McGraw Hill.
- Banks J. 1998. *Handbook of Simulation*. John Wiley.
- Bratley P, Fox BL & Schrage LE. 1987. *A Guide to Simulation*. Springer.
- Deo N. 1987. *System Simulation with Digital Computer*. Prentice Hall of India.
- Gentle GE. 2005. *Random Number Generation and Monte Carlo Methods*. Springer.
- Gordan G. 2007. *System Simulation*. Pearson Edu.
- Kennedy WJ & Gentle JE. 1980. *Statistical Computing*. Marcel Dekker.
- Kleijnen JPC. 1974. *Statistical Techniques in Simulation*. Parts I, II. Marcel Dekker.
- Knuth DE. 1968. *Art of Computer Programming*. Vol. I. *Fundamental Algorithms*. Addison Wesley.
- Press WH, Flannery BP, Teukolsky SA & Vetterling WT. 1986. *Numerical Recipes: The Art of Scientific Computing*. Cambridge Univ. Press.
- Ripley BD. 1987. *Stochastic Simulation*. John Wiley.
- Taha HA. 2003. *Operations Research: An Introduction*. Prentice Hall of India.

MCA 572

GIS AND REMOTE SENSING TECHNIQUES

2+1

Objective

The basic objective of this course is to teach concepts of GIS and remote sensing with specific applications in agriculture related statistics.

Theory

UNIT I

Introduction to Geographical Information System (GIS); Introduction- maps and spatial information, components of a GIS; GIS Internals - data representation- raster and vector data structures and analysis techniques.

UNIT II

Digital Elevation Models; Data input, verification, storage and output.

UNIT III

Spatial modelling- manual and automatic digitizing process; Data errors in GIS; Classification methods-multivariate analysis and classification.

UNIT IV

Spatial interpolation; Current and potential uses of GIS in agricultural planning; Software components used in GIS; GIS in India.

UNIT V

Physics of remote sensing, atmospheric effects and remote sensing sensors; Spectral signatures of earth surface features, spectral characteristics of vegetation, soil and water.

UNIT VI

Data acquisition system, satellite image acquisition; Data collections: pre-processing and data storage; Visual and digital image interpretation; Digital image processing.

Practical

Digitization of a map with the help of a digitizer; Map editing; Geo-referencing and map projections; Creation of attribute database and linking with spatial data; General analysis of the data with the help software; Applications of digital elevation models using GIS; Spatial interpolations using GIS; Visual interpretations of remote sensing data; Geometric corrections of remote sensing digital data; Methods for improving quality of digital data and Techniques of image classifications.

Suggested Readings

- Annadurai S & Shanmugalakshmi R. 2007. *Fundamentals of Digital Image Processing*. Pearson Edu.
- Burrough PA. 1986. *Principles of Geographic Information System for Land Resources Assessment*. Oxford Univ. Press.
- Curran PJ. 1985. *Principles of Remote Sensing*. Longman.
- Jensen JR. 1996. *Introductory Digital Image Processing*. Prentice Hall.
- Lillesand TM & Kiefer RW. 1987. *Remote Sensing and Image Interpretation*. John Wiley.
- Peuquet DJ & Marble DF. 1990. *Introductory Readings in Geographic Information System*. Taylor & Francis.

MCA 573

DATA WAREHOUSING AND DATA MINING

2+1

Objective

The basic objective of this course is to familiarize students about this state of art of Business Intelligence in relation to agricultural research, development and planning.

Theory

UNIT I

Concepts and principles of data warehousing; Data warehousing architecture.

UNIT II

System process and process architecture; Data warehousing design; Database schema.

UNIT III

Partitioning strategy; Aggregations; Data marts; Meta data management; Data warehouse process.

UNIT IV

Query Management; Data warehouse security; Backup and recovery; Capacity planning; Testing the warehouse.

UNIT V

Introduction to data mining; Neural networks; Fuzzy logic.

UNIT VI

Visualization techniques; Decision trees; Association rules; Statistical and clustering models.

