ICAR FIFTH DEANS'
COURSE CURRICULUM AND SYLLABUS
B.Sc. (Hons.) Forestry

COLLEGE OF FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI- 396450

ICAR FIFTH DEANS' COURSE CURRICULUM AND SYLLABUS B.SC. (HONS.) FORESTRY

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College of Forestry

Navsari Agricultural University, Navsari

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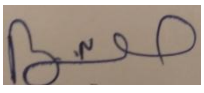
Dr. B.N. Patel
Dean
Faculty of Forestry
Navsari Agricultural University

FOREWARD

Forestry education in India as a part of NARES began in 1985 in SAUs where as in Navsari Agricultural University under the aegis of ASPEE College of Horticulture and Forestry (ACHF), B.Sc. (Forestry) started in1988. ACHF is a constituent college of NAU has all activities of forestry education, research and extension besides PG research and Teaching in forestry since 1992. The College has adopted all ICAR Deans' committee prescribed syllabus since its inception and also contributed in framing of the course curriculum. Forests and trees are the major contributors for human welfare by providing diverse wood and non wood products as well as essential environmental services for survival of mankind. Development of technologies and recommendations related to forestry, agroforestry, medicinal plants, NRM and nursery/ propagation are essential for the productivity enhancement and diversification of Indian agriculture. Its being the only Forestry College under SAUs of the Gujarat, the responsibility and accountability for improvement and way ahead in field of forestry or agroforestry lies on the strong shoulders of the NAU foresters.

The current compilation of Vth Deans' syllabus of B.Sc. (Hon.) Forestry degree in coherence with ICAR recommended syllabus and modifications as per local conditions has been adopted in college from academic session 2017-18. The syllabus has been reoriented to tackle the emerging challenges and provide opportunities by articulation of the knowledge and skills needed among the graduates. The recommended curricula will help in reforms and innovations for enhancing employability, employment potential, entrepreneurship, and science-led transformation of India's food and wood system to forestry graduates.

I congratulate the Principal, College of Forestry and U.G. Coordinator (Forestry) for compiling the "ICAR Vth Deans' Course curriculum and syllabus - B.Sc. (Hons.) Forestry" document for easy adoption. I wish this document will fulfill the academic and practical use of all stakeholders, students, teachers and other academicians interested in the field of forestry.



(B.N.Patel)

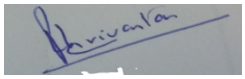
Dr. P.K Shrivastava
Principal
College of Forestry
Navsari Agricultural University

PREFACE

The College of Forestry under the aegis of Navsari Agricultural University is one among the oldest forestry faculty imparting Forestry education undergraduate programme since 1988. Thereafter, Post graduate programmes leading to M.Sc. (Forestry) and Ph.D. (Forestry) degrees commenced from 1993-94 and 2006-07, respectively. It has been spearheading forestry research, education and extension activities for promotion of forestry / agroforestry for productivity enhancement and diversification of Indian agriculture. In Forestry education within National Agricultural Research and Education System (NARES), the college is one of the pioneers in India adopting regularly revised ICAR's Dean Committee course curriculum in B.Sc. (Hons.) Forestry and recently from academic year 2017-18 adopted ICAR's Vth Deans' Committee syllabus.

College of Forestry which is the only institute in Gujarat for forestry is committed to development of tree based land used systems for livelihood, nutritional and environmental security at state and national level. Though, NAUs jurisdiction is in south Gujarat but College of forestry at NAU is a main stakeholder in matters related to forestry for the whole state of Gujarat. The college is committed to transform itself into an organization engaged fully with the forest department, tribals, farmers, industry, entrepreneurs and consumers at large. To keep pace with the changing environment, the College of Forestry has been updating its visions and strategies from time to time and also adopting ICAR recent academic and skill development (Student READY) programme for better human resource generation in forestry.

The document on "ICAR Vth Deans' Course curriculum and syllabus for B.Sc. (Hons.) Forestry" is an offshoot of common syllabus recommended by Vth Dean Committee and modifications carried out to suit the local conditions in the course curriculum as adopted in NAU. I appreciate the efforts taken by Dr. Manmohan J Dobriyal, Associate Professor & U.G. Coordinator (Forestry) and team to prepare the document. I am hopeful that document will be helpful as a ready reference book for the academic and practical use of forestry faculty and students and other stakeholders interested in field of forestry.



(P.K. Shrivastava)

FORESTRY IN NATIONAL AGRICULTURAL RESEASRCH AND EDUCATION SYSTEM (NARES) IN INDIA

Forestry is an interesting field of study which deals with theory and practice of all that constitutes the creation, conservation and scientific management of forests and the utilization of their resources. The scientific forestry started in India as early as 1864 during Britishers' time when Dr. Detrich Brandish the first Inspector General of Forest started to train the forestry professionals for the forest management. In the present scenario the forest of India managed by the IFS officers selected through UPSC or the state level services as SFS and FRO from science stream. The trained forestry professionals with B.Sc. Forestry (4 year degree), M.Sc. Forestry and Ph.D. Forestry from various universities are yet not directly selected as per their specialisaton in Indian forestry sector. In recent time most of these forestry professionals find placed either in faculty of forestry in universities, Forest services, ICFRE, ICAR, plantations, forest based industries corporate and other natural resource sectors. In all these organization forestry professionals are occupying their position with competitions from other disciplines. Forestry as a professional courses not have specialize services like Economic services, geological services, statistical services, Engineering services where specialize graduates are eligible where as in forest service all science discipline are eligible. To make the forestry graduates more competent in changing global scenario the ICAR's forestry course curriculum keep on modifying to excel the students in their professional fields with current knowledge.

As far as forestry education in academic institutions is concerned, the National Commission on Agriculture (1976) initiated to include the Forestry education in the academic institutions and universities for dispersal of idea in conservation of natural resources and protection of environment. The basic aim to launch the forestry education in the academic institutions was to promote the skilled and knowledgeable man power with present trends and requirements for the development of forestry sector for entrepreneurship and environment management and to make Indian forestry globally competitive. As a result of this the first academic programme as B. Sc. Forestry a three year degree course was started in Birsa Agricultural University, Ranchi in the year 1979. Later, during the year 1985 - 1986 the four year professional degree startred in the agricultural universities viz. YSPUHF, Solan; TNAU, Coimbatore and PDKV, Akola etc. In addition to this post graduate programme in forestry with specialization had also started in academic institutions. At present there are around 25 State Agricultural Universities, 3 Deemed Universities, 8 Traditional Universities and 20 private colleges are offering these forestry programmes and many more are planning to start. After 30-32 years of journey of forestry education in the academic institutions with more

than five thousand forestry graduates there is a strong point to be pondering that what do the forestry professionals (B. Sc, M.Sc. and Ph.D. forestry) study in their course curricula and where do they set off. The study parameter reveals that the B.Sc. Forestry programme covers various courses in different departments mainly comprised of **Silviculture & Agroforestry** that includes the subjects as Principles & Practices of Silviculture; Silviculture of Indian Trees; Agroforestry systems and Management; Plantation Forestry; Silvicultural systems; Nursery management; World Forestry System; Livestock Management; Forest Mensuration; Environmental Science; Fundamentals of Horticulture. **Forest Biology & Tree Improvement** covers Forest Ecology, Biodiversity & Conservation; Dendrology; Principles of Tree Improvement; Tree Seed Technology; Fundamentals of wild Life; Forest Pathology; Wild Life Management; Forest Entomology and Nematology. **Forest Products & Utilization** makes trained to the forestry graduates in the subject Wood Anatomy; Logging & Ergonomics; Wood Products & Utilization; Wood Science & Technology; Ethnobotany; Utilization of Non-Timber Products; Medicinal & Aromatic Plants. **Natural Resource Management** covers Principles of Hydrology, Soil and Water Conservation; Soil Survey, Remote Sensing and Wasteland Development; Fundamentals of Geology and Soil Science; Rangeland Management; Forest Management; Policy and Legislation; Agrometerology; Forest Business Management; Marketing and Trade of Forest Produce; Principles of Forest Economics; Project planning and Evaluation, Chemistry and Fertility of Forest Soils; Forest Engineering. **Basic Sciences & Humanities** includes the courses like Plant Biochemistry and Biotechnology; Principles of Cytology and Genetics; Entrepreneurship Development and Communication skills; Elementary Statistics and Computer Application; Principles of Plant Physiology; Tree Physiology; Introductory Forest Economics; Forest Tribology and Anthropology and Fundamental of Extension Education are also being taught in B.Sc. Forestry programme. In addition to this the forest field and Forest based industrial attachment under Forestry Work Experience (FWE) and Experiential learning (EL) is an important component of practical exposure and hands on training.

Thus forestry graduate course covers more descriptive aspects than all the syllabus of Indira Gandhi National Forest Academy, Dehradun, State Forest College and Rangers Training School which are providing training to Indian forest services and State forest services. The ICAR Vth Deans' Committee again revised the course curriculum of B.Sc. (Hons.) Forestry with the changing needs of forest and natural resource sector in public and private sectors. The dynamic system of revision promote the updating of the old courses, introducing new courses and focus on to practical oriented courses to generate skilled and trained manpower in forestry sector with global standards. The consistent and cohesive efforts of ICAR and ICFRE can only streamline the professional forestry in India.

ICAR VTH DEANS' FORESTRY SYLLABUS NAU, NAVSARI

B.Sc.(Hons.) Forestry

Defining UG & PG degree for general market needs & for specialized jobs and uniformity in UG & PG degree nomenclature

i). UG degree: B. Sc. (Hons) Forestry

ii). PG degree: M.Sc. Forestry and Ph.D. Forestry

PG with following specializations is recommended

S. No.	Specialization in M.Sc. / Ph.D.
1	M.Sc./ Ph.D. Forestry (Silviculture & Agroforestry)
2	M.Sc./ Ph.D. Forestry (Forest Biology & Tree Improvement)
3	M.Sc./ Ph.D. Forestry (Natural Resource Management)
4	M.Sc./ Ph.D. Forestry (Forest Products & Utilisation)
5	M.Sc./ Ph.D. Forestry (Wildlife Sciences)

Department-wise Courses in B.Sc. (Hons) Forestry

C. Code	Course Title	Credit Hrs.
Department of Silviculture & Agroforestry (SAF)		
SAF 1.1	Introduction to Forestry	2+0
SAF 1.2	Introduction to Agronomy and Horticulture	2+1
SAF 2.3	Principles of Silviculture	2+1
SAF 3.4	Principles of Agroforestry	2+1
SAF 3.5	Forest Mensuration	2+1
SAF 3.6	Rangeland and livestock management	1+1
SAF 4.7	Forest Inventory and Yield Prediction	1+1
SAF 4.8	Silviculture of Indian Trees	2+1
SAF 5.9	Practices of Silviculture	2+1
SAF 6.10	Forest Extension & Community Forestry	2+1
SAF 6.11	Recreation & Urban Forestry	1+1
SAF 6.12	Plantation Forestry	2+1
SAF 8.13	Agroforestry Systems and Management	1+1
		22+12 = 34

Department of Forest Biology & Tree Improvement (FBT)		
FBT 2.1	Dendrology	2+1
FBT 3.2	Wildlife Biology	2+1
FBT 3.3	Forest Ecology & Biodiversity Conservation	2+1
FBT 3.4	Forest Genetics & Tree Improvement	2+1
FBT 3.5	Forest Ecophysiology	1+1
FBT 4.6	Ornithology & Herpetology	2+1
FBT 4.7	Seed Technology & Nursery Management	2+1
FBT 8.8	Forest Biotechnology	2+1
FBT 8.9	Wildlife Management	1+1
	Total	**16+9 = 25**
Department of Forest Products & Utilisation (FPU)		
FPU 2.1	Wood Anatomy	1+1
FPU 4.2	Wood Products & Utilization	2+1
FPU 4.3	Ethnobotany and MAPs	2+1
FPU 4.4	Logging and Ergonomics	1+1
FPU 4.5	Non-Timber Forest Products	2+1
FPU 5.6	Wood Science and Technology	2+1
FPU 6.7	Marketing and Certification of Forest Products	1+1
	Total	**11+7= 18**
Department of Natural Resource Management (NRM)		
NRM 1.1	Fundamentals of Geology & Soil Science	2+1
NRM 1.2	Environmental Studies and Disaster Management	2+1
NRM 2.3	Forest Protection	2+1
NRM 2.4	Soil Biology & Fertility	2+1
NRM 3.5	Forest Survey & Engineering	2+1
NRM 5.6	Agrometeorology and Climate Change	2+1
NRM 5.7	Forest Management	2+1
NRM 5.8	Principles of Economics and Marketing	2+1
NRM 5.9	Restoration of Degraded Lands	1+1
NRM 6.10	Forest Laws, Legislation and Policies	2+0
NRM 6.11	Geomatics-Remote Sensing & GIS	1+1
NRM 6.12	Forest Hydrology and Watershed Management	2+1
	Total	**22+11 = 33**
Department of Basic Science & Humanities (BSH)		
BSH 1.1	Information & Communication Technology	1+1
BSH 1.2	Introductory Botany *	1+1*
BSH 1.3	Communication Skills and Personality Development	1+1
BSH 1.4	Plant Physiology	2+1
BSH 2.5	Basic Mathematics*	2+0 *
BSH 2.6	Plant Biochemistry	1+1
BSH 2.7	Statistical Methods and Experimental Techniques	2+1
BSH 2.8	Principles of Plant Cytology and Genetics	2+1
BSH 6.9	Entrepreneurship Development and Business Management	1+1
BSH 8.10	Forest Tribology & Anthropology	2+0
BSH 8.11	Agricultural Informatics	1+1
	Total	**16+9 = 25**

Forestry Student READY Programme (FRP)		
FRP 4.1	Study Tour of State Forest	0+1
FRP 5.2	Experiential Learning (Forest Nursery)	0+5**
FRP 5.3	Experiential Learning (Apiculture)	0+5**
FRP 6.4	Experiential Learning (Forest Nursery)	0+5**
FRP 6.5	Experiential Learning (Apiculture)	0+5**
FRP 7.6	Forestry Work Experience	0+20
FRP 7.6.1	Attachment with forest department- 8 Weeks	10 (0+10)
FRP 7.6.2	Industry /NGO Attachment- 3 weeks	4(0+4)
FRP 7.6.3	Socio-economic Surveys and Village Attachment- 2 weeks	3(0+3)
FRP 7.6.4	Weapon Training and First-Aid Training -1 week	1(0+1)
FRP 7.6.5	Report Writing & Presentation-1 week	2 (0+2)
FRP 7.7	All India Study Tour (3 weeks)	0+3
FRP 8.8	Project Work & Dissertation	0+10
	Total	**0+44 = 44**
NCC/NSS		
NNP 1.1	NCC/NSS	0+1*
NNP 2.2	NCC/NSS	0+1*
NNP 3.3	NCC/NSS	0+1*
NNP 4.4	NCC/NSS	0+1*
NNP 5.5	NCC/NSS	0+1*
NNP 6.6	NCC/NSS	0+1*
		0+6 = 6
	Grand Total	**87+98 = 185**
	Non credit courses (NNP, BSH 1.2 and BSH 2.5)	3+7= 10
	Total credit courses	**84 +91=175**

*** Non credit courses (Non grade)**

**** In ELP any one model will be opted.**

Semester-wise Courses - B.Sc. (Hons.) FORESTRY

C. Code	Course Title	Credit Hrs.
Ist Semester		
SAF 1.1	Introduction to Forestry	2+0
SAF 1.2	Introduction to Agronomy and Horticulture	2+1
NRM 1.1	Fundamentals of Geology & Soil Science	2+1
NRM 1.2	Environmental Studies and Disaster Management	2+1
BSH 1.1	Information & Communication Technology	1+1
BSH 1.2	Introductory Botany	1+1*
BSH 1.3	Communication Skills and Personality Development	1+1
BSH 1.4	Plant Physiology	2+1
NNP1.1	NCC/NSS	0+1*
		13+8 = 21
IInd Semester		
SAF 2.3	Principles of Silviculture	2+1
FBT 2.1	Dendrology	2+1
FPU 2.1	Wood Anatomy	1+1
NRM 2.3	Forest Protection	2+1
NRM 2.4	Soil Biology & Fertility	2+1
BSH 2.5	Basic Mathematics	2+0*
BSH 2.6	Plant Biochemistry	1+1
BSH 2.7	Statistical Methods and Experimental Techniques	2+1
BSH 2.8	Principles of Plant Cytology and Genetics	2+1
NNP 2.2	NCC/NSS	0+1*
	Total	**16+9 = 25**
IIIrd Semester		
SAF 3.4	Principles of Agroforestry	2+1
SAF 3.5	Forest Mensuration	2+1
SAF 3.6	Rangeland and livestock management	1+1
FBT 3.2	Wildlife Biology	2+1
FBT 3.3	Forest Ecology & Biodiversity Conservation	2+1
FBT 3.4	Forest Genetics & Tree Improvement	2+1
FBT 3.5	Forest Ecophysiology	1+1
NRM 3.5	Forest Survey & Engineering	2+1
NNP 3.3	NCC/NSS	0+1*
	Total	**14+9 = 23**
IVth Semester		
SAF 4.7	Forest Inventory and Yield Prediction	1+1
SAF 4.8	Silviculture of Indian Trees	2+1
FBT 4.6	Ornithology & Herpetology	2+1
FBT 4.7	Seed Technology & Nursery Management	2+1
FPU 4.2	Wood Products & Utilization	2+1
FPU 4.3	Ethnobotany and MAPs	2+1
FPU 4.4	Logging and ergonomics	1+1
FPU 4.5	Non-Timber Forest Products	2+1
FRP 4.1	Study Tour of State Forest	0+1*
NNP 4.4	NCC/NSS	0+1*
	Total	**14+10 = 24**