Practical

Data warehouse design, selection of schema; Normalization and renormalization; Query plan strategy; Performance tuning, backup and recovery of data warehouse; Dynamic reporting and OLAP cubes; Data mining techniques: Neural networks, fuzzy logic, visualization techniques and decision trees.

Suggested Readings

- Gupta GK. 2006. *Introduction to Data Mining with Case Studies*. Prentice Hall of India.
- Han J & Kamber M. 2006. *Data Mining: Concepts and Techniques*. 2nd Ed. Morgan Kaufman.
- Inmon B. 2005. *Building the Data Warehouse*. 4th Ed. John Wiley.
- Kelly S. 1997. *Data Warehousing in Action*. John Wiley.
- Kimball R. 2000. *The Data Webhouse Toolkit: Building the Web-Enabled Data Warehouse*. John Wiley.
- Kimball R. 2002. *The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling*. John Wiley.
- Kimball R. 2004. *The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data*. John Wiley.
- Kimball R. 2005. *The Microsoft Data Warehouse Toolkit: With SQL Server 2005 and the Microsoft Business Intelligence Toolset*. John Wiley.
- Kimball R. 2008. *The Data Warehouse Lifecycle Toolkit*. 2nd Ed. *Practical Techniques for Building Data Warehouse and Business Intelligence Systems*. John Wiley.
- Lee KH. 2005. *First Course on Fuzzy Theory and Applications*. Springer.

MCA 574

MULTIMEDIA AND APPLICATIONS

1+1

Objective

This course introduces students to current practices, technologies, methodologies, and authoring systems in the design and implementation of systems that incorporate text, audio, images, animation and full-motion video.

Theory

UNIT I

Introduction to Multimedia Technology - Computers, communications and entertainment; Framework for multimedia systems.

UNIT II

M/M devices, presentation devices and the user interface, M/M presentation and authoring.

UNIT III

Digital representation of sound and transmission; Brief survey of speech recognition and generation; Digital video and image compression; JPEG image compression standard; MPEG motion video compression.

UNIT IV

DVD technology, Time based media representation and delivery; M/M software environment; Limitation of workstation operating systems.

UNIT V

M/M systems services; OS support for continuous media applications; Media stream protocol; M/M file system and information representation.

UNIT VI

Data models for M/M and Hypermedia information.

Practical

Script Writing and Story Boards; Hot Spots and Buttons, Layouts and designing of visuals, Basics of colors; Working with text, presentations, charts and putting animations; Creating interactive presentations; Adobe Photoshop – Introduction, Working with images, Image editing and cleaning;

Macromedia Flash - Introduction, Creating shapes, Inserting text, Concepts of colors, layers, frames and timelines; Creating Animation - Creating scenes, creating movie, testing and playing movie; Adobe Acrobat – Overview, Creating Adobe PDF e-Books; Macro Media Director Basics.

Suggested Readings

Furhet B. 1998. *Multimedia Technologies and Applications for the 21st Century*. Kluwer.

Gibbs SJ & Tsischritziz DC. 1995. *Multimedia Programming - Objects, Environment & Framework*. Addison-Wesley.

Kerman P. 2002. *Teach Yourself Macromedia Flash MX*. Sams Publ.

Luther AC. 1994. *Authoring Interactive Multimedia*. Academic Press.

Parekh R. 2006. *Principles of Multimedia*. Tata McGraw-Hill.

Vaughan T. 2003. *Multimedia-Making it Work*. McGraw-Hill.

MCA 575

ARTIFICIAL INTELLIGENCE

2+1

Objective

The primary objective of this course is to provide an introduction to the basic principles and applications of Artificial Intelligence that includes problem solving, knowledge representation, reasoning, decision making, planning, perception & action, and learning.

Theory

UNIT I

Introduction to Artificial Intelligence (AI); Scope of AI: Games, theorem proving, natural language processing, robotics, expert system.

UNIT II

Knowledge: General concept of knowledge, Knowledge based system, Representation of knowledge, Knowledge organization and manipulation, Acquisition of knowledge.

UNIT III

Symbolic approach: Syntax and Semantics for Propositional Logic (PL) and First order predicates logic (FOPL), Properties of well formed formulas (wffs), Conversion to clausal form, Inference rules, Resolution principle, Non deductive inference methods.

UNIT IV

Search and Control strategies: Blind search, Breadth- first search, Depth – First search, Hill climbing method, Best – First search, Branch and Bound search.

UNIT V

Learning: Concept of learning, learning automation, genetic algorithms, learning by induction.

UNIT VI

Expert System: Introduction to expert system, Characteristics features of expert system, Applications, Importance of Expert system, Rule based system architecture.

Practical

Search and Control strategies: Blind search, Breadth- first search, Depth – First search, Hill climbing method, Best – First search, Branch and Bound search; Learning by induction; Genetic algorithms; Case study of a rule based expert system and Construction of Decision tree.

Suggested Readings

- Akerkar R. 2005. *Introduction to Artificial Intelligence*. Prentice-Hall of India.
- Giarratano J & Riley G. 1998. *Expert Systems - Principles and Programming*. 3rd Ed. PWS Publ.
- Gonzalez A & Dankel D. 2004. *The Engineering of Knowledge-Based Systems*. Prentice Hall.
- Hill EF. 2003. *Jess in Action*. Manning Publ.
- Jackson P. 1999. *Introduction to Expert Systems*. Addison Wesley.
- Nilson NJ. 2000. *Artificial Intelligence: A New Synthesis*. Morgan Kaufman.
- Nilson NJ. 2001. *Principles of Artificial Intelligence*. Narosa.
- Rich E & Knight K. 2002. *Artificial Intelligence*. Tata McGraw Hill.
- Russell S & Norvig P. 2003. *Artificial Intelligence: A Modern Approach*. Prentice Hall.

MCA 576

BIOINFORMATICS COMPUTING

2+1

Objective

The aim of the course is to introduce modern computational practices in bioinformatics at the algorithmic level that will train the students to complement researchers with biological background.

Theory

UNIT I

The Central Dogma, Review and Utilization of Biological Databases.

UNIT II

Overview of Algorithms: Pattern Matching, Biological Motivation Naïve Algorithm.

UNIT III

Pre-processing: Suffix trees Time and Space Considerations. Approximate Pattern Matching: Sequence Comparisons, Dot Plots. Sequence Alignment: Dynamic Programming, Global and Local Alignments Scoring Matrices, BLAST, FASTA Parameters.

UNIT IV

Similarity and Distance: PAM & BLOSUM matrices, Heuristic Approaches.

UNIT V

Exhaustive Search Fragment Assembly: DNA Sequencing, Greedy Algorithms, Sequencing by Hybridization Fragment Assembly.

UNIT VI

Graph Algorithms, Overlap Graphs, and Hamiltonian Path Wrap-up.

Practical

Suffix trees: Time and Space Considerations; Approximate Pattern Matching: Sequence Comparisons, Dot Plots; Sequence Alignment: Dynamic Programming, Global and Local Alignments Scoring Matrices, BLAST, FASTA Parameters; Similarity and Distance: PAM & BLOSUM matrices, Heuristic Approaches and Exhaustive Search Fragment Assembly: DNA Sequencing, Greedy Algorithms, Sequencing by Hybridization Fragment Assembly, Graph Algorithms, Overlap Graphs, and Hamiltonian Path Wrap-up.

Suggested Readings

- Bryan B. 2002. *Bioinformatics Computing*. Prentice Hall.
Duda RO, Hart PE & Stork DG. 1999. *Pattern Classification*. John Wiley.
Ewens WJ & Grant GR. 2001. *Statistical Methods in Bioinformatics*. Springer.
Jones NC & Pavel AP. 2004. *Introduction to Bioinformatics Algorithms*. MIT Press.
Koskinen T. 2001. *Hidden Markov Models for Bioinformatics*. Kluwer.
Krane DE & Raymer ML. 2002. *Fundamental Concepts of Bioinformatics*. Benjamin / Cummings.
Krawetz SA & Womble DD. 2003. *Introduction to Bioinformatics: A Theoretical and Practical Approach*. Humana Press.
Lesk AM. 2002. *Introduction to Bioinformatics*. Oxford Univ. Press.
Shortliffe EH & Cimino JJ. 2006. *Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)*. Springer.
Wang JTL, Zaki MJ, Toivonen HTT & Shasha D. 2004. *Data Mining in Bioinformatics*. Springer.