Vth Semester		
SAF 5.9	Practices of Silviculture	2+1
FPU 5.6	Wood Science and Technology	2+1
NRM 5.6	Agrometeorology and Climate Change	2+1
NRM 5.7	Forest Management	2+1
NRM 5.8	Principles of Economics and Marketing	2+1
NRM 5.9	Restoration of Degraded Lands	1+1
FRP 5.2	Experiential Learning (Forest Nursery)	0+5**
FRP 5.3	Experiential Learning (Apiculture)	0+5**
NNP 5.5	NCC/NSS	0+1
	Total	**11+12 = 23**
VIth Semester		
SAF 6.10	Forest Extension & Community Forestry	2+1
SAF 6.11	Recreation & Urban Forestry	1+1
SAF 6.12	Plantation Forestry	2+1
FPU 6.7	Marketing and Certification of Forest Products	1+1
NRM 6.10	Forest Laws, Legislation and Policies	2+0
NRM 6.11	Geomatics-Remote Sensing & GIS	1+1
NRM 6.12	Forest Hydrology and Watershed Management	2+1
BSH 6.9	Entrepreneurship Development and Business Management	1+1
FRP 6.4	Experiential Learning (Forest Nursery)	0+5**
FRP 6.5	Experiential Learning (Apiculture)	0+5**
NNP 6.6	NCC/NSS	0+1*
	Total	**12+13 = 25**
VIIth Semester		
FRP 7.6	**Forestry Work Experience**	**0+20**
FRP 7.6.1	Attachment with forest department- 8 Weeks	10 (0+10)
FRP 7.6.2	Industry /NGO Attachment- 3 weeks	4(0+4)
FRP 7.6.3	Socio-economic Surveys & Village Attachment- 2 weeks	3(0+3)
FRP 7.6.4	Weapon Training and First-Aid Training -1 week	1(0+1)
FRP 7.6.5	Report Wring & Presentation-1 week	2(2+0)
FRP 7.7	All India Study Tour (3 weeks)	0+3
	Total	**0+23 = 23**
VIIIth Semester		
SAF 8.13	Agroforestry Systems and Management	1+1
FBT 8.8	Forest Biotechnology	2+1
FBT 8.9	Wildlife Management	1+1
BSH 8.10	Forest Tribology & Anthropology	2+0
BSH 8.11	Agricultural Informatics	1+1
FRP 8.8	Project Work & Dissertation	0+10*
		7+14 = 21
	Grand Total	**87+98 = 185**
	Non credit courses (NNP, BSH 1.2 and BSH 2.5)	3+7= 10
	Total credit courses	**74 +91=175**

*** Non credit courses (Non grade)**

**** In ELP any one model will be opted.**

COURSE DETAILS OF B.SC. (HONS) FORESTRY

DEPARTMENT OF SILVICULTURE & AGROFORESTRY (SAF)

SAF 1.1 INTRODUCTION TO FORESTRY 2 (2+0)

Theory :

Forests - definitions, role, benefits - direct and indirect. History of Forestry - definitions, divisions and interrelationships. Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands. Agroforestry - farm forestry, social forestry, joint forest management - concepts, programmes and objectives. Important acts and policies related to Indian forests. Global warming - forestry options for mitigation and adaptation - carbon sequestration. Important events/dates related to forests and environment - themes and philosophy.

Introduction to world forests - geographical distribution and their classification, factors influencing global forests distribution - productivity and increment of world forests. Forest resources and forestry practices in different regions of the world - Western Europe, North America, Central Africa, Australia, Central America, Russia, Japan, and China. General problems of forest development and economy. Forest based industries in the developed and developing countries. Trade patterns of forest based raw materials. Recent trends in forestry development in the world. National and international organizations in forestry.

Suggested Readings :

Beazley, M. 1981. The International Book of Forest. Mitchell Beazly Publishers, London.
Champion, H, G and Seth, S.K. 1968. Forest types of India,a revised survey of forest types of India, GOI Press,New Delhi, 404p.
Grebner, D.L., Bettinger, P and Siry, J.P. 2012. Introduction to Forestry and Natural Resources. Academic Press. 508p (Google eBook).
Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi, 473p.
Mather, A.S. 1990. Global forest resources. Belhaven, London.
Persson, R. 1992. World forest resources. Periodical experts, New Delhi.
Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.

SAF 1.2 INTRODUCTION TO AGRONOMY AND HORTICULTURE 3 (2+1)

Theory:

Agronomy, scope and its role in crop production-Major Field crops of India – classification, area, distribution and productivity of major Field crops. Farming and cropping systems – mono, sole and multiple cropping, relay, sequential and inter cropping. Tillage- definition- objectives – types of tillage- tillage implements – tilth - characteristics of good tilth - Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources- organic manures – fertilizers – biofertilizers- Integrated Nutrient Management-Importance of water in plant growth-Soil properties influencing moisture availability – texture, structure and organic matter status-Irrigation and drainage. Weed control – definition and characteristics of weeds, classification of

weeds – damages due to weeds - benefits of weeds. -Control v/s prevention of weeds – methods of weed control-Classification of herbicides–Integrated weed management. Soil and its management-Definitions and importance of horticulture- Economic importance and classification of horticultural crops and their culture and nutritive value- area and production- exports and imports- fruit, vegetables, plantation and spice crops-soil and climate–principles-planning and layout- management of orchards- planting systems and planting densities- Principles and methods of pruning and training of fruit, plantation crops-use of growth regulators in horticulture crops-Horticultural zones of state and country.

Practical:

Identification of field crop and tillage implements. Preparation of seed beds, identification of fertilizers and manures – mixing chemical fertilizers – calculating fertilizer requirements. Identification of green manure plants. Identification of important weeds of the region with particular reference to forest plantations. Preparation of weed herbarium. Calculations of spray volume and herbicide concentrations. Methods of application of herbicides. Identification of horticultural crops-garden tools and implements. planning and layout of orchard and plantations. Digging and filling of pits for fruit and plantation crops-planting systems, training and pruning of orchard trees-preparation and application of regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits-bearing habits and maturity standards, harvesting, grading, packaging and storage.

Suggested Reading:

Agrawal,R.L.1980.Seedtechnology.Oxford&IBHPublishingCo.,NewDelhi
Balasubramaniyan, P and Palaniappan, S.P.. 2001. Principles and Practices of Agronomy. Agro Bios (India)Ltd., Jodhpur.
Bose, T.K. 1985. Fruits of India- Tropical and subtropical. Naya Prakash, Calcutta
De,G.C.1989.Fundamentalsof Agronomy. Oxford&IBH Publishing Co.,NewDelhi
ICAR.2006.HandbookofAgriculture,ICAR,NewDelhi.
Jitendra Singh Basic Horticulture , Kalyani Pub
Neeraj Pratap Singh Basic Concepts of Fruit Science
Palaniappan, S.P. 1988. Cropping systems in the tropics - Principles and management. Wiley Eastern Limited,NewDelhi
Prasad and Kumar Principles of horticulture
Randhawa,M.S.1982.History of agriculture in India,VolI,II&III.ICAR,NewDelhi
Reddy.S.R.1999. Principles of Agronomy, Kalyani Publishers, Ludhiana.
Sankaran, S. and Subbiah Mudaliar, V.T. 1991. Principles of Agronomy.

SAF 2.3 PRINCIPLES OF SILVICULTURE 3 (2+1)

Theory :

Definition and classification of forestry, branches of forestry and their relationships. Definition, objectives and scope of silviculture. Status of forests in India and their role. History of forestry development in India. Trees and their distinguishing features. Growth and development. Forest reproduction - flowering, fruiting and seeding behaviour. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of climatic factors. Role played by

light, temperature, rainfall, snow, wind, humidity and evapo-transpiration in relation to forest vegetation. Bioclimatic and micro climate effects. Edaphic factors - influence of biological agencies, parent rock, topography on the soil formation. Soil profile – physical and chemical properties, mineral nutrient and their role, soil moisture and its influence on forest production. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation. Impacts of controlled burning and grazing. Influence of forests on environment. Tending and cultural operations- weeding- kinds of weeding- release operations- singling, cleaning–liberation cutting-girdling- chemical treatment-peeling. Thinning-kinds of thinning - improvement felling-salvage cuttings- pruning- pollarding, lopping. Forest types of India and their distribution. Plant-forest succession, competition and tolerance.

Practical:
Acquaintance with various silvicultural terms. Study about habits of plants and developmental stages of tree growth and its structure. Study about tree morphology- stem, crown and root characters. Vegetative and reproductive phenology. Study of site factors like climatic, edaphic, physiographic and biotic. Study of microclimate and forest soils. Study of forest succession. Study about different forest types of the state. Various tending operations- weeding, cleaning, singling, pruning, pollarding, lopping and thinning.

Suggested reading :
Baker, F.S. 1950. Principles of Silviculture, McGraw Hill, N.Y.
Champion, H.G. and Trevor, G. 1936. Handbook of Silviculture, Cosmo Publication, New Delhi
Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture, McGraw Hill, N.Y.
Dwivedi. A. P. 1993. Textbook of Silviculture. International Book Distributors.
Evans, J E. 1982. Plantation Forestry in the Tropics. The English Language Book Society and Clarendon Press – Oxford
Gunter, S., Weber, M,M Stimm, B and Mosandl, R. 2011. Silviculture in the Tropics. Springer-VerlagBerlin.
Haig, I. T. Huberman, M. A. and Aung Din, U. 1986. Tropical Silviculture, Vol. I and II. Food and Agriculture Organization of the United Nations, Rome
Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, Dehra Dun
Kostler, J. 1956. Silviculture. International Book Distributors, P.O. Box 4. Dehra Dun
Lal, J. B. 2003. Tropical Silviculture, New Imperatives: New Systems, International Book Distributors, Dehra Dun.

SAF 3.4 PRINCIPLES OF AGROFORESTRY 3 (2+1)

Theory :
Over view of Indian agriculture- its structure and constraints. Concept of sustainable agriculture and land use management. Agroforestry definition and scope, rising demands of fuel wood, fodder and timber. History of agroforestry- Social, ecological, and economic reasons for agroforestry. Classification of agroforestry system - structural, functional, socioeconomic, and ecological basis. Traditional agroforestry systems: shifting cultivation, taungya, homegardens. Land use - definition, classification, and planning. Land capability classification and land use – definition, classification, and planning. Plantation agriculture and plantation forestry. Choice of

species for agroforestry - criteria for selection of fodder trees, fuel wood and charcoal trees, food and medicinal uses, pulp wood and round wood used; multipurpose trees, nitrogen fixing trees. Provisional and regulatory services of agroforestry- Food and nutritional security- Tree crop interactions in Agroforestry-Positive interactions: Increased productivity, Soil improvement, Nutrient Cycling, Microclimate Amelioration-carbon sequestration. Negative interactions: Competition, Allelopathy. Industrial agroforestry concept and importance.

Practical :

Study the components, arrangement and functioning of various forest and agro-ecosystems- Collection of information on various tree and agricultural crops on their habitat, growth, tolerance to various climatic and edaphic factors and study their compatibility for integration- Study land capability classification of various topographic regions. Visit to problem sites such as wind prone, mined areas, degraded sites, flood prone areas etc and design suitable land use strategies

Suggested reading :

Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.

Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.

Kumar, B. and Nair, P.K.R. (eds). 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Springer Science, the Netherlands

Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p

Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.

Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi.

Nair, P.K.R. 2007. An Assessment of Ecological Diversity in Agroforestry Systems in the Tropics. Springer. 680p.

Nair, PKR 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Nether

Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

SAF 3.5 FOREST MENSURATION 3(2+1)

Theory:

Forest Mensuration- Definition, objectives and scope of forest mensuration. Scales and Units of measurement, error and accuracy. Measurement of individual tree parameters - tree diameter and girth - objectives, standard rules governing measurement at breast height and instruments used. Upper stem diameter measurement- Objective and instruments used. Bark measurements objectives, bark thickness, bark surface area and bark volume. Crown measurement- objectives, crown diameter, crown height, crown surface area and crown volume. Height measurement-direct and indirect methods. Height measurement principles- geometric and trigonometric principles, height measuring instruments, error in height measurement and height measurement of learning tree. Trees stem form- theories, classification of form factors and form quotient. Volume tables- definition, classification and preparation. Tree biomass- objective and biomass

estimation methods. Age determination of tree- objective and methods. Tree growth measurement – objectives, increment, determination of increment, stump analysis, stem analysis and increment boring. Measurement of tree crops – objectives, crop diameter, crop height, crop age and crop volume.

Practical :

Units of measurement and uses in forestry. Measurements of diameter, girth and upper stem diameter of trees using Calipers, Tape, Ruler, Penta Prism, Criterion Dendrometer *etc*. Measurement of bark thickness, bark volume, bark area. Measurement of crown diameter, crown area and crown volume. Measurement of tree height using instrumental methods- Abney's level, Ravi Altimeter, Spiegel Relaskop, Clinometer etc. Estimation of form factor. Volume estimation of logs, felled trees and standing trees. Preparation of local volume table. Determination of age of standing trees by increment boring method. Study on stump analysis. Calculation of CAI and MAI.

Suggested readings :

Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun.364 pp.

Forest mensuration: A Handbook for Practitioners.(2006). Forestry Commission Publications. 330 pp.

Husch, B., Beers, T.W. and Kershaw,Jr. J.A. (2002). Forest Mensuration (4th edition). John Wiley & Sons, Nature.456 pp.

Laar, V. A. and Akca, A. (2007). Forest Mensuration. Managing Forest Ecosystems (Vol.13).Springer.384pp.

West, P.W. (2009). Tree and Forest Measurement (2nd edition). Springer. 192pp.

Agarwal, P. (2008). Forest Mensuration- Tree measurement. Bishen Singh Mahendra Pal Singh Publishers & Distributors of Scientific Books, 220pp.

Panwar, P. and Bhardwaj, S.D. (2005). Handbook of Practical Forestry. Agrobios (India), 191pp.

SAF 3.6 RANGELAND AND LIVESTOCK MANAGEMENT 2 (1+1)

Theory :

Definition, scope and importance – cattle and fodder resources of India, grassland types of India and their distribution – ecological status of Indian grasslands – principles of grassland management for maximizing forage yield and quality. Feeding habit and grazing behavior of range animals. Carrying capacity – definition, method of calculation. Establishment and management of grasslands – selection of species, planting, cultural practices – liming, fertilizer application, burning, weed control, grazing and cutting intensity. Storage of fodder – silage and hay – methods of preparation – hay banks, Fodder trees and shrubs, Forest grazing.

Definition and importance of Livestock management. Important breeds of important livestock eg. Cattle, buffalo, sheep and goat. Breeding and reproductive management for higher productivity. Feeding management – types of feedstuffs available for feeding livestock, methods of feeding. Assessing nutritive value of feed and fodder, estimation of digestible nutrients and energy in feedstuffs. Principles of rationing. Prevention and control of diseases.

Practical:

Study of grassland and rangelands in the area. Different tools/instruments used in livestock

management; Routine management practices followed on livestock farms; Identification of feedstuffs and their nutritive value; Nutritive requirement animals;; Study of housing systems and requirements; Preservation of fodder as hay, silage and leaf meal.

Suggested Readings :

Banerjee, G.C. 2010. A text book on Animal Husbandry, 8th Edition, Oxford and IBH New Delhi.
Holechek J.L. et al. 1989. Range Management. Prentice Hall, New Jersey
Sastry, N.S.R. and C.K. Thomas. 2005. Livestock Production Management, Kalyani Publishers, New Delhi.
Singh R.V. 1982. Fodder trees of India. Oxford and IBH New Delhi.
Ward H.M. 1980. Grasses. A handbook for use in the field and laboratory, Scientific Pub., Jodhpur

SAF 4.7 FOREST INVENTORY AND YIELD PREDICTION 2 (1+1)

Theory :

Yield - In regular forests-In Irregular forests. Estimation of growth and Yield of stands - Forest Inventory - Point sampling Forest Inventory - Definition-objectives- Kinds of enumeration- Tree assessment techniques- Measurement of wood volume, tree volume & tree volume tables - Kinds of sampling -Sampling design - Kinds of sampling units- Fixed area and point sampling units - Plots, strips, topographical units - sampling intensity- Inventory designs used in India - Sampling errors and non sampling errors- Organization of field work and conduct of enumeration - Point sampling- Concept of horizontal point sampling . Estimation of growth and yield prediction in forest stands- Stand structure - Growth of stand - Methods of predicting future growth of stands - Stand density - Canopy density -Crown competition factor- Yield tables- definition- Preparation of yield table - Application and use of yield tables - Stand table-definition and use.

Practical :

Study the demarcation and alignment of plots, strips etc. Field exercise on Horizontal Field demonstration of various sampling techniques- Simple, stratified, multi stage, multiphase, non-random sampling techniques. Visit forest areas for forest enumerations- point sampling- use of wedge prism and Relaskop - Field exercise on the determination of site quality -Visit to local forest divisions and study the methods of preparation and use of yield tables. Method demonstration on the use of aerial photographs in forest inventory

Suggested Readings:

Chapman, H.H and Meyer, W.H. (2008).Manual of Forest Mensuration: Methods and Techniques. Asiatic Publishing House, New Delhi, 522p.
Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.
Heindjik, D. (1975). Forest Assessment. International Book Distributors, Dehradun, 349p
Husch, B., Beers, T.W. and Kershaw, Jr. J.A.(2002). Forest Mensuration (4th edition). John Wiley & Sons, Nature.456 pp.
Kangas, A. and Maltamo, M. (2006). Forest Inventory: Methodology and Applications. Managing Forest Ecosystems (Vol.10).Springer.340pp.
Philip, M.S.(1994).Measuring Trees and Forest. AB International, UK,310p
Scott,C.T and Gove, J.H. (2002). Forest Inventory. Encyclopedia of Environmetrics (Vol 2), John

Wiley & Sons. pp 814–820
Shiver, B.D and Borders, B.E.(1996). Sampling Techniques for Forest Resource Inventory. John Wiley and Sons, New York, 356p
Spurr, H.S. (1952).Forest Inventory. John Wiley and Sons, New York, 476p.

SAF 4.8 SILVICULTURE OF INDIAN TREES 3 (2+1)

Theory:

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, and economic importance of the following tree species of India. Broadleaved species: *Tectona grandis, Shorea robusta, Dalbergia latifolia, Dalbergia sissoo, Anogeissus spp, Terminalia spp., Santalum album, Swietenia macrophylla, Albizia spp, Santalum album, Pterocarpus marsupium, Gmelina arborea, Pterocarpus santalinus, Azadirachta indica, Hopea parviflora, Lagerstroemia microcarpa, Bamboos, reeds and rattan, Quercus spp.* Conifers*: Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, Pinus wallichiana*. Fast growing MPTs*:,Tropical pines, Eucalyptus spp, Casuarina equisetifolia, Leucaena leucocephala, Ailanthus triphysa, Grevillea robusta, Pongamia pinnata, Melia dubia, Acacia spp, Populus spp.*

Practical:

Study the morphological description and field identification characteristics of trees, seeds and seedlings, phenology, - collection of seeds- planting and stand management practices of *Tectona grandis, Dalbergia latifolia, Santalum album, Swietenia macrophylla, Eucalypts, Acacias, Bamboos,* fast growing MPTs etc. Study the silviculture of trees in response to light, fire, drought, frost, root suckering, coppicing and pollarding, etc. Visit various problem areas and study on species suitability-. Visit forest plantations and other woodlots- study the planting density and stand management regimes for various end uses such as timber, pulpwood, plywood, cottage industries etc.

Suggested Readings:

Bebarta, 1999. Teak: Ecology, Silviculture, Management and profitability, IBD, Dehra Dun
Champion, H.G. and A.L. Griffith. 1989. Manual for General Silviculture for India ICFRE booklets on tree species
Kadambi, K. 1993. Silviculture and Management of teak. Nataraj Publishers, Dehra Dun. p. 137.
Lamprecht H 1989. Silviculture in the Tropics. GTZ, GmBH, FRG
Troup, RS 1922. Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun, 1975.
Renuka, C., Pandalai, R.C. and Mohanan, C. 2002 Nursery and silvicultural techniques for rattan, Kerala Forest research Institute.
Seethalakshmi, K.K. and Muktheshkumar, M.1998. Bamboos of India: a compendium, Kerala

SAF 5.9 PRACTICES OF SILVICULTURE 3 (2+1)

Theory:

Regeneration of forests – objectives, ecology of regeneration- Natural and Artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment. Requirement for natural regeneration. Dieback in seedling with examples. Advance growth, coppice, root sucker. Regeneration survey- Natural regeneration supplemented by artificial regeneration. Artificial regeneration - object of artificial regeneration - advantages. Factors governing the choice of regeneration techniques. Choice of species - factors that govern - hardwoods, softwoods, fast growing, exotic and indigenous species. Sowing v/s planting - different kinds of sowing. Preparation of planting material- stump preparation- field planting-site preparation- planting density spacing -marking- boundary demarcation, fencing, alignment and staking-kinds of pit making-patterns of planting, Plant protection and sanitation measures, - forest nutrition- fertilization in trees. Artificial regeneration in problematic areas. Silvicultural system - definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate strip and progressive strip systems. Shelterwood system -Uniform system, Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications. Accessory systems. Coppice system -Simple coppice system, Coppice of the two rotation system, Shelterwood coppice system, Coppice with standard system, Coppice-with-reserve system, Coppice selection system, Pollard system. Conversion and its implications. Choice of silvicultural system. Dauerwald concept. Culm selection system in Bamboo, Silvicultural systems followed in other countries - changing concepts and emerging trends in silvicultural systems-case studies.

Practical:

Acquaintance with modern silvicultural tools. Vegetation survey and forest inventory, Assessment of forest composition. Study about stand structure. Assessment of natural regeneration. Planting pattern and planting technique for afforestation and reforestation. Exercise on nursery practice- seed collection, characterization, seed pre-treatment- nursery stock preparation- field preparation- marking, alignment and stacking, pit making-planting, fertilization in trees-plant protection and sanitation measures. Study of afforestation and reforestation success.

Suggested Reading:

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture, McGraw Hill, N.Y.

Duryea, M.L. and Landis, T.D. (eds.) 1984. Forest NurseryManual: Production of bare root seedlings. Martinus Nijhoff/Dr W. Junk Publishers. The Hague/Boston/ Lancaster, 386 p.

Evans, J.1982. Plantation Forestry in the Tropics. The English Language Book Society and Clarendon Press - Oxford

Khanna, L.S.1989. Principles and Practice of Silviculture. Khanna Bandhu, Dehra Dun

Smith, D.M. 1986. The Practice of Silviculture, Edn 8. New York, John Wiley

Ram Prakash and Khanna, L.S. 1991. Theory and Practice of Silvicultural Systems. Dehra Dun, International Book Distributors, Dehra Dun.

Trevor, G. Silvicultural Systems. Part II of Manual of Indian Silviculture by H.G. Champion and Sir Gerald Trevor. 1938.

SAF 6.10 FOREST EXTENSION & COMMUNITY FORESTRY 3 (2+1)

Theory:

Introduction- human behaviour and psychology. Concept, scope, principles, philosophy and objectives of extension education and forestry extension education. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and types of education, Formal, informal non-formal education. People's participation in Forestry programmes. Elements of extension education, man himself man's environment and man's created devices. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Van Vigyan Kendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ICFRE. Communication: meaning, definition, elements and selected models. Audio-visual aids: importance, classification and selection. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group.

Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry. Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment-NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Gender dimensions in Community forest management. Social Forestry- definition, need and purpose, historic development. Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Microplan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies.

Practical:

Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/Mahila Mandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing). Group discussion at farm homesteads. Preparing individual and village level production plans. Preparation of charts, posters and flash cards. Participation in conducting exhibitions and method demonstrations/campaigns at the village level. Familiarization of the use of audio-visual aids. PRA exercises. Visit to village to study the community forestry components- Community reserve, organizational set up and administrative procedures in a social forestry (SF) Range, Microplan preparation-Field visit to a JFM operational area and conduct PRA surveys. Afforestation techniques and social forestry.

Suggested reading:

FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.

L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.

D. Sim, H. A. Hilmi (1987), Forestry Extension Methods, FAO Forestry Paper-80, P. 153.

K.A. Jalihal, V. Veerabhadraiah (2007), Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.
Balakathiresan, S. (1986). Essentials of forest management, Nataraj Publishers, Dehradun.
Bullock, R. C. L. and Hanna, K.S. (2012). Community Forestry Local Values, Conflict and Forest Governance. Cambridge University Press.
Gunter, J. (Ed.). (1973). The Community Forestry Guidebook (http://www.forrex.org/ sites/ default/ files/ forrex_series/FS15.pdf).
Ojha, H.R., Timsina, N.P., Kumar, C., Banjade, M.R and Belcher, B. (2007). Communities, Forests and Governance: Policy and Institutional Innovations from Nepal. Adroit Publishers, New Delhi, India.
Roy, S.B. and Chatterjee, M.(1994). Joint Forest Management. Inter India Publications
Tiwari, K.M. (1983). Social forestry for rural development. International Book Distributors.
Vyas, G. P.D. (2006). Community Forestry. Agrobios, India.

SAF 6.11 RECREATION & URBAN FORESTRY 2 (1+1)

Theory:

Forest recreation-Definition and scope-social and environmental aspects of recreation components new approaches in forest recreation. Importance of Phenological studies in Landscaping. Principles and elements of landscaping -types of landscape designs-formal- Persian and Mughal designs, and informal- british and Japanese. Landscape components- plant and other components- lawn, pergolas, hedges, edges, topiary, baloon, arbours, carpet beds, trees, flower beds, annuals, and climbers. Practices of landscaping-Tools and implements for landscaping. Specialised gardens-butterfly, water, bog or marsh, terrace, roof, Sunken, Indoor and rock. Planning and planting programmes in institutional and industrial complexes, roads, bridges, parking area and other structures. Urban forestry – definition and scope – uses of urban forests, Management of urban and peri-urban forest Arboriculture, and its importance in urban forestry. Management of tree structure and canopy Architecture.

Practical:

Preparation, planning and designing the planting pattern for parks, sanctuaries and industrial premises. Phenology and planting arrangement in urban forestry; visit to landscaped areas, parks tourist spots and centres, national parks and sanctuaries. Techniques and designs for Urban Forestry and Recreational forestry plantation. Techniques of Nursery raining and Plantation for recreation and urban forestry.

Suggested Reading:

Douglar,J. Hort, R. A and Ranganadhan,S. (1982). Forest Farming. Natraj Publications, Dehradun.
Gopikumar K. (2008). Arboriculture Principles and Practices. Published by Khanna Bandhu, Dehradun
Hamm,W.E and Cale, D.N.(1987). Wild Land Recreation, John Wiley and Sons, New York.
Miller,R.W.(1988). Urban Forestry. Prentice Hall International Ltd. London
Singh,S.P.(1986). Planting of Trees. B.R. Publishing corporation, Delhi.
Gordon Bradley (1995). Urban Forest Landscapes: Integrating Multidisciplinary Perspectives.

Journals: Urban Forestry and Urban Greening, An International Journal aimed at presenting high-quality research with urban and peri-urban woody and non-woody vegetation and its use, planning, design, Elsevier Publications.

SAF 6.12 PLANTATION FORESTRY 3 (2+1)

Theory:

Plantations-definition and scope- History of plantations- Development of plantation forestry- present status in national and international scenario- Plantation organization and structure- Plantation characteristics-species composition-age class distribution- stocking- Land and plantation development – National land use policy- land use for forestry- Social and economic factors in plantation development finance- economics of plantation development- land availability-labour-infrastructure, economic, marketing, social and cultural effects.- Plantation planning-National and regional planning-project appraisal and project implementation– feasibility studies- Plantation silviculture - Choice of species-concept of fast growth-exotics vs. indigenous- traditional vs. intensive forest management- Plantation establishment-essentials-ground preparation- Planting- planting stock- planting pattern- spacing-general planting rules-protection and after care of newly planted seedlings.- Plantation maintenance- death of seedling-weed control –-cleaning, singling, pruning. Nutrition in plantations- nutrient deficiencies, symptoms of deficiency- use of fertilizers- - Major pest and disease in plantations- sanitation and control measures. Dynamics of stand growth- stand density management in plantations- spacing-planting density regulation- Thinning regimes- improvement fellings- CCF-MCA- Site quality evaluation- stand basal area, site index concept in plantation forestry- plantation productivity assessment- growing stock assessment MAI of different plantations- Modern concepts in plantation forestry. Plantation records- plantation journal- sustainability of plantations- fast growing plantations-myths and reality- Industrial plantation- paper and pulp wood- Match wood plantation- plywood plantation Plantations yielding NTFPs- Energy plantation- high density short rotation plantations- petro-crops-energy from biomass.-Strip plantation-road side plantation-canal side plantation- railway side plantation- Clonal plantations- development and management of clonal plantation- Plantations as potential carbon sinks- C Sequestration, C Substitution and C Conservation functions; LULUCF and REDD concepts, AR-CDM concepts.

Practical:

Study the tools and materials for plantation establishment- Visit small and large plantations-study their management and functioning- Exposure to plantation project preparation- economic evaluation and feasibility studies of plantation projects. Study of planting operations- study of tending techniques Planting methods and techniques for different types of plantations including energy plantations, canal bank plantations - pulp wood plantations- study of KFDC plantations-road side plantations plantation planning- Plantation journal- Choice of species for plantations-economic considerations in plantation Study of govt vs. pvt. Plantations.

Suggested Readings:

Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.
Evans, J. and Turnbull, J.W. 2004. Plantation Forestry in the Tropics: The Role, Silviculture and Use of Planted Forests for Industrial, Social, Environmental and Agroforestry Purposes. OUP

Oxford, 467.
Nambiar, E.K.S., Cossalter, C and Tiarks.A. 1998. Site Management and Productivity in Tropical Plantation Forests. Workshop Proceedings, South Africa.
Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.
Bowen, G.D., E. K. S. Nambiar, E.K.S 1984. Nutrition on Plantation Forests. Academic Press, 1984 - Nature - 516 pages
Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. 2006. Plantation Forestry in the Tropics. Springer Tokyo.
Krishnapillay.B. 2000. Silviculture and Management of teak plantations. Unasy.201. 51:14-21p.

SAF 8.13 AGROFORESTRY SYSTEMS AND MANAGEMENT 2(1+1)

Theory:

Agroforestry systems in different agro climatic zones, components, production and management techniques. Alley cropping- functional and structural attributes of alley cropping, Structural and functional attributes, soil management, choice of species and system productivity of various Agroforestry systems. High-density short rotation plantation systems, silvicultural woodlots/energy plantations. Different types of Pastoral siviculture and silvopastoral systems Silvoagriculture systems- Agrosilviulture, Pastoral silviculture , Silvopastoral andAgrosilvopastoral systems and their mangement; agrihortisilviculture, silvihorticulture, hortipastoral , aquaforestry, shelterbelts and windbreaks - design, aerodynamics and management; live fences; fodder trees and protein banks. Agroforestry for wasteland development. Canopy management - lopping, pruning, pollarding, and hedging. Diagnosis and design methods and approaches.Biophysical and ecological functions of agroforestry: Nutrient cycling and role of agroforestry in soil and water conservation - micro-site enrichment by trees, N fixation, improvement in soil physico-chemical properties and soil organic matter status, litter and fine root dynamics, nutrient pumping; beneficial effects of species mixture - rhizosphere and phillosphere effects. Carbon sequestration-Climate change mitigation and phytoremediation. Adverse effects of trees on soils - competition, allelopathy – causes and mechanisms. Soil fertility considerations in Agroforestry – nutrient needs of trees and crops, activities of soil fauna and microorganisms affecting plant growth. People’s participation, rural entrepreneurship through Agroforestry and industrial linkages. Financial and socio-economic analysis of Agroforestry systems. Evaluation of tangible and intangible benefits.