MCA 577

SOFT COMPUTING

2+0

Objective

This course introduces the soft computing techniques and their applications in solving real world problems. The course is dealt with the perspective of using soft computing techniques in machine learning.

Theory

UNIT I

Introduction to soft-computing tools – Fuzzy Logic, Genetic Algorithm, Neural Networks and Probabilistic Reasoning, Rough Sets.

UNIT II

Applications of Fuzzy Logic concepts in Knowledge Management.

UNIT III

Optimization problem solving using genetic algorithm.

UNIT IV

Neuron as a simple computing element, the perceptron, multilayer neural networks, Neural network approaches in data analysis, design and diagnostics problems; Applications of probabilistic reasoning approaches.

Suggested Readings

Goldberg DE. 1989. *Genetic Algorithms in Search, Optimization, and Machine Learning*. Addison Wesley.

Haykin S. 1998. *Neural Networks: A Comprehensive Foundation*. Prentice Hall.

Jang JR, Sun C & Mizutani E. 1996. *Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*. Prentice Hall.

Kecman V & Kecman V. 2001. *Learning and Soft Computing: Support Vector Machines, Neural Networks, and Fuzzy Logic Models*. MIT Press.

Lee KH. 2005. *First Course on Fuzzy Theory and Applications*. Springer.

Mitra S & Acharya T. 2003. *Data Mining: Multimedia, Soft Computing, and Bioinformatics*. John Wiley.

MCA 578

INFORMATION SECURITY

2+0

Objective

This course provides exposure to challenges and techniques for securing the information in servers and Web enabled systems. The course deals with theoretical as well as practical issues of Information Security.

Theory

UNIT I

General introduction to security, Cryptographic techniques: classical cryptography, conventional cryptography (DES), public-key cryptography (RSA), and digital signatures (DSA), steganography.

UNIT II

Security services: message integrity, confidentiality and authentication, certification and key management (PKI).

UNIT III

Network security applications: IP security (IPsec), Web security (SSL, TLS, SET), Electronic mail security (PGP, S/MIME), and SNMP security.

UNIT IV

Access control in computer networks: authentication protocols and services (Kerberos), firewalls and Virtual Private Networks (VPNs).

UNIT V

System security: intrusion detection, viruses.

UNIT VI

E-commerce securities: e-payment systems, fair data exchange.

Suggested Readings

Amoroso E. 1994. *Fundamentals of Computer Security Technology*. Prentice-Hall.

Chapman B & Zwicky ED. 2000. *Building Internet Firewalls*. O'Reilly.

Ford W. 1994. *Computer Communications Security*. Prentice Hall.
Pfleeger CP. 2006. *Security in Computing*. Prentice Hall.
Stallings W. 2003. *Cryptography and Network Security: Principles and Practice*. Prentice-Hall.

List of Journals

Statistics / Agricultural Statistics / Bio-Statistics

- American Statistician
- Annals of Institute of Statistical Mathematics
- Annals of Statistics
- Australian and New Zealand Journal of Statistics
- Biometrical Journal
- Biometrics
- Biometrika
- Bulletin of Calcutta Statistical Association
- Canadian Journal of Statistics
- Communication in Statistics (Simulation & Computation)
- Communication in Statistics (Theory & and Methods)
- Experimental Agriculture
- Institute of Mathematical Statistics Bulletin (IMSB)
- Journal of American Statistical Association
- Journal of Applied Statistics
- Journal of the Indian Society of Agricultural Statistics
- Journal of the International Statistical Review
- Journal of Statistical Planning and Inference
- Journal of Statistical Theory and Practice
- Journal of Statistics, Computer and Applications
- Journal of Royal Statistical Society, Series A
- Journal of Royal Statistical Society, Series B
- Journal of Royal Statistical Society, Series C
- Metrika
- Metron
- Scandinavian Journal of Statistics (Theory & Applied)
- Sankhya
- Statistica
- Statistical Science
- Statistics and Probability Letters
- Technometrics