Practical:

Study characteristics of trees/shrubs/grasses for agroforestry. Visit prominent agroforestry systems, other plantation crop combinations, homegardens, other integrated multitier agroforestry systems and study their structural and functional attrbutes. Volume and biomass estimation- C sequestration assessment- Crown measurement, light interception, leaf area index measurements in agroforestry systems. Annual crops/grass growth measurements and yield estimation. Diagnosis and design - methodology. Survey agroforestry practices in local/ adjoining areas. Multistoried cropping system and canopy architecture management

Suggested reading :

Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.
Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.
Kumar, B. and Nair, P.K.R. (eds). 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Volume 3 in the Book Series "Advances in Agroforestry". Springer Science, the Netherlands
Kumar, B.M. 2011. Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. Agriculture, Ecosystems and Environment. 140: 430–440
Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p
Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.
Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi.
Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. Journal of Sustainable Agriculture. Volume 29, Issue 4: 135-153.
Nair PKR, Rao MR, and Buck LE (eds), 2004. New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.
Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutr. Soil Sci. 172: 10–23.
Nair, PKR 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

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DEPARTMENT OF FOREST BIOLOGY AND TREE IMPROVEMENT (FBT)

FBT 2.1 DENDROLOGY 3(2+1)

Theory :

Introduction to dendrology – history, significance of dendrological studies and applications in tree identification; Botanical Nomenclature – ICBN (International code of Botanical Nomenclature) Rules and Codes of ICBN, Binomial and Polynomials; Systems of classification – Natural, Artificial and Phylogenetic classification. Principles of systematic. Demerits and merits of plant classification as given by Engler and Prantl, Hutchinson and Bentham and Hooker; Morphology as a tool for tree identification – Field characters – Branching pattern, Leaf, Fruit and Bark. Role of reproductive characters (Flower types, floral formulas and floral diagrams). Reproductive morphology of plants with reference to description and identification of reproductive parts; General form of woody trunk and deviations like buttresses, flutes, crooks, etc. Morphology and description of bark of common Indian trees including types of exfoliationpatterns in bark; Characteristics of blaze on bark, colour, gums, latex, Resins, Oleo-gum-resinsincluding common trees yielding tannins, gums, resins and other secretory products; Methods of Floristic survey and need for botanical explorations; herbarium techniques, collection, processing and preservation of plant material. General study of herbarium, arboretum, Palmetum, Fruticetum, Bambusetum and Xylarium; Allelopathic interactions of forest trees; Endemic, Rare, Endangered, Threatened and Exotic trees of India; Study of families, as survey of trees or woody plant resources: Magnoliaceae, Rhizophoraceae, Ebenaceae, Sapotaceae, Caesalpiniaceae, Santalaceae, Mimosaceae, Elaeagnaceae, Fabaceae, Meliaceae, Salicaceae, Lauraceae, Apocynaceae, Betulaceae, Fagaceae, Moraceae, Tiliaceae, Euphorbiaceae, Pinaceae, Dipterocarpaceae, Cupressaceae, Guttiferae (Clusiaceae), Taxaceae, Myrtaceae, Rubiaceae, Sterculiaceae, Bignoniaceae and Combretaceae.

Practical:

Morphological description of plant parts with special reference to identification – Types of leaves, Phyllotaxy, Venation, Inflorescence and bark identification; Methods of plant collections and herbarium preparation; Study of trees and woody plants of Magnoliaceae, Ebenaceae, Caesalpiniaceae, Mimosaceae, Fabaceae, Meliaceae, Salicaceae, Tiliaceae, Taxaceae, Pinaceae, Myrtaceae, Rubiaceae, Sterculiaceae, Bignoniaceae and Combretaceae. (As per regional trees and woody plants); Visit to Botanical gardens and Arboretum for identification.

Suggested reading :

R. Naqshi. (1993). *An Introduction to Botanical Nomenclature*. Scientific Pub. Jodhpur.

Ashok Kumar (2001). *Botany in Forestry and Environment*. Kumar Media (P) Ltd. Gandhinagar, Gujarat.

Charles McCann. (1966). *100 Beautiful Trees of India*. D. B. Taraporevala Sons & C. Pvt. Ltd. Mumbai. (Available online PDF)

D. Brandis. Revised by R. D. Jakarti (2010). *Indian Trees.*. Dehradun.

D. N. Tewari (1992). *Tropical Forestry in India*. International Book Distributors, Dehradun.

Father H. Santapau. (1966). *Common Trees*. (Available online PDF)

Eric A. Bourdo Jr. (2001). *The Illustrated Books of Trees. A Visual Guide to 250 species.* Published by Salamander Books Pvt. Ltd. London. (Available online PDF)

Gurucharan Singh. (2000). *Plant Systematics*. Oxford and IBH Publishing Co. New Delhi.

K. C. Sahni. (2000). *The Book of Indian Trees*. Bombay Natural History Society. Mumbai.
M. S. Randhawa. (1957). *Flowering Trees in India*. Sree Saraswati Press Ltd. Kolkatta.
N. L. Bor (1990). *Manual of Indian Forest Botany*. Periodical Expert Book Ag. New Delhi.
Pradip Krishnen (2013). *Jungle Trees of Central India*. Penguin Books India Pvt. Ltd.
R. N. Parker. (1933). *Forty Common Indian Trees and How to know them*.
S. K. Jain and R. R. Rao. (1977). *Handbook of Field and Herbarium Methods*. Today and Tomorrow's Printers and Publishers. New Delhi.
S. N. Pandey and S. P. Mishra. (2008). *Taxonomy of Angiosperms*. Ane Books India, Delhi.
S. R. Mishra. (2010). *Textbook of Dendrology*. Discovery Publishing New Delhi.

FBT 3.2 WILDLIFE BIOLOGY 3 (2+1)

Theory:

History of Wildlife in India; Values of Wildlife : Ethical, cultural, scientific, economical, aesthetic & negative values; Basic requirements of wildlife – food, water, shelter, space, limiting factors; Food chain, Food web, Ecological pyramids; Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals; Zoogeographical regions (Animal Distribution) and biomes of the world; Wildlife Habitat: Niche, Territory, Home Range, Territoriality, Edge, Cruising Radius, Carrying Capacity; Animal behavior and adaptation; Wildlife census; Habitat Improvement: Food, Water, Shelter improvement; Captive wildlife: Zoos and safari parks, Captive breeding for conservation, Central zoo authority of India

Practical:

Measuring and mapping habitat variables; Estimating abundance and monitoring of wildlife species and their habitats; Remote Sensing and GIS techniques in Wildlife Conservation; Important protected areas of India; Study of indirect evidence (pugmarks, excreta etc.) of wildlife.

Suggested reading

Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. Oxford Univeristy Press, New Delhi.
Dasmann, R.F. 1982. Wildlife Biology. Wiley Eastern Ltd. New Delhi.
Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.
International Zoo Books, Published by New York Zoological Society, New York
Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press
Lever, C. 1985. Naturalised mammals of the world. John Wiley, London
Mathur R. 1985. Animal Behaviour. Oxford University Press
Mills, L. S. 2013. Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2). Wiley-Blackwell.
Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.
Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
Sukumar, R. Asian Elephant. Ecology and Management. Oxford University Press Cambridge.
Wildlife Institute of India (2004) Compendium on the notes on the course Captive management of Endangered Species. Wildlife Institute of India. Dehra Dun
Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England.
Zoos Print and Zoo Zen, Published by Zoo Outreaches Organization, Coimbatore

FBT 3.3 FOREST ECOLOGY & BIODIVERSITY CONSERVATION 3 (2+1)

Theory:

Historical development of ecology as a science. Levels of biological organization. Major forest Ecosystem. Forest environment- major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow. Population ecology - definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management. Community ecology- species interactions, ecological succession, terminology, basic concepts, theories of succession- climax vegetation types, forest management and succession. Island Biogeography. Autecology of important tree species. Perturbation ecology- Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices. Principles of conservation biology, Ex situ and In situ methods of conservation, Genetic and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide. Introduction to IPR and quarantine laws.

Practical:

Study of ecological modifications in plants; Effects of fire on forest ecosystem; Study of population dynamics using model systems; Preparation of life tables; Study of spatial dispersion among plants; Study of Forest composition; Niche analysis; Computation of diversity indices; Measurement of diversity of plants and insects in a nearby forest; Study of succession in field and water bodies; Visit to different ecosystems. Estimation of growth and productivity of Plantation/site. Field data processing and analysis-Calculation of IVI, Diversity indices Assessment of tree volume and carbon sequestration

Suggested reading:

Odum EP 1983. Basic Ecology. Saunders College Publishing, Philadelphia etc. 613p.

Misra KC 1974. Manual of Plant Ecology. Oxford &IBH Pub Co. New Delhi etc. 491p.

Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub.Co. New Delhi, 404p.

Montagnini, F and Jordan, C.F. 2005. Tropical Forest Ecology: The Basis for Conservation and Management. Springer. 295p.

Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p.

Saggwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p.

PD Sharma, 2013. Ecology and Environment. (11th Edition), Rastogi Publications, Meerut.

Kimmins JP. 1976. Forest Ecology. MacMillan.

Nautiyal S & Koul, AK. 1999. Forest Biodiversity and its Conservation Practices in India. Oriental Enterprise.

FBT 3.4 FOREST GENETICS & TREE IMPROVEMENT 3(2+1)

Theory:

Introduction – history and development of tree improvement – its relation to other disciplines of forestry. Reproduction in forest trees. Anthesis and pollination – their importance in tree breeding. Incompatibility and sterility. Quantitative inheritance. Relevance in forestry. Genetic, environmental and interaction components of variation - heritability and genetic advance. Genetic basis of tree breeding. Natural variability in trees – types and importance.-

forces that change variability. Exotic forestry. Provenance testing. Selection- seed production areas–seed orchards. Progeny trial and improvement of seed orchards. Combining ability and genetic gain – Hybridization in trees – back cross breeding, heterosis breeding. Mutation breeding; Ploidy breeding. Breeding procedures for development of hybrids, / varieties of various crops. DUS testing, Concepts of Geographical indications. Artificial hybrids in trees crossing in trees-problems and perspectives-crossing hybrids and hybrid breakdown. Hybrid nomenclature in trees- Future of hybrid in applied tree improvement. Breeding for resistance to insect pests' diseases, air pollution and for wood properties. Vegetative propagation and Clonal forestry. Conservation of forest tree germplasm. Recent techniques in tree improvement.

Practical

Floral biology and phonological observations in some important species. Pollen morphology. Estimation of pollen sterility and viability. Emasculation and hybridization in forest tree species. Different breeding methods – flow chart. Recording observations in provenence trial. Estimation of phenotypic and genotypic coefficient of variation. Estimation of genetic advance, heritability and GCA. Exercise in plus tree selection– recording data – design and observation in teak, eucalyptus seed orchard.

Suggested reading:

Surendran, C., Sehgal, R.N. and Parmathma, M. (Eds.) (2003). A text book of Forest Tree Breeding. ICAR, New Delhi.

Wright, J. (2012). Introduction to Forest Genetics. Elsevier.

Zobel, B. and Talbert, J. (2003). Applied Forest Tree Improvement. Blackburn Press.

Bedell P. E. (2007). Tree Breeding for Genetic Improvement of Tropical Tree Species (1st Ed).

Allied T.L. White and Adams (2010). Forest Genetics.

FBT 3.5 FOREST ECOPHYSIOLOGY 2 (1+1)

Theory:

Introduction to Ecophysiology – Geographic and climatic factors - Forest ecosystems – Environmental factors influencing forest growth and productivity. Carbon balance - Dry matter production and partitioning – GPP and NPP of forest stands – productivity and biomass in tropical deciduous and evergreen forest ecosystems. Canopy area - Leaf area index and dry matter production – Interception of solar radiation and tree growth- Shade tolerance and adaptations of trees.

Environmental stresses - water stress - physiological changes - adaptation to drought and its amelioration, flooding – mechanism of tolerance to water logging. Temperature stress – Physiological changes - low and high temperature - chilling injury - tolerance – alleviation - salt stress – physiological changes and alleviation, Air pollution – physiological effects of air pollutants. Ecophysiological responses of forests to atmospheric change – Impact of elevated CO2, -Leaf gas exchange, Photosynthesis, Plant respiration – Carbon sequestration, Effect of Green house gases (CH4, NO2, CFCs) - Adaptation and Mitigation

Practical:

Estimation of leaf area and LAI. Chlorophyll stability index – membrane stability index – Water use efficiency. Estimation of evapo-transpiration. Measurement of photosynthetic production. Translocation studies in plants; Effect of growth promoters on plants; Effect of growth retardants

on plants; impact of light / shade on growth and yield of crops. Studies on deciduous nature of trees/senescence; Regulation of senescence in tree species using agrochemicals; Biochemical composition in tree species in relation to physiology.

Suggested reading :

Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody plants. John Wiley and Sons. New York

Lambert, Chapin, F.S. and Pons,T.L. (2008). Plant Physiological Ecology. Springer Science & Business Media inc. Newyork.

Landsberg , J.J (2010). Physiological Ecology of Forest Production : Principles, Processes and Models. Academic Press Inc., London

Landsberg, J.J and Gower, S.T. (1997). Applications of Physiological Ecology to Forest Management. Academic Press Inc., London.

Larcher, W. (2003) Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media

Longman, J.A. and Jenik. (1987). Tropical Forests and its Environment. ELBS, London.

Nobel P. S. (2005). Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, Amsterdam

Taiz, L. and Zeiger, E. (2010) Plant Physiology (5th edition). Sinauer Associates, Inc., Massachusetts.

Wilkins, B.M, (1984). Advanced Plant Physiology. Longman Scientific & Technical.

FBT 4.6 ORNITHOLOGY & HERPETOLOGY 2+1

Theory:

Ornithology: Origin of birds, morphological and physiological adaptations; Classification of Indian birds. Biogeographic patterns of Indian avifauna; Avifauna of Himalayas, Western and Eastern Ghats, Island, waterfowl, desert avifauna; Birds of Agriculture: Beneficial and Harmful; Economic ornithology; Bird Extinctions; Endangered and threatened birds of India and their conservation; Migration: Kinds of migration in birds; Bird census techniques.

Herpetology : Zoogeography of amphibians and reptiles; Amphibians and reptile of India; Factors affecting distribution of herpeto fauna; Biology of major Indian amphibians, turtles, crocodilians, lizards and snakes; Thermoregulation, aestivation, hibernation and other eco-physiological adaptations; Conservation issues of herpetofaunain Indian

Practical:

Field identification of major birds of Gujarat; Birding: preparation of checklist /inventory, Study of nearby wetland; Species conservation projects, Characteristics and morphological features of herpeto fauna of India, Snake rescue techniques and release in natural habitat, Snakebite and its management, Study of role of nearby NGOs in Herpetofauna / snake conservation.

Suggested reading:

Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.

Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.

Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.

Das, I. 2002. A photographic guide to Snakes and other reptiles of India. New Holland Publishers

(UK) Ltd.
Grimmet, R. Inskipp T and Inskipp, I. 2003. Handbook of Birds of Indian subcontinent. Oxford University press
Grimmet, R. Inskipp, T and Nameer, P.O. 2007. Birds of southern India, BNHS series.
Gururaja KV. 2012. Pictorial Guide to frogs and toads of the Western Ghats. IISc. Bangalore.
Kazmierczak, K. and van Perlo B. 2000. A field guide to the birds of the Indian subcontinent, Yale University Press, New Haven. CT.
Kentwood D. Wells. 2007. The Ecology and Behavior of Amphibians. Th University of Chicago Press, Chicago.
Rasmussen P C and John C. Anderton.2012. *Birds of South Asia: The Ripley guide*. Vol. I and II, Smithsonian Institution and Lynx Edicions, Washington DC and Barcelona.
Wallace GJ and HD Mahan. 2005. An Introduction to Ornithology. 3rd Ed. McMillion publishing company. New York.
Whitaker, R. and Captain, A. 2004. Snakes of India. The Field Guide. Draco Books.
Chengalpattu, Tamil Nadu, xiv+479, pls, text-figs.
William E. Duellman and Linda Trueb. 1986. Biology of Amphibians. John Hopkins University Press, Maryland.
Vidyarthi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi.

FBT 4.7 SEED TECHNOLOGY & NURSERY MANAGEMENT 3 (2+1)

Theory :

Importance of seed in present day forestry, seed and fruit development, type of fruits, seed dispersal. Seed collection; planning and organization, methods of seed collection, Fruit and seed handling - maintaining viability and identity-special precautions of handling of recalcitrant seeds. Seed processing; operations prior to extraction-pre-cleaning, pre curing, drying; methods of extraction- operations after extraction- cleaning, grading and control of moisture level, Pre-storage treatments. Safety precautions during processing. Seed storage- definition- purpose, orthodox and recalcitrant seeds- natural longevity of tree seeds, factors affecting longevity in storage, Harrington's rules. Storage condition and ageing of seeds. Storage methods - Storage containers. Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy. Seed dressing and pelleting. Seed testing; definition- ISTA rules, seed sampling, seed weight, purity analysis, moisture analysis, germination testing, vigour, indirect tests of viability, seed health. Seed Act and Seed Certification

Introduction and scope of Forest nursery. Nursery establishment - site selection – planning and layout of nursery area. Types of forest nursery, types of nursery beds, preparation of beds, Methods of seed sowing.seedling growth and development, pricking, weeding, hoeing, rotation, organic matter supplements and cover crops, mycorrhizae, fertilization, watering, shading, root pruning, root culturing techniques, hardening, grading, packaging, storing and transportation. Containerised nursery techniques - advantages, disadvantages - root deformations - container designs and types/root trainers and rooting media. Conditions/practices affecting survival and early growth, acclimating containerised stock, advantages, disadvantages. Study of important nursery pests and diseases and their control measures.

Practical :

Identification of seeds of tree species; Seed maturity tests; Physical purity analysis; Determination of seed moisture; Seed germination test; Hydrogen peroxide test; Tetrazolium test

for viability; Seed vigour and its measurements; Methods of breaking dormancy in tree seeds; Study of seed collection and equipments; Planning of seed collection; Seed collection; Seed extraction; Visit to seed production area and seed orchard; Visit to seed processing unit/testing laboratory; Study of seed sampling equipments. Study of nursery tools and implements, growing media and containers. Nursery site and bed preparation. Pre-sowing treatments. Sowing methods of small, medium, and large sized seeds. Mother beds and transplant bed preparation- Pricking and transplanting of in transplant beds. Visit to tree nurseries

Suggested readings:

An introduction to tree seed technology by R. Umarani & K. Vanangamudi
Forest tree seeds by S.S. Negi
Forest seed by P. Khullar (ICFRE Publication)
Advances in seed science and technology by K. Vanangamudi *et al*.
A guide to forest seed handling (FAO publication)
Tropical forest seeds by Lars Schmidt
Modern nursery management by R.L. Bhardwaj and D.K. Saroliya
Nursery and plantation practices in forestry by Vinod Kumar
Nursery and planting techniques of forest trees in tropical South – Asia by S.N. Rai
Practical Nursery Production by R.S. Saini *et al*.

FBT 8.8 FOREST BIOTECHNOLOGY 3 (2+1)

Theory:

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in forestry: Totipotency and Morphogenesis, Nutritional requirements of invitro cultures; Techniques of In-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting in-vitro culture; Applications and Achievements; Soma clonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in tree improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in crop improvement.

Practical:

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoresis technique

Suggested reading:

Bajaj, Y.P.S. (Ed) (1988). Biotechnology in Agriculture and Forestry 2. Crops 1. Springer-Verlag, Berlin.
Dhawan, V (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US
EIRI Board. (2007) Hand Book of Biotechnology. Engineers India Research Institute, NaiSarak, Delhi
Gupta, P.K. (2010) Elements of Biotechnology (2nd Ed). Rastogi Publications
Neumann, K.H., Kumar, A., and Sopory, S.K. (2008) Recent Advances in Plant Biotechnology and Its Applications. I. K. International Pvt Ltd
Punia, M.S. (1998). Plant Biotechnology and Molecular Biology. A laboratory manual. Scientific Publishers, Jodhpur,
Rehm, H.J. and Rheed,G. (Ed) (1993). Biotechnology Vol.2, VCH Verlagsgesellschaft, Germany.
Surendran, C., Sehgal, R.N. and Paramathma, N. (Eds.) A Textbook of Forest Tree Breeding, ICAR, New Delhi.
Thieman, W.J. and Palladino, M.A. (2009). Introduction to Biotechnology, Second Edition. Pearson Benjamin Cummings, San Fransisco

FBT 8.9 WILDLIFE MANAGEMENT 2 (1+1)

Theory:

Principles and practices of wildlife management; Forest and wildlife management in India. Population Management: Capture, handling, bio-telemetry, reintroduction, prey-predator relationship; Species conservation projects: lion, lion, elephant, rhino, crocodile, musk deer etc. Wildlife Management plan for Protected Areas; In-situ and Ex-situ management/ conservation. Man-animal conflict and its management; Red data book and IUCN; Wildlife Ecotourism: sustainable tourism and people's participation; Agencies in wildlife conservation: IUCN, CITES, WWF, IBWL; Community participation in wildlife management; Case studies; Wildlife policies and legislation, Wildlife (Protection) Act, 1972

Practical:

Study of nearby protected area management; Participation in capture operations; Visit to Zoo/ captivity and studying management practices; Use of collars and radio tracking equipment. Wildlife photography and conservation; Study of wildlife management plan of nearby protected area; Wildlife based ecotourism model study

Suggested Readings

Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State Univ. Press USA.
International Zoo Books, Published by New York Zoological Society, New York
Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press
Lever, C. 1985. Naturalised mammals of the world. John Wiley, London
Mills, L. S. 2013. Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2). Wiley-Blackwell.
Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.
Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
Wildlife Institute of India (2004) Compendium on the notes on the course Captive management of Endangered Species. Wildlife Institute of India. Dehra Dun
Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England
Zoos Print and Zoo Zen, Published by Zoo Outreaches Organization, Coimbatore

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DEPARTMENT OF FOREST PRODUCTS & UTILISATION (FPU)

FPU 2.1 WOOD ANATOMY 2 (1+1)

Theory :

Introduction to Wood Anatomy. The plant body–Cell and organelles, Kinds of woody plants–Porous wood and non-porous wood. The plant body; a tree and its various parts. Types of plant tissues–meristems, promeristem, primary meristem, secondary meristem, apical and intercalary meristems. Simple tissues- parenchyma, collenchyma, sclerenchyma. Complex tissues-Xylem and Phloem. Tissue system-vascular bundles/vascular tissue system. Anatomy of stems and roots of ducats and monocots. The secondary growth in woody plants. Mechanism of wood formation in general, and with special reference to typical dicot stem. Physiological significance of wood formation. General/physical features of wood; colour, hardness, weight, texture, grain, lusture, etc. The macroscopic features of bark, wood, sapwood, heartwood, pith, juvenile wood, mature wood, growth rings-early and late wood. Transformation of sapwood to heartwood, factors affecting transformation. The microscopic features of wood- tracheids, vessels, fibers, axial parenchyma (soft tissues), wood rays, resin canals, gum canals, latex canals and cell inclusions. Three dimensional features of wood; transverse, tangential and radial surfaces. Abnormalities in wood- deviation from typical growth form (leaning, bending, crook, fork, buttress), grain deviation, false and discontinuous growth rings. Reaction wood-compression and tension wood. Disruption of continuity of inner wood, shakes, included bark, resin pockets, pith flecks, live knots and dead knots.

Practical:

Study of primary growth in typical dicot and monocot stems; Study of vascular bundles in monocots and dicots; Study of three dimensional features (cross, radial and tangential planes) of logs (woody trunks); Comparative anatomical features of softwoods and hardwoods; Study of general properties of wood. Study of anatomical features of different types of wood pores /vessels; Study of soft tissues in timbers and their distribution; Study of wood rays and their types; Study of non-porous woods, their physical and anatomical description; Study of cell inclusions in wood. Study of gross anatomical features of wood for field identification of important Indian timbers of respective states.

Suggested Reading:

Evert R.F. 2006. Esau's plant anatomy-Meristems, Cells, and tissues of the plant body: their structure, function and development.601 pp.

Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.

Pearson R.S. and Brown, H.P. 1981. Commercial timbers of India-Volume1 and 2.1135 pp.

Rao, R. K. and Juneja, K. B. S. 1971. Field identification of fifty important timbers of India. Indian Council of Forestry Research and Education, New Forest, Dehra Dun. 123p.

Chowdhury K.A. 1951.West Bengal commercial timbers-their identification, properties and uses Vol. 1. Indian Forest Records (New series), 96 pp.

FPU 4.2 WOOD PRODUCTS & UTILIZATION 3(2+1)

Theory :

Pulp and paper industry. Introduction and raw material; pulping-mechanical,

chemical, semichemical and semi-mechanical; pulp bleaching; stock preparation and sheet formation; types of paper; manufacture of rayon and other cellulose derived products. Manufacture, properties and uses of Composite wood- plywood, fiberboard, particleboard and hard board. Adhesives used in manufacture of composite wood. Improved wood-definition, types (impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood esp. acetylation of wood). Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast. Uses of wood. Structural uses of Timber. Decorative uses of wood. Wood carving and handicrafts. Nano technology in wood. Biochar. Short rotation forestry crops. Other forest based industries – veneer, sawn wood, furniture, bamboo, sports goods, pencil making, match box and splint making.

Practical:

Visit to paper industry to study pulp and papermaking. Study and collection of different types of papers. Study of different types of paper boards. Visit to Rayon industry. Visit to plywood industry to study the manufacturing processes. Study of plywood, fiberboards, particleboards, and hard boards. Visit to other wood based industries. Visit to wood distillation unit. Visit to nearby industrial plantations. Study of types of improved wood. Visit to saw mill to study veneering and different kinds of sawing, Visit to wood based handicraft manufacturing unit.

Suggested Reading:

Mehta, T. (1981). A Handbook of Forest Utilization, Periodical Expert Book Agency.

FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

Hoadley, B. 2000. Understanding Wood: A Craftsman's guide to wood technology. Taunton Press. Newtown, USA. 223p.

Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2nd Ed. Miller and Freeman Publication, Inc. USA. 388p.

FPU 4.3 ETHNOBOTANY AND MEDICINAL & AROMATIC PLANTS 3 (2+1)

Theory:

Definition and scope of ethnobotany. Terms employed in relation to ethnobotany and its relationship with man and domestic animals. Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects. Important plants and their folk uses for medicines, food, dyes, tans, etc Methods and tools in Ethnobotanical studies. Ethnobotany of tribals in Southern India. Traditional Botanical Knowledge- concepts. Major tribes of Northern, Central, North East and Andaman and Nicobar Islands. Ethnobotany of the plants from the following families. Guttiferae (Clusiaceae), Malvaceae, Fabaceae, Mimosaceae, Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae.

Definition - role of medicinal and aromatic plants in Indian economy - Important essential oil yielding plants in India - Detailed study of lemon grass, citronella, palmarosa, vetiver, japanese mint, eucalyptus, jasmine, patchouli and geranium - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils. Medicinal plants in India and Gujarat - history, origin, area and distribution,

production, botany and varieties - cultivation, extraction of active principles and their uses - uses of different medicinal plants like *Atropa, Cinchona, Rauvolfia, Opium, Sandal, Acorus, Cannabis, Digitalis, Strychnos nux-vomica, Aconitum, Neem, Dioscorea, Costus, Solanum* etc. Cultivation practices of medicinal plants like *Adhathoda zylanica, Sida cordifolia, Sterospermum colais, Plumbago zylanicum, Tinospora cordifolia, Kaemferia glanga, Indigofera tinctoria.* Conservation packages for the medicinal plants collected in wild.

Practical:

Field visit to different tribal regions to gain ethnobotanical knowledge and the inter-relation between plant and people- Survey and identification of plants used by the tribals for medicine, food and other social purposes- Collection and preparation of herbarium specimens of the above plants- Identification of medicinal and aromatic plants – propagation techniques – Harvesting and oil extraction of aromatic plants – Field visit, collection and preparation of herbarium – Visiting commercial units of medicinal plants.

Suggested reading:

Cunningham, A. 2014.Applied Ethnobotany: "People, Wild Plant Use and Conservation". Taylor & Francis,300p.

Maheshwari, J.K. 2000.Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers,Jodhpur, India, 672p.

Jain, S.K. 2010.Manual of Ethnobotany (2nd Ed).Scientific Publishers, India, 242p.

Atul, C.K. and Kapur, B.K. (1982).Cultivation and utilization of medicinal plants.RRL., CSIR, Jammu-Tawi.

Chopra, R.N., Nayar, S.L. and Chopra, I.C. (1956).Glossary of Indian medicinal plants. CSIR, New Delhi.

Gunther, E. (1975). The essential oils. Robert, K Krieger Pub. Co., New York.

EIRI Board. (2007). Handbook of Medicinal and Aromatic Plants: Cultivation, Utilisation and Extraction Processes. Engineers India Research Institute, NaiS arak, Delhi,.

Khan, I.A. and Khanum, A. (2005). Medicinal and Aromatic Plants of India ; Herbal Wealth for HumanHealth (1st Ed). Ukaaz Publications.

Muralia, S. (2006).Medicinal and aromatic plants (1st Ed).Neha Publishers & Distributors.

Chopra, A.K. (2007). Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books.

FPU 4.4 LOGGING AND ERGONOMICS 2(1+1)

Theory:

Definition and scope of logging, logging plan and execution. Location and demarcation of the area for logging and estimation of produce available for extraction. Implements used in logging operation; traditional and improved tools. Felling rules and methods, Work contracts related to felling and removing (contract system, convener systems) etc. Conversion, measurement and description of converted material. Means of transport of timber; carts, dragging, skidding, overhead transport, ropeways, skylines. Transport by road and railways. Transport by water; floating, rafting and concept of booms. Non-destructive sampling methods of wood. Grading and storage of timber in the depots for display and disposal, temporary and final storage. Timber Depots; types, lay out and management. Systems of disposal of timber. Ergonomics: definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipments,

safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.

Practical:

Equipments and tools used in logging operations and their uses. Instructions regarding maintenance of various records and registers in logging operations; Conversion of felled trees into logs, poles, firewood, pulpwood. Visit to local saw mills to study the equipments used and process of conversion. Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers. Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites. Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes. Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination. Stacking of the lots for display and final disposal; recording of the lots for auction sale. Final disposal of the material. Visit during the auction sale in the government timber depots; Preparation of ergonomic check lists. Familiarize the e-auctioning procedure of State Forest Department.

Suggested Reading:

Brown, N. C. 2002. Principles and methods of harvesting of timber. Biotech books, Delhi. 430p.

Staaf, K.A.G. and Wiksten, N.A. (1984). Tree Harvesting Techniques. Martinus Nijhoff/DR W. Junk Publishers, Netherlands.

FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

GFC. [Guyana Forestry Commission]. 2002. Code of practice for timber harvest. 2 nd Ed. Georgetown, Guayana. 42p.

Hakkila, P. 1989. Utilization of residual forest biomass. Springer-verlag, Berlin. 567p.

Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.

Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.

Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.

Wakermann, A. E. 2002. Harvesting timber crops. Biotech books, Delhi. 433p.

FPU 4.5 NON-TIMBER FOREST PRODUCTS 3(2+1)

Theory :

Introduction, methods of collection, management and importance of Non-Timber Forest Products (NTFP). Fodder (grasses and tree leaves), canes and bamboos. Essential Oils – sources, nature of occurance, methods of extraction, classification, storage and uses. Non-essential oils – nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans- nature, classification, uses and important tannin yielding plants. Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses. Katha and Cutch – sources, extraction and uses. Drugs, spices, wild edible plants part like fruits, flowers, roots, tubers, vegetables, leaves and edible products, poisons and bio-pesticides. Animal products – honey and wax, silk, lac, fish, Wild edible animal products (from birds, reptiles, insects, snail etc.), trophies like tiger, panthers, elephants etc.

Mineral products and other miscellaneous products.

Practical:

Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources. Study of non-essential oils and their sources. Study of gums and resins and their collection. Study of tans and dyes and their sources. Study of fibers, flosses and their collection from nearby forests. Visit to Herbal Gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild edible plants, poisons and bio-pesticides and their collection from nearby forests. Visit to nearby extraction units.

Suggested Reading:

Mehta, T. (1981). A Handbook of Forest Utilization, Periodical Expert Book Agency.

FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

Krishna murthi T.(1993) Minor forest products of india, Oxford & IBH Publishing Co Pvt. Ltd.

Krishna murthi T.(2010) Minor forest products of india(Non- Timber Forest Products), Second edition. BS Publications

Mishra, T.K., Banerjee, S.K and Pal, D.C. (2004). An Omnibus of Non- Timber Forest Products of India, Prashant Gahlot at Valley Offset Printers and Publishers, Dehra Dun.