Computer Application

- ACM Transactions on Knowledge Discovery from Data
- Applied Intelligence - The International Journal of Artificial Intelligence, Neural Networks, and Complex Problem-Solving Technologies
- Computational Statistics & Data Analysis, Elsevier Inc.
- Computers and Electronics in Agriculture, Elsevier Inc.
- Data Mining and Knowledge Discovery: An International Journal (DMKD)
- Expert Systems with Applications, Elsevier Inc.
- IEEE Transactions on Knowledge and Data Engineering
- IEEE Transactions on Neural Networks

- IEEE Transactions on Pattern Analysis and Machine Intelligence
- International Journal of Computing and Information Sciences
- International Journal of Information and Management Sciences
- International Journal of Information Technology
- Journal of Artificial Intelligence Research
- Journal of Combinatorics, Information and System Sciences
- Journal of Computer Sciences and Technology
- Journal of Computer Society of India
- Journal of Indian Society of Agricultural Statistics
- Journal of Intelligent Information Systems - Integrating Artificial Intelligence and Database Technologies
- Journal of Machine Learning Research
- Journal of Statistics, Computer and Applications
- Journal of Systems and Software
- Journal of Theoretical and Applied Information Technology
- Knowledge and Information Systems: An International Journal (KAIS)
- Lecture Notes in Computer Science, Springer Verlag.
- Machine Learning
- Transactions on Rough Set

e-Resources

- Design Resources Server. *Indian Agricultural Statistics Research Institute(ICAR), New Delhi 110 012, India.* www.iasri.res.in/design.
- Design Resources: www.designtheory.org
- Free Encyclopedia on Design of Experiments
- http://en.wikipedia.org/wiki/Design_of_experiments
- Statistics Glossary http://www.cas.lancs.ac.uk/glossary_v1.1/main.html.
- Electronic Statistics Text Book: <http://www.statsoft.com/textbook/stathome.html>.
- Hadamard Matrices <http://www.research.att.com/~njas/hadamard>;
- Hadamard Matrices
<http://www.uow.edu.au/~jennie/WILLIAMSON/williamson.html>.
- Course on Experimental design: <http://www.stat.sc.edu/~grego/courses/stat706/>.
- Learning Statistics: <http://freestatistics.altervista.org/en/learning.php>.
- Free Statistical Softwares: <http://freestatistics.altervista.org/en/stat.php>.
- Statistics Glossary http://www.cas.lancs.ac.uk/glossary_v1.1/main.html.
- Statistical Calculators: <http://www.graphpad.com/quickcalcs/index.cfm>
- SAS Online Doc 9.1.3: <http://support.sas.com/onlinedoc/913/docMainpage.jsp>

Suggested Broad Topics for Research

Statistics / Agricultural Statistics / Bio-Statistics

- Design and analysis of multi-response experiments
- Design and analysis of micro-array experiments
- Design and analysis of experiments for precision agriculture
- Design and analysis of agroforestry experiments
- Bayesian designing of experiments, Bayesian optimality and Bayesian analysis of experimental data
- Computer aided search of efficient experimental designs for various experimental settings
- Fractional factorials including search designs, supersaturated designs, computer experiments, etc.
- Statistical techniques in bioinformatics, biotechnology, microbiology, genomics, etc.
- Optimality aspects and robustness of designs against several disturbances under various experimental settings (single factor, multi-factor, nested classifications, etc.)
- Small area estimation
- Computer intensive techniques in sample surveys
- Analysis of survey data, regression analysis, categorical data analysis, analysis of complex survey data
- Assessment and impact survey methodologies, valuation of natural resources, its degradation, depletion, etc.
- Linear and non-linear modeling of biological and economical phenomena
- Non-linear time series modeling
- Non-linear stochastic modeling
- Forecast models for both temporal and spatial data
- Innovative applications of resampling techniques
- Applications of remote sensing, GIS, ANN etc. in modeling various phenomena
- Econometric models for risk, uncertainty, insurance, market analysis, technical efficiency, policy planning, etc.
- Statistical studies on value addition to crop produce

Computer Application

- Web solutions in agriculture
- Decision Support/Expert Systems/Information Management Systems in Agriculture
- Software for Statistical Data Analysis
- Modelling and Simulation of Agricultural Systems
- Application Software for GIS and Remote Sensing
- Office Automation and Management System

Compulsory Non-Credit Courses

The following non-credit courses are compulsory for all streams.

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 505	CROP PRODUCTION: CONCEPTS AND PRACTICES	2+1
PGS 506	DISASTER MANAGEMENT	1+0

PGS 501 **LIBRARY AND INFORMATION SERVICES** **0+1**
 (Compulsory for M.Sc. programme in all disciplines;
 Optional for Ph.D. programmes)

Objective

To equip the library users with skills: to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer. Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources. Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.). Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography. Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services. Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 **TECHNICAL WRITING AND COMMUNICATIONS SKILLS** **0+1**
 (Compulsory for M.Sc. programme in all disciplines;
 Optional for Ph.D. programmes)

Objective

To equip the students/scholars with skills to write dissertations, research papers, and also with skills to communicate and articulate in English (verbal as well as written).

Practical

Technical writing

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc. Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion). Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations

in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations. Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication skills

Grammar (Tenses, parts of speech, clauses, punctuation marks). Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription. Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Carmen R. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek, Chandigarh.
- Chicago Manual of Style*. 14th Ed. 1996. Prentice-Hall of India, New Delhi.
- Collins' Cobuild English Dictionary*. 1995. Harper Collins, New York.
- Gibaldi, Joseph. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press, New Delhi.
- Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford UP, Oxford.
- Mills GH & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston, New York.
- Mohan K. 2005. *Speaking English Effectively*. Macmillan India, New Delhi.
- Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice-Hall of India, New Delhi.
- Shelton JH. 1994. *Handbook for Technical Writing*. NTC Business Books, Chicago.
- Smith RW. 1969. *Technical Writing*. Barnes & Noble, New York.
- Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand, New Delhi.

PGS 503
(e-course)

INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE

1+0

(Compulsory for M.Sc. programme in all disciplines;
Optional for Ph.D. programmes)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR), related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

UNIT I

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs.

UNIT II

Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks,

protection of plant varieties and farmers' rights and bio-diversity protection.

UNIT III

Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives.

UNIT IV

Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI, Wallingford.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill, New Delhi.
- India, Ministry of Agriculture. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation, New Delhi.
- Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies, New Delhi.
- Rothschild M & Newman S. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI, Wallingford.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya, Delhi.
- The Indian Acts - *Patents Act, 1970 & Amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 & amendments; Layout Design Act, 2000; PPV & FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

PGS 504
(e-course)

AGRICULTURAL RESEARCH, RESEARCH ETHICS 1+0
AND RURAL DEVELOPMENT PROGRAMMES
(Compulsory for Ph.D. programme)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Govt.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Reg. Agril. Research Institutions; Consultative Group on International Agril. Research (CGIAR); International Agril. Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla GS & Singh G. 2001. *Indian Agriculture – Four Decades of Development*. Sage Publ., New Delhi.
- Kartar Singh. 1998. *Rural Development – Principles, Policies and Management*. Sage Publ., New Delhi.
- Punia, M.S. *Manual on International Research and Research Ethics*. CCS HAU Hisar.
- Rao BSV. 2007. *Rural Development Strategies and Role of Institutions – Issues, Innovations and Initiatives*. Mittal Publ., New Delhi.

PGS 505

CROP PRODUCTION: CONCEPTS AND PRACTICES 2+1 (Compulsory for non-agriculture graduates of Master's programme)

Objective

To impart theoretical and practical knowledge about crop production under different agro-ecological conditions.