Nair, K.K.N. (2000). Manual of Non-Wood Forest Produce Plants of Kerala, Kerala Forest Department, Government of Kerala, Thiruvananthapuram.

Nautiyal, S and Kaul, A.K.(2003). Non –Timber Forest Products of India, Jyothi- Publishers and Distributors, Dehra Dun.

FPU 5.6 WOOD SCIENCE AND TECHNOLOGY 3 (2+1)

Theory :

Wood as raw material, kinds of woods– hardwood, softwood. Bamboos and canes. Merits and demerits of wood as raw material. The physical properties of wood–density and specific gravity; wood and water relationship-moisture content, shrinkage, swelling, movement, fibre saturation point, equilibrium moisture content; electrical, thermaland acoustic properties of wood. Mechanical properties of wood- general principles, tension, compression, static bending, impact bending, shear, indentation, torsion, cleavage and nail and screw pulling test. Suitability of wood for various end uses based on mechanical and physical properties. Wood seasoning – Introduction, principles, objectives and importance of wood seasoning; classification of timber based on seasoning behaviour;seasoning methods – air seasoning, kiln seasoning, type of kilns and drying schedules, special seasoning methods; seasoning defects and their control. Wood preservation– principles, processes, need, types of wood preservatives (oil type, organic solvent type, water soluble leachable type, water soluble fixed type.), classification of timbers based on durability, general idea about fire retardants and their usage. Non-pressure methods – steeping, dipping, soaking open tank process, Boucherie process. Pressure methods – full cell process, empty cell process (Lowry and Rueping). Wood machining: Sawing milling– sawing techniques; Saw mill machineries-cross-cutting machines, head saws (circular, gang, frame and band saws) re-saws. Wood working- wood working machineries (sawing, planing, moulding, boring, mortising, Tennoning and turning machines)**.** Dimensional stabilization of

wood by surface coating method, bulking method, impregnation of resins and polymers. Wood finishing.

Practical:

Different kinds and types of wood available as raw material. Preliminary idea regarding procurement and temporary storage of logs. Nomenclature of sawn material after conversion of timbers into various sawn forms. Estimation of moisture content of wood by oven-dry and moisture meter. Estimation of wood density by various methods. Determination of calorific value of wood. Testing of various mechanical properties of wood. Wood seasoning- air seasoning, kiln seasoning and special seasoning methods. Seasoning defects and their control. Chemicals used in wood preservatives, methods of wood preservation and fire retardant treatments. Various types of wooden joints in timber structures and furnitures, Saw mill and wood workshop machineries. Polishing and finishing of wood.

Suggested Reading:

Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.

Walker, J.C.F., Butterfield B.G., Langrish T.A.G., Harris J.M., Uprichard J.M. 1993. Primary wood processing-principles and practices. Chapman and Hall, London.595 pp.

FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.

Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.

Pandey C.N. and Jain V.K. 1992. Wood Science and Technology. ICFRE [Indian Council of Forestry Research and Education],FRI, Dehradun.144 pp.

Kumar S. and Dev I.1993. Wood Preservation in India. ICFRE [Indian Council of Forestry Research and Education],FRI, Dehradun.262 pp.

Rajput S.S., Shukla, N.K., Gupta, V.K and Jain J.D. 1996. Timber mechanics-strength,classification and grading of timber. . ICFRE [Indian Council of Forestry Research and Education], FRI, Dehradun.189 pp.

Thyagarajan C. 2010. A text book of an insight into wood processing technology. AWTC, IWST, Bangalore.254 pp.

FPU 6.7 MARKETING AND CERTIFICATION OF FOREST PRODUCTS 2(1+1)

Theory :

Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and their features. Demand forecasts. Price determination in timber and non-timber forest produce. Economic features of specialized timber markets in terms of degree and type of competition in buying and selling, price spreads across different channels of marketing, costs of marketing functions involved like pre-commercial thinning, commercial thinning, harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood, veneers; type and degree of competition in market for services of saw mill and other intermediate wood processing industries. Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Forests produce price analysis. Market integration and market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies, role of cooperative societies in marketing of timber and non-timber forest produce. Economic policy and regulations of international timber

trade. Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO). Marketing management in forest produce.

Definition of forest certification. Forest Certification process and methods – Advantages and Disadvantages. Certification schemes in operation. Forest Stewardship Council (FSC), Programme for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit. Indian scenario in certification.

Practical:

Library review of studies on marketing and trade of; timber forest produce (teak, rosewood, Terminalia spp. Pterocarpus and other important timber of national importance etc.); Non-Timber Forest Produce (NTFP such as bamboo, canes, eucalypts etc.); forest based medicinal plants. Visits to timber produce and NTFP markets to collect price data and quantity sold and to observe auctions and competitions. Analysis of price and quantitative data of timber forest produce, NTFP for examining trend; seasonal, cyclical variations. Analysis of price spread of different marketing channels and assessment of market integration. Visit to markets of forest based medicinal plants. Study of buy back arrangements in forest based medicinal plants trade. Valuation of timber and NTFP (existence value, use and option values, intrinsic value etc). Development of hypotheses to study the marketing of forest produce. Presentation of results on analysis of price and quantity.

Suggested reading:

Gray, J. W. 1993. Forest resource systems in developing countries. Food and agricultural organization. Rome. 259p.

ITTO. [International Tropical Timber Organisation]. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.

ITTO. [International Tropical Timber Organisation]. 2012. Annual review and assessment of the world timber situation, Yogyakarta, Indonesia. 182p.

Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.

Muraleedharan, P. K. Subramanian, K. K., and Pillai, P. P. 1998. Basic readings in forest economics. Kerala Forest Research Institute and Ford Foundation, Thrissur, Kerala. 177p.

Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers & Publishers), Dehradun, India. 140p.

Bass, S. Introducing forest certification. 1996. A report prepared by the Forest Certification Advisory Group (FCAG) for DGVII of the European Commission. European Forest Institute, Discussion Paper 1. 30p. Details available at: http://www.giz.de/Themen/de/dokumente/en-d28-inenpenennt-certification-verification-forest-manage.pdf.

Bass, S., Thornber, K., Markopoulos, M., Roberts, S. and Grieg-gran, M. 2001. Certification's Impact on forests, stakeholders and supply changes. International Institute for Environment and Development. London. 153p.

Conroy, M. E. 2007. Branded! How the "certification revolution" is transforming global corporations. New Society publishers, Gabriola Island, BC. 354p.

Gupta, H. S., Yadav, M., Sharma, D. K. and Singh, A. M. 2013. Ensuring sustainability in forestry: certification of forests. TERI, New Delhi. 284p.

DEPARTMENT OF NATURAL RESOURCE MANAGEMENT (NRM)

NRM 1.1 FUNDAMENTALS OF GEOLOGY & SOIL SCIENCE 3(2+1)

Theory:

Introduction: - Introduction to geology and soil science and their major branches, concept(s) of earth, land and soils. The earth - origin, major division of the earth (atmosphere, hydrosphere and lithosphere), interior of the earth, earth's crust and its elemental composition. Soil- concept, definition, functions and characteristics of soils, major components of soils (volume basis), surface soil, sub soil, cultivated and forest soils. Weathering and soil formation:- Rocks and minerals and its occurrence, rock cycle, classification of rocks - igneous, sedimentary and metamorphic rocks, classification of minerals, weathering of rocks and minerals, weathering agents and active and passive factors affecting soil formation.

Soil profile: - Definition, master horizons, transitional and subordinate horizons, solum and regolith, fundamental and specific pedogenic processes of profile development/soil formation.

Soil physical properties: - Importance of physical properties and factors governing it. Soil texture - definition, determination of soil texture, methods of determination, Stoke's law and its assumption and limitations, classification of soil separates (sand, silt, clay), characteristics of soil separates and its influence on properties and behavior of soils, textural classes based on textural triangle. Soil structure - definition, formation, classification, factors affecting it and importance of soil structure. Soil consistency - stickiness and plasticity, indices of soil plasticity, Soil crusting, Soil compaction. Soil density and porosity - definition and relationship, calculation of porosity and hectare soil weight, importance of bulk density and porosity and factors affecting it. **Soil colour** - determination of soil colour and factors affecting it. Soil air and its composition, aeration and importance of soil air in agriculture. Soil temperature - sources and losses of heat, thermal properties of soil and effect of temperature on plant growth. **Soil colloids:** - Description and important properties of soil colloids, classification of soil colloids based on their nature and elemental composition and their explanation and distribution (in short), silicate clay minerals, structure (silica and alumina sheet) and type of silicate clay minerals (1:1, 2:1 and 2:1:1 type), sources of charge on soil colloids.

Soil organic matter: - Definition and origin of soil organic matter in the soil, composition of soil organic matter, decomposition of organic matter and factors affecting it, various organisms involved to decompose organic matter, humus formation. Role of organic matter in the soil.

Soil reaction (pH): - Concept and definition, importance of soil reaction (pH), reaction of forest soils, buffering capacity of soils. **Soil water: -** Meaning and importance of soil water, structure and properties of water, potential of soil water, physical and biological classification of soil water, units for water measurement, soil water constants, movement of soil water, entry of water in soils and determination of soil water.

Soil survey and classification: - Soil survey– definition, objective, type and importance of soil survey. Soil classification- History, comprehensive systems of soil classification, soil orders and its salient features, land capability classification, soils of different ecosystem and their properties. **Problematic soils**: - Definition, major problematic soils of India viz. acid soils, sandy soils, clay soils, salt affected soils, calcareous soils, water logged soils and compacted soils, their key diagnosis and major constraints for crop production, causes of different problem soils and its

impact on soil properties. Quality of irrigation water: Quality parameters and assessment

Practical:

Introduction to soil science laboratory, collection and preparation of soil samples, identification of rocks and minerals, profile study in the field and Excursion tour for identification of rocks and minerals and profile studies, mechanical analysis of soils, determination of bulk density, particle density, porosity, soil colour and soil temperature. Determine soil pH, soil EC and soil organic matter. Determine water soluble and exchangeable cations.

Suggested reading:

Biswas, T. D. and Mukherjee, S. K. 2001. Test Book of Soil Science (2nd Edition), McGraw Hill Education (India) Private Limited, New Delhi.

Brady, N. C. and Weil, R. R. 2010. Elements of the Nature and Properties of Soils (3rd Edition.), Pearson Education, New Delhi

Brady, N. C. and Weil, R. R. 2010. The Nature and Properties of Soils (14th Edition), Pearson Education, New Delhi

Foth, H.D. 1991. Fundamentals of Soil Science (8th Edition), John Wiley & Sons, Delhi.

Das, D .K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana

Khan, T. O. 2013 Forest Soils: Properties and Management, Springer International Publishing, Switzerland

ISSS, 2002. Fundamentals of Soil Science. Indian Society of Soil Science, IARI, New Delhi.

Pritchett and Fisher RF 1987. Properties and Management of Forest Soils. John Wiley,

Gupta, P.K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), AGROBIOS, Jodhpur (India).

Jaiswal, P.C. 2006. Soil, Plant and Water Analysis (2ndEdition),Kalyani pub Ludhiana.

Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher

NRM 1.2 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT 3 (2+1)

Theory

Unit 1 : Multidisciplinary nature of environmental studies Definition, scope and importance

Unit 2: Natural Resources: Renewable and non-renewable resources Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

Unit 3: Ecosystems • Concept of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem :- a. Forest ecosystem , b. Grassland ecosystem

c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4: Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India.

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation.

Hot-sports of biodiversity.

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.

Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 5 : Environmental Pollution: definition, cause, effects and control measures of :-

a. Air pollution ,b. Water pollution ,c. Soil pollution, d. Marine pollution, e. Noise pollution

f. Thermal pollution, g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Pollution case studies.

Unit 6: Social Issues and the Environment: From Unsustainable to Sustainable development

Urban problems related to energy Water conservation, rain water harvesting, watershed management Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Prot. Act

Forest Conservation Act, Issues involved in enforcement of environmental legislation. Public awareness.

Unit 7: Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Unit 8: Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

DISASTER MANAGEMENT

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 waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT-III:-Disaster Management- Effect to migrate natural disaster 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 reading:

Ghadekar, S.R. (2003) Meteorology, Agromet Publishers, Nagpur

Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi

Mavi, H.S. (1994) Agrometerology, Oxford &IBH, New Delhi

Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,

Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg

Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi

Adam Markham (Editor).2010. Potential Impacts of Climate Change on Tropical Forest Ecosystems. Amazon publishers.

Bravo, F., LeMay, V., Jandl, R., Gadow, K. von (Eds.).2008. Managing Forest Ecosystems: The Challenge of Climate Change. Springer publication. Pp 324

Charlotte Streck, Robert O'Sullivan, Richard G. Tarasofsky, Toby Janson-Smith.2011. Climate Change and Forests: Emerging Policy and Market Opportunities. Brookings Institution Press.

Claussen, Eileen; Cochran, Vicki Arroyo; Davis, Debra P.; Pew .2001. Climate Change: Science, Strategies, & Solutions. Brill Academic Pub. Pp 393

Peter H Freer-Smith, Mark S J Broadmeadow, Jim M Lynch.2011. Forestry and Climate Change. CABI Publishers.

Peter Thompson. 1991. Global warming – The debate. Strategy Europe Ltd., London, U.K. p. 130.

Richard Max-Lino.2012. Sustainability, Climate Change, Forestry and Forest Carbon. World Scientific Publishing Co. pp 250.

NRM 2.3 FOREST PROTECTION 3 (2+1)

Theory

Unit-1 : Introduction – Importance of protection in Indian Forestry – classification of injurious agencies. Injury to forest due to fires, causes and character of forest fires – fire prevention activity – fire suppression – fire fighting equipments – fire control policy and objectives. Fire fighting in other countries. Injury to forest due to man, lopping – cutting for fuel wood – Encroachment- different types, control of encroachment illegal felling of trees- method of control legislation. Forest weeds and weed management, management of woody climbers, parasites and epiphytes.

Unit-2 : Importance of Forest Pathology, tree disease classification, Principles of tree disease management, - Causes and symptoms- losses due to forest tree diseases, root diseases (wilt, root- and butt rot), stem diseases (heart rots, stem blisters, rusts, stem wilt, cankers, pink diseases, gummosis, water blister) and foliar diseases (rust, powdery mildew, leaf spot, leaf and twig blight, abnormal leaf fall, needle blight etc.) of Etiology, symptoms, mode of spread, epidemiology and management, including chemical, biological, cultural and silvicultural practices. Nursery diseases and their management. Disease due to physiological causes. Abiotic diseases.

Unit-3: Forest Entomology in India. Methods and principles of pest control: Mechanical, physical, silvicultural, legal, biological and chemical. Principles and techniques of Integrated Pest Management in forests. Classification of forest pests: types of damages and symptoms; factors for outbreak of pests. Nature of damage and management: Insect pests of forest seeds, forest nursery and standing trees of timber yielding species of natural forest and Plantation forest species. Insect pests of freshly felled trees, finished timbers and their management.

Practical:

Visit to forest areas with fire damages, Studying fire registers as records, studying encroachment problems caused due to disturbance-visit to illegally felled areas- Visit to fire station, Study and acquaint with machinery used for fire control, identification of weeds, parasites and epiphytes. Observation of symptoms in laboratory and in forests - examination of scrapings - host-parasite relationships - causal organisms of above forest diseases. Examination of cultures of important pathogens. visit to nurseries and plantations. Insect pests of forest seeds; forest nurseries; standing trees; freshly felled trees and finished products. Visit to forest nurseries and plantations. Survey and identification of invertebrate fauna from forest areas. Methods of isolating soil invertebrate macro and micro fauna. Insecticides and their formulations, plant protection appliances.

Suggested reading :

Agrios, G.N., (1997). Plant Pathology. 4thEdn, Horcourt Asia Pvt. Ltd., Singapore.

Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind pub Delhi

Brown, A.A and Davis, K.P. (1973). Forest Fire Control and Use. Mc Graw Hill Book Co. New York. Delhi.159p.

Elton, C. S. (2000). The Ecology of Invasions by Animals and Plants. Univ. of Chicago

Fuller, M. (1991). Forest Fires. Wiley Nature Editions, New York.

Ghadekar, S.R. (2003) Meteorology . Agromet Publishers, Nagpur

Hal, R.B.(1990). Principles and Procedure of Range Management. International Book Distributors,Dehra Dun.

Johnson,A.E and Miyanishi, K. (2001). Forest Fires: Behavior and Ecological Effects. Academic Press.

Khanna, L.S.(1988). Forest Protection. Khanna Bandhu, Dehra Dun.206p.

Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi

Luna, R.K. (2007). Principles and Practices of Forest Fire Control. International Book Distributors, Dehradun.466p.