Theory

UNIT I

Agriculture and its role in national development, food security; General features of climate - India; Crop environment, weather and significance of various weather elements; Crop production - definition and scope, crop classification based on season, life cycle, taxonomy and economic use; Growth and yield of crops, growth parameters, yield attributes and factors affecting them; Thermal and photo response of plants, thermal indices and growing degree day concept in crop phenology.

UNIT II

Quality of good seed, ideal condition for germination, seed treatment, hybrid and composite seeds, categories of seeds (certified, foundation and breeder seed); Importance of sowing time, seed rate, sowing methods, plant population; Tillage and intercultural operations - objectives and methods; Weeds in crop production; Irrigation - scheduling, methods and water use efficiency; Harvesting, threshing, winnowing, storage and processing.

UNIT III

Crop rotations, mixed cropping, inter cropping, its objectives and importance; Definitions of monocropping, double cropping, multiple/intensive cropping, relay cropping with example in brief; Farming system and sustainable agriculture.

UNIT IV

Rainfed agriculture and dry farming, soil moisture conservation; Agronomic techniques to improve crop yields and watershed management.

UNIT V

Soil as a three phase disperse system, its physical chemical and biological properties; Soil fertility and soil productivity, manures and fertilizers, integrated nutrient management; Soil and water testing: objectives, sampling techniques, interpretation of results and recommendations; Selection of soil, and management of water and nutrients in pot culture experiments; Problem soils and their management; Soil and water pollution.

UNIT VI

Classification of vegetable crops; Types of vegetable farming; Principles of vegetable production; Raising of vegetable seedlings under different environmental conditions; Important practices of cool and warm season vegetable crops.

UNIT VII

Concepts in Horticulture - methods of propagation, systems of planting and layout, training and pruning, fruit growth and development, fruit maturity and ripening; Post harvest management of fruits and flowers; Production technology of fruit and flower crops.

Practical

Identification of seeds of different crops, germination test and seed rate calculations; Visit to farm for identification of different crop plants and measurement of growth; Herbicide formulations, delivery systems; Field layout of different sowing methods.

Sampling, processing, storage and analysis of soil samples for available nutrients (N, P, K, S, Fe, Zn, Mn and Cu); Sampling, processing, storage and analysis of plant samples for N, P, K, S, Fe, Zn, Mn and Cu content.

Raising nursery in field and protected conditions; Practices in methods of propagation; Various methods of training system and pruning, system of planting; Post harvest processing.

PGS 506
(e-Course)

DISASTER MANAGEMENT
(Compulsory for Ph.D. Scholars)

1+0

Objective

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water

pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management-Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

BSMA Committee on Statistical Sciences
(Agricultural Statistics/Bio-Statistics/ Computer Application)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR
dated January 14, 2008)

Name	Address	Specialization
Dr. K. Palanisami <i>Convener</i>	TNAU, Coimbatore	
Dr. V.K. Gupta* ICAR National Prof.	IASRI, New Delhi	Computer Applications
Dr. B.S. Kulkarni Prof. & Univ. Head	Dept. of Maths. and Stat., ANGARU, Hyderabad	Math. & Stat.
Dr. S. V. Mahajan Prof. of Statistics	Dept. of Statistics, MPKV, Rahuri	Statistics
Dr. V.K. Bhatia Principal Scientist	IASRI, New Delhi	Agr. Statistics
Dr. H.L. Sharma Professor	College of Engg. & Tech., JNKVV, Jabalpur	Statistics
Dr. D.K. Jain Principal Scientist	Dairy Economics, Management and Statistical Division, NDRI, Karnal	
Dr. M. Gopala Rao Professor	Dept. of Statistics, Osmania University, Hyderabad	Statistics
Dr. L.S. Kaushik Prof. (Retd.) Member Secretary	Dept. of Maths. & Stat., CCS HAU, Hisar	Statistics

* Lead the BSMA Committee during absence of Dr K. Palanisami vide ICAR order dated 22.04.2008

Co-opted Member

Dr. P.K. Malhotra Head, Division of Computer Applications, IASRI, New Delhi