Mavi, H.S. (1994) Agrometerology . Oxford &IBH, New Delhi

Negi, S.S. (1999). Handbook of Forest Protection. International Book Distributors.271p.

Rao, GSLHVP (2003) Agromateorology, KAU, Thrissur,Kerala,

Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer BerlinHeidelberg

Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi

Bakshi, B.K.,(1976), Forest Pathology; Principles and Practices in Forestry. Pub. Comptroller of Publications, Delhi. 400p.

Boyce, J.S. (1961). Forest Pathology, 3rd edition. McGraw-Hill. New York, 572 pp

Devasahayam, H.L.and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts. New India Publishing Agency

Pathak, V.N., Khatri, N.K. and Manish Pathak. (2000). Fundamentals of Plant Pathology. Eds.Agribios (India), Jodpur. 356 p.

Singh, R.S (2002).Introduction Principles of Plant Pathology. Oxford & IBH, New Delhi

NRM 2.4 SOIL BIOLOGY AND FERTILITY 3 (2+1)

Theory:

Introduction:- Forest soils vs. cultivated soils, properties of soils under different forest ecosystem, meanings of soil fertility and productivity and factors affecting it, mineral nutrition of plants, terminology viz. element, compound, nutrient, nutrition, beneficial, and essential nutrients.

Essential nutrients:- Discovery, usable form by plants, average concentration in plant tissue, criteria of nutrient essentiality, detailed classification of essential nutrients based on their source, plant requirement, mobility in the soil and plants and biochemical behaviour and physiological functions, relationship between nutrient concentration and plant growth - deficient, hidden hunger, critical limit, sufficient, excessive and toxic, available nutrients, nutrient content, general functions, deficiency and toxicity of essential nutrients and beneficial nutrients.

Basic soil-plant relationship:- Basic dynamic processes of nutrient availability – nutrient uptake and removal/mining, nutrient fixation and release, nutrient cycling in the forest soils, mechanism of nutrient transport, major nutrients sources in the root zone and losses of nutrients from the soil system, nutrient transformation and availability in the soils and soil pH and nutrient availability.

Ion exchange:- Ion exchange phenomenon - Ion exchange, adsorption, desorption, sorption, cation and anion exchange capacity of soils, base saturation and base unsaturation, ESP, significance of CEC with respect to soil fertility and factors affecting it.

Nutrient interactions:-Definition, mechanisms/types of interactions, interaction between macro and micro nutrients, chelates and plant nutrition.

Soil organisms:- Forest soil environment, diversity of organisms in the soil- macro and micro organisms and their distribution. Macro organisms- earthworms, Ants and termites and plant roots, soil micro animals- nematodes, protozoa *etc.* and their role in soil, Soil microorganisms- prokaryotes (bacteria and archaea), fungi, actinomycetes, Cyanobacteria (blue-green algae) *etc.* in the soil ecosystem their distribution, interaction effect and functions in the soil. Factors affecting their growth and activity in the soils- OM, oxygen, temperature, pH *etc.* Atmospheric N fixation by organisms and some tree species and microbial transformation of N, P, S and micronutrients in the soils. Mycorrhizal growth of fungi and plant nutrition. Concepts of rhizosphere, Rhizodeposition and phyllosphere.

Soil organic matter:- Decomposition of organic matter and release nutrient in the soils (nutrient cycling), humus formation, microbial degradation of cellulose and lignin, C: N ratio of organic matter and nutrient availability - mineralization and immobilization, role of organic matter in the soil.

Nutrient management:- Explanation, methods of soil fertility evaluation – diagnosis of deficiency symptoms, biological test, soil testing and plant tissue analysis and fertilizers recommendation.

Manures and fertilizers:- Definition and comprehensive classification, nitrogenous, phosphatic, potassic, secondary and micronutrient fertilizers, mixed fertilizers, bio fertilizers, time and methods of fertilizer application.

Soil fertility management:- Optimum, efficient and balanced use of nutrients, integrated and site specific nutrient management and crop rotation, fortification of consume through nutrient management. Acid, salt affected and calcareous soils - appraisal, characteristics and problems

with respect to nutrient availability and their fertility management.

Practical:

Basic requirements for analytical laboratory. Handling and management of laboratory chemicals and basic principles for laboratory safety. Some essential terminology related to analytical laboratory and preparation of different standard solutions for laboratory use. Determine soil organic carbon, available N, available P_2O_5, available K_2O, and micronutrients from the soils and interpretation of their results. Determine water soluble and exchangeable cations CEC by summation method and ESP. Estimate the gypsum requirement of sodic soils and lime requirement of acid soils.

Suggested reading:

Havlin *et al.* 2014. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (8th Edition), PHI Learning Pvt. Ltd., Delhi

Binkley, D. and R. Fisher 2012. Ecology and Management of Forest Soils (4th Edition), John Wiley & Sons Singapore Pte. Ltd., Singapore

Reddy M. V. 2001. Management of Tropical Plantation Forests and Their Soil Litter System-Litter, Biota and Soil Nutrient Dynamics, Science Publishers, U. S.

Khan, T. O. 2013 Forest Soils: Properties and Management, Springer International Publishing, Switzerland

Brady, N. C. and Weil, R. R. 2010. Elements of the Nature and Properties of Soils (3rd Edition.), Pearson Education, New Delhi

Das, D .K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana

ISSS, 2002. Fundamentals of Soil Science. Indian Society of Soil Science, IARI, New Delhi.

Pritchett and Fisher RF 1987. Properties and Management of Forest Soils. J Wiley, N York.

Gupta, P.K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), AGROBIOS, Jodhpur (India).

Jaiswal, P.C. 2006. Soil, Plant and Water Analysis (2nd Edition), Kalyani Pub, Ludhiana.

Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course**,** Scientific Publisher

J. Benton Jones, Jr. 2012. Plant Nutrition and Soil Fertility Manual (2nd Edition), CRC, USA.

Mengel, et al. 2001 Principles of Plant Nutrition (5th Edition), Springer

NRM 3.5 FOREST SURVEY & ENGINEERING 3 (2+1)

Theory

Forest survey, scope and types of surveying, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chain of sloppy grounds, chaining across obstacles; cross staff surveying, Areas of irregularly bounded fields- different methods; Simpson's, trapezoidal rule; compass surveying, chain and compass traversing, magnetic and true bearing, prismatic compass, local attraction. Computation of interior angles and balancing of closed traverse. Plane table surveying; plane table and its accessories, methods of plane table surveying. Leveling: terms used types of level. Dumpy levels and its adjustments, booking the staff readings, calculation of reduced levels. Contour surveying. Buildings materials- types, strength and characteristics, site selection for building construction, forest roads- alignment, construction and drainage; retaining walls, breast wall, water ways and culverts; bridges-types, selection of site, simple wooden beam bridge, spurs.

Practical:

Chain surveying, compass traversing; plane table surveying, leveling, calculations of earth work for construction of forest; roads & earth dams; alignment of forest roads; preparation building plans; design of water ways; design of simple wooden beam bridge; design of retaining walls. Design of check dams.

Suggested reading:

Kanetkar,T.P. and Kuakarni,S.V. (1989). Surveying and levelling. Vidyarthi Griha Prkashan, Pune.

Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.

Parkash, R. (1983). Forest Surveying, International Book Distributor, Dehradun

Negi, S.S. (1997). Hand Book of Forest Engineering, International Book Distributor, Dehradun.

NRM 5.6 AGROMETEOROLOGY AND CLIMATE CHANGE 3(2+1)

Theory:

Agrometerology – definition, aim and scope. Factors and elements of weather and climate. Composition and structure of atmosphere. Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost. Cyclones, anticyclones and thunder storms. Solar radiations components and effect on plant growth. Effect of weather and climate on the growth and development of crops. Climatic normals for crops and trees. Agro climatic zones of India . Evaporation and transpiration.

Climate change: Understanding climate change and its Consequences. Global warming and its effects on Forest. Forest and climate change: Vulnerability and adaptability - Evidence of forest disturbance due to climate change –Climate change influence on agro-forestry- Climate resilient forestry. Economic worth of carbon storage in forest – Forest and UN convention on climate change - NATCOM initiatives – Decision making in emission of Green House Gases (GHG). Kyoto protocol, awareness about climate change. National action plan for climate change – Green India mission- Indian Network for Climate Change Assessment (INCCA) - State Action Plans on Climate Change.

Practical:

Study of temperature instruments, pressure instruments, humidity instruments, wind instruments, rain instrument and wind rose. Solar radiation instruments with pyranometer. Layout of an agromet observatory and types. Measurement of wind and evaporation. Measurement of sunshine hours. Measurement of soil temperature and dew. Estimation of green house gases into atmosphere.

Suggested reading:

Ghadekar, S.R. (2003) Meteorology . Agromet Publishers, Nagpur

Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi

Mavi, H.S. (1994) Agrometerology . Oxford &IBH, New Delhi

Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,

Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg

Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.

NRM 5.7 FOREST MANAGEMENT 3(2+1)

Theory:

Definition, Scope, Objective and Principles of Forest Management. Organization of state forests.. Sustained yield-definition, Principles and limitations increasing and progressive yields. Sustainable Forest Management-Criteria and Indicators- Rotation-definitions-various types of Rotations-length of rotations choice of type and kind of rotation. Normal forest-definitions basic factors of normality. Growing stock, Estimation of growing stock. Yield regulation- concept, basis and yield regulation models- Estimation of growth and yield prediction in forest stands- Stand structure - Stand density - Working plan-Working Plan Code 2014- preparations objectives and uses-forest maps and their uses. Joint forest management - Modern tools in forest management. Concept and Importance of Ecotourism, Ecotourism in Indian perspectives.

Practical :

Visit to different forest divisions to study the various stand management aspects including thinning, felling and sale of timber. Study forest organizational set up and forest range administration including booking of offences. Visit to forest plantation- Field Exercise for the estimation of actual growing stock volume. Study the different field exercises for data collection for working plan. Acquaintance with Forest Code, Forest maps and plantation journals.

Suggested reading :

Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun.

Bhattacharya P., Kandya A.K. and Krishna Kumar (2008). Joint Forest Management in India, Aavishkar Publisher, Jaipur.

Desai, V. (1991). Forest Management in India –Issues and Problems. Himalaya Pub. House, Bombay.

Edmunds, D and Wollenberg, E (2003). Essentials of Forest Management, Natraj Publishers, Dehra Dun.

Jerome L Cutter et al. (1983). Timber Management: A Quantitative Approach. John Wiley and Sons

National Working Plan Code (2014). MoEF, New Delhi.

Ramprakash, (1986). Forest Management, IBD, Dehradun.

Mathur, V.P. and Ranganathan, C.R. (1985). Forest Management. Jugal Kishore & Co. (Pub.Div.) Dehradun.

Recknagel, A and Bentley. J. (1988). Forest Management. IBD, Dehradun.

Trivedi, P, R and Sudarshan, K, N. (1996). Forest Management. Discovery publications, New Delhi.

Stephen Wearing, John Neil (1999). Ecotourism: Impacts, Potentials, and Possibilities. REPP Ltd.

Jack Randall (2011). Eco-Tourism, Published by Discovery Publishing House Pp. 232.

NRM 5.8 PRINCIPLES OF ECONOMICS AND MARKETING 3(2+1)

Theory :

Economics- Meaning, definition, subject matter- Divisions of economics - Importance of economics- Forest Economics- Meaning, definition- Basic concepts - Goods, service, utility, value, price, wealth, welfare- Wants- Meaning, characteristics, classifications of wants,

importance. Theory of consumption- Law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations, law of equimarginal utility-Importance. Consumer surplus-Meaning, definition, importance. Demand- Meaning, definition, kinds of demand, demand schedule, demand curve, law of Demand, extension and contraction vs increase and decrease in demand. Elasticity of demand- Types of elasticity of demand, degrees of price elasticity of demand, methods of measuring elasticity, factors influencing demand, elasticity of demand, importance of elasticity of demand – supply- meaning, supply function-Law of supply- factors influencing supply- Production- Meaning, factors of production land, labour, capital, organization, entrepreneurship- Distribution- rent, wages, interest, profit- National Income - definition and concepts -. Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets – Marketing of various channels – Price spread – Marketing Efficiency – Integration – Constraints in marketing of agricultural produce. Market intelligence – Basic guidelines for preparation of project reports-Bank norms – Insurance – SWOT analysis – Crisis management.

Practical:

Library review of studies on marketing, visits to local timber and non-timber markets; collection and analysis of price and quantity data for various forest products; study of marketing channels and price spread for important timber and non-timber forestry products.

Suggested Readings:

Dewett, K..K. 2005. Modern Economic Theory. S. Chand, New Delhi.

Dewett,K.K.,Verma. 2004 Elementary Economic Theory, S.Chand, New Delhi

Jhingan,M.L.2012. Macro Economic Theory. Vrinda publishers, New Delhi .

Reddy, S. S., Raghu Ram, P., Neelakanta Sastry, T.V., Bhavani, D. I. 2004. Agricultural Economics. Oxford and IBH Publishers, New Delhi.

John E. Wagner, 2012, Forest Economics: A Managerial Approach, Routledge , Tylor & Francis Group, London

NRM 5.9 RESTORATION OF DEGRADED LANDS 2 (1+1)

Theory:

Degraded lands: Concept, classification, status, extent and causes of degraded lands/wastelands, different types of degraded lands – physical, chemical and biological land degradation. Soil erosion- types, causes and mechanism, measures to control erosion, ravine and sand dune formation and their control measures. Salt affected soils- classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices. Acid soils-definition, characteristics, causes and afforestation. Water logged areas- explanation, impact on pant growth and Biodrainage techniques. Afforestation and reclamation of denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas. Desertification- definition, impact and causes, prevention and counter measures (shelter belts and wind breaks). Soil pollution- types, effects and control measures through forestry techniques. National and state level programmes on degraded lands/wasteland development. Role of Government agencies and NGO’s in degraded lands/wasteland development programme.

Practical:

Tree species suitable for different degraded lands. Identification and study of various degraded lands. Visit to nearby degraded lands (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas) and afforestation techniques in degraded sites. Methods and techniques for evaluation of degraded lands.

Suggested reading:

Anil Kumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi

Brady, N. C. and Weil, R. R. 2010. The Nature and Properties of Soils (14th Edition), Pearson Education, New Delhi

Butler, B.E. 1980. Soil Classification for Soil Survey. Clerneder Press-Oxford Publ. Co., London.

Gregersen, H. Draper, S. and Elz. D.(eds.) 1989. People and Trees- The Role of Social Forestry in Sustainable Development EDI Seminar Series, The World Bank, Washington, D. C. 273p

Hegde NG 1987. Handbook of Wasteland Development. BAIF, Pune 102p.

Hegde NG and Abhyankar 1986 (eds). The Greening of Wastelands. BAIF, Pune 204p

IARI 1960. Soil Survey Manuel, IARI. New Delhi.

ICAR 1977. Desertification and its Control. ICAR, New Delhi 358p. National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix,

Imeson A. 2012 Desertification, Land Degradation and Sustainability, John wiley and Sons.

Luna, R. K. 1989 Plantation Forestry in India, International book distributors, Dehra Dun. Forestry; Ministry of Agriculture and Irrigation, Govt. of India, New Delhi 457p.

Prasad, V. N. 1985. Principles and Practices of Social-Cum-Community Forestry. International Book Distributors, Dehradun, 108p

Shah, S. A. 1988. Forestry for People. ICAR, New Delhi, 147p.

Sharma, SC, Chaturvedi RB and Mishra OP 1990. Utilization of Wastelands for Sustainable Development In India. Concept Publishing Co. New Delhi-59, 488p

NRM 6.10 FOREST LAWS, LEGISLATION AND POLICIES 2(2+0)

Theory :

Forest Policy: definition, necessity and scope. Legal and institutional approaches to forest resource management. Legal rights- types of legal rights, law of evidence, admission, confession, punishments. Constitutional provisions related to forest conservation. Indian National Forest Policies-NFP-1894, NFP, 1952 and NFP, 1988, Forest Law: legal definition. Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act. Detailed study of IFA 1927. Forest (Conservation) Act, 1980 and its amendments. The Biological Diversity Act, 2002 The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. Brief description about other major forest laws of regional, national and international significance. Indian Penal Code and Criminal Procedure Code related to forests. National Green Tribunal.

Suggested Readings :

Chaturvedi, A.N. (2011). Forest Policy and Law. Khanna Bandhu Publishers, Dehradun.

Negi, S.S. (1997). Forest Policy and Law, IBD, Dehradun.

Bakshi, P.M. (2009). The Constitution of India. 9th edition. Universal Law Publishing Co.Pvt.Ltd. New delhi.

Dutta, R. and Yadav, B. (2012). Supreme Court on Forest Conservation. Universal Law Publishing Co., New Delhi, India

Joy, P. P. (2012). Set up your criminal practice. Swamy Law House,

Ernakulam Shetty, B. J. (1985), A Manual of Law for Forest Officers, Sharda Press, Mangalore.

Takwani, C. K. T and Thakker, M. C.(2012). Takwani Criminal Procedure. Lexis Nexis Butterwarths Wadhwa, Nagpur

NRM 6.11 GEOMATICS- REMOTE SENSING & GIS 2 (1+1)

Theory:

Definition, scope, history and development of remote sensing; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Types of remote sensing; Principles and applications of optical, thermal & microwave remote sensing; Aerial photographs – types, scale, & resolution; Photo interpretation, Satellite remote sensing - platforms and sensors; Satellite systems. Indian Remote Sensing Programme; Visual and digital image processing; Application of satellite based remote sensing techniques in forestry - vegetation mapping using satellite imagery; Forest cover monitoring and damage assessment; Microwave remote sensing.

Introduction to GIS - Components of GIS, hardwares and softwares; Differences between GIS and conventional cartography; Spatial and non-spatial data, Integration of attribute data with spatial data. Spatial data - Raster and Vector data, Thematic over lays in GIS- topology building and calculation of area and length *etc.* Application of GIS in forestry – using imageries and integration with GIS data. Maps-its projection, Toposheet and Map reading; Global Positioning System (GPS) applications in resource inventory, Global Navigation Satellite System, Galileo, IRNSS.

Practical:

Preparation of base maps, thematic maps; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping; Digital image processing; Introduction to various GIS and RS software; Exercises in viewing, editing, overlay. Visit to the RS and GIS labs at State level.

Suggested Reading:

Aber, J.S., Marzolff, I., and Ries, J. (2010): Small-Format Aerial Photography: Principles, Techniques and Geoscience Applications, Elsevier, Amsterdam, 268pp.

Campbell, J.B. (2002). Introduction to Remote Sensing (3rd edition). Taylor and Francis, London Environment System Research Institute, (1999). GIS for Everyone. Redlands,CA:ESRI

Campbell, J.B. and Wynne, R.H. (2011): Introduction to Remote Sensing (5th Ed.), Guilford Press, New York, 667pp.

Chang, Kang-tsung. 2002. Introduction to Geographic Information Systems. New Delhi: Tata McGraw-Hill Publishing Company Limited.

DeMers, Michael N. 2000. Fundamentals of Geographic Information Systems (2nd Ed.)

(Wiley Student Edition). New York: John Wiley & Sons, Inc.
Jackson, M.J. (1992). Integrated Geographical Information Systems. International Journal of Remote Sensing, 13(6-7): 1343-1351
Jensen, J.R. (2006): Remote Sensing of the Environment: An Earth Resource Perspective (2nd Ed.), Prentice Hall, New Jersey, 608pp.
Konecny, G. (2003): Geoinformation: Remote sensing, Photogrammetry and GeographicInformation Systems, Taylor & Francis, London, 266pp.
Lillesand, T.M. and Kiefer,W.R.(1994).Remote sensing and Image Interpretation, Fourth edition. John Wiley & Sons,Inc., USA
Lillesand, T.M., Kiefer, R.W., and Chipman, J.W. (2007): Remote Sensing and ImageInterpretation (6th Ed.). Wiley, New Jersey, 804pp.
Morgan, D., and Falkner, E. (2001): Aerial Mapping: Methods and Applications (2nd Ed.), CRC Press, Boca Raton, Florida, 216pp.

NRM 6.12 FOREST HYDROLOGY AND WATERSHED MANAGEMENT 3(2+1)

Theory :

Importance and scope of Hydrology, Definitions, Hydrological cycle. Energy and water balance equations. Precipitation - rain and snow hydrology. Interception, infiltration, evapotranspiration, surface water, run off, factor affecting runoff, runoff estimation by rational method. Runoff water measuring devices. Hydrograph. Soil water energy concept, movement, availability and measurement. Soil erosion, Universal soil loss equation, Agronomical and engineering practices for soil and water conservation, Recharging of water springs. Forest treatment and water yield. Watershed management - principles (concept), objectives and practices for sustainable productivity, water harvesting techniques and structures – farm ponds, check dams and earthen dams. Water well, aquifers. Water application methods – surface, sub-surface, drip and sprinkler irrigation system. Drainage – types of drainage system, their selection, design and installation and maintenance. Importance of forests in water conservation, Grassland management.

Practical:

Study of hydrological equipments; Measurement and analysis of rainfall data; Estimation of runoff using rational formula; Preparation, use and analysis of hydrograph; Measurement of evaporation by different methods; Visit to forest watersheds to study the effect of forest treatment on hydrological properties. Assessment of the impact of watershed treatments such as afforestation/restocking, assisted regeneration etc. on the watershed functioning- field layout- regeneration assessment- interpretation of results.

Suggested reading:

Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, Delhi
Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of Agricultural Research, New Delhi, 176 p
Gurmail Singh et al., 1988. Manual of Soil and Water Conservation. Oxford IBH Pub Co.
Michael, A.M. 2008. Irrigation theory and practice, Vikas Publishing House Pvt Ltd. 768p
Michael, A.M. and Ojha, T.P. (1966). Principles of Agri. Engg., Jain Brothers, Jodhpur.
Murthy, JVS (1998). Watershed Management, New Age International, New Delhi.
Murthy, V.V.N. (1985). Land and water management engineering. Kalyani Pub, Delhi.
Subramanya, K. (2006). Engineering hydrology, Tata McGraw Hill publication.
USDA 1961. A Manual on Conservation of Soil and Water. Oxford and IBH Pub Company.

DEPARTMENT OF BASIC SCIENCE AND HUMANITIES (BSH)

BSH 1.1 INFORMATION & COMMUNICATION TECHNOLOGY 2 (1+1)

Theory

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing.

Practicals: Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

Suggested Readings

Norton Peter, "DOS Guide", Prentice Hall of India
Norton Peter, "Introduction to Computers", TMH
Rajaraman V, "Fundamentals of Computers", PHI

BSH 1.2 INTRODUCTORY BOTANY 2 (1+1)

Theory :

Introduction to Allied and Applied Branches of Botany; General classification of plants – Phanerogams, Cryptogams, Angiosperms and Gymnosperms, Dicotyledons and Monocotyledons; General body organization and characters of Algae (e.g. *Chlamydomonas*), Fungi (*Mucor*), Bryophytes (*Moss*) and Pteridophytes (*Nephrolepis*); Parts of flowering plants- Root system and Shoot system, typical structure of root, stem and leaf; Functions of root, stem and leaves; Basic Structure of Flower- Essential and Non essential parts of flower; Morphology of root, stem and leaves; Morphology of Flower with emphasis on Inflorescence; Types of Phyllotaxy and Venation in leaves, types of placentation and aestivation in flower; Basic types of tissues (Structure and Function) - Dermal, Vascular and Ground tissues; Parenchyma, Sclerenchyma, Collenchyma, Chlorenchyma, Aerenchyma, Cambium, Xylem and Phloem; Types of vascular bundles in flowering plants.

Practical:

Morphology of root, stem and leaves with special emphasis on underground and aerial modifications in root and stem; simple and compound leaves; types of phyllotaxy and venation (live specimens); typical structure of bisexual flower; types of inflorescence (live specimens); types of tissues with the aid of permanently mounted slides; Tissue organization in Dicot root, stem and leaves; Tissue organization in Monocot root, stem and leaves with the aid of permanent slides or study charts.

Suggested reading :

A.C. Dutta. (1998). *Botany for Degree Students*. (1998). Oxford University Press. India
A.C. Dutta. (2000). *Class Book of Botany*. Oxford University Press. India
Ashok Bendre and Ashok Kumar. (1984). *Textbook of Practical Botany*. Vol. I and II. Rastogi Publications. Meerut. India. (Also available on Flipkart and Amazonbooks. Com)
Ashok Bendre and P. C. Pande. (1996). *Introductory Botany*. Rastogi Publications. Meerut.
Ashok Kumar (2001). *Botany in Forestry and Environment*. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
P. Pandey. (2012). *Taxonomy of Angiosperms*. S. Chand and Company Ltd. New Delhi.
Gurucharan Singh. (2000). *Plant Systematics*. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
S. N. Pandey and S. P. Mishra. (2008). *Taxonomy of Angiosperms*. Ane Books India, Delhi.

BSH 1.3 COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT 2 (1+1)

Theory:

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Applied Grammar: Introduction to Word Classes. Structure of the Verb in English. Uses of Tenses. Study of Voice. Use of Conjunctions and Prepositions. Sentence Patterns in English. Spoken English: Conversations of Different Situations in Everyday Life. The Concept of Stress, Stress Shift in Words and Sentences. Words with Silent Letters and their Pronunciations. The Basic Intonation Patterns.

Practical: Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Suggested Readings

Carroll, B.J. 1986. English for college, Macmillan India Ltd. New Delhi
Hahn, "The Internet complete reference", TMH
Hornby, A.S. 1975. Guide to patterns and usage in English. Oxford University, NewDelhi.
Qurik, R and Green baum, S 2002. A University grammar

BSH 1.4 PLANT PHYSIOLOGY 3(2+1)

Theory:

Introduction to tree physiology. Photosynthesis - C3, C4 and CAM plants - Photorespiration - Factors affecting photosynthesis. Respiration - energetic of dark respiration. Plant-water relations, Concept of water potential, ascent of sap and water balance. Stomatal physiology - stomatal conductance – resistance. Mineral nutrition - macro-micro nutrients - Arnon's criteria of essentiality – deficiency. Plant growth regulators – classification. Tree structure, Growth and development - growth kinetics. Growth regulation and co-ordination - Plant growth analysis

-Canopy architecture. Forest Biomes. Light interactions models of forest canopies - Sun plants and shade plants - shade tolerance. Temperature - temperature influence on forest development - energy budgets - low and high temperature - Physiological adaptations for high temperature - chilling injury. Water stress - Mechanism of drought tolerance and drought resistances - Physiological basis of drought avoidance and tolerance. Water relations of forest trees – Transpiration from forest canopies – Evapotranspiration models of forest stands - Water use efficiency of forest stands. Salinity stresses its effects on tree growth. Resistance to salinity. Forest and microclimate. Carbon balance and dry matter production in forest trees - Dry matter production and partitioning – source/ sink - . GPP and NPP of forest stands -Carbon cycling - Nutrient dynamics and plant growth – Nutrient cycling of C,N,P,S.

Practical :

Preparation of solutions. C3 and C4 leaf anatomy. Estimation of transpiration using porometer. Estimation of photosynthesis using IRGA. Extraction and estimation of chlorophyll in plants. Estimation of stomatal index. Demonstration of plasmolysis. Estimation of water potential in plants using Plant water status console. Estimation of leaf area of plants. Plant growth analysis – RGR, NAR, and LAR - specific leaf area and leaf weight ratio - LAI - CGR – LAD etc… Measurement of moisture stress tolerance parameters in trees - membrane stability, chlorophyll stability, proline content, wax and cuticle thickness. Measurement of relative water content, leaf water potential, osmotic potential. Measurements of stomatal resistance/stomatal conductance under varying stress condition. Observation on tree architecture of important species

Suggested reading:

Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.

Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York

Larcher, W. (2003). Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media

Longman, K.A. and Jenik, J. (1987). Tropical Forests and its Environment. ELBS, LondonRaven, P., Johnson, G.B., Mason,K.A., Losos, J.B., Singer, S.S. (2014). Biology (10th edition) . McGraw-Hill Education, London

Salisbury, F. B. and Ross,C. W. (2004) . Plant Physiology. Thomson Asia Ptd,Ltd. Singapore.

Taiz, L. and Zeiger, E. (2010) Plant Physiology (5th edition). Sinauer Associates, Inc., Massachusetts.

BSH 2.5 BASIC MATHEMATICS 2(2+0)

Theory

Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combinations. Matrix of a system of linear equations. Binomial theorem for positive integral index, any index and their applications, addition and subtraction formulae. A, B and C, D formulae. Sine and Cosine formulae. Inverse Trigonometric functions, ratios and their interrelationships. Limit of functions-differentiations and integrations simple applications-maxima and minima least square techniques- Introduction to matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices.

Suggested Readings:

Chatterjee S. K. (1970). Mathematical Analysis. Oxford & IBH.

Frank, A. (1962). Schaum's Outline of Theory and Problems of Matrices. McGraw-Hill
Frank, A. 1967. Theory and Problems of Differential Equations. McGraw-Hill
Gentle JE. (2007). Matrix Algebra: Theory, Computations and Applications in Statistics. Springer
Narayan, S. (1953). A Text Book of Matrices. S. Chand and Company.
Parameswaran, S. (1976). An introduction to mathematics. Oxford & IBH Publishing Co. 172p.
Priestley, H.A. (1985). Introduction to Complex Analysis. Clarenton Press
Walter R. (1976). Principles of Mathematical Analysis. McGraw-Hill.

BSH 2.6 PLANT BIOCHEMISTRY 2 (1+1)

Theory:

Introduction to plant Biochemistry. Chemistry of carbohydrates – classification, mono, di and polysaccharides, anomerism, epimerism, mutarotation, configuration of sugars and inversion. Chemistry of lipids – classification. Fatty acids and its classification. Chemistry amino acids, peptides and proteins, classification, levels of protein structure. Chemistry of nucleic acids – bases, sugars, Nucleosides and nucleotides. Structure and function of RNA and DNA. Enzymes – classification, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates – Photosynthesis – light reaction, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3 and C4 plants, CO2 fixation, regulation of photosynthesis - glycolysis, TCA cycle, electron transport chain. Lipids metabolism – beta oxidation and fatty acid biosynthesis.

Practical:

Practical Qualitative tests for carbohydrates, Quantitative estimation of reducing sugars- Qualitative tests for lipids, Determination of Saponification number of oils/fats, Determination of Iodine number of fatty acids- Qualitative tests for proteins/amino acids, Estimation of protein by Lowry's method- thin layer chromatography.

Suggested Readings:

Conn, E.E. and Stumpf, P.K. (1989). Outlines of Biochemistry, Wiley Eastern Ltd., New Delhi
Mazur, A and Harrows, B. (1971). Textbook of Biochemistry. W.B. Sanders Publications, Delhi
Robert, C. B. (1983). Modern concepts in Biochemistry. Allyn and Bacon Inc. London
William , H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford Uni Press.
Sadasivam, S and Manickam, A. (2008). Biochemical methods, New age International (P) pub.

BSH 2.7 STATISTICAL METHODS AND EXPERIMENTAL TECHNIQUES 3(2+1)

Theory:

Basic concepts, functions of statistics, variables and sources of data. Collection of statistical data - classification and tabulation of data, formation of frequency distribution.Diagrammatical and graphical representation of data. Simple, multiple, component and percentage bar diagram, pie diagram, histogram, frequency polygon and frequency curve.Measures of central tendency - requisites for an ideal measures of central tendency - arithmetic mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, - its calculation for raw and grouped data, properties, merits and demerits, comparison of different averages. Weighted arithmetic mean. Measures of dispersion – range, mean deviation, standard deviation, standard error of mean, variance, quartile deviation, CV%. Comparisons of different measures of dispersion and their

applications to specific situations. Introduction to skewness and kurtosis.

Presentation of bivariate data, scatter diagram, measure of association – correlation coefficient and properties, rank correlation, fitting of simple linear regression, correlation vs. regression, interpretation and application.Elementary ideas on probability – complementary, addition and multiplication laws on probability. Theoretical distributions, binominal, poison and normal distributions. Normal distribution- properties, application of normal probability integral. Binomial theorem on probability and Poisson distributions.

Sampling, basic concepts, sampling vs. complete enumeration, parameter and statistic, sampling unit, sampling frame, sample size, sampling methods, simple random sampling and stratified random sampling. Tests of significance: concepts, hypotheses, critical region, large and small sample tests for equality of means, applications and assumptions, one and two samples t and Z test, Paired t test. Test of significance of correlation and regression. Chi-square test - introduction, application - independence of attributes and test for goodness of fit for mendalian ratios. Test for variances - F tests. Introduction- important terms and definitions, need for designing an experiment. Basic principles of experimental design- replication, randomization and local control. Analysis of variance – assumptions, construction of ANOVA table, conclusions based on ANOVA. Randomization and Layout of CRD, RBD and LSD and introduction to preparing of ANOVA table and calculations for CRD, RBD and LSD.

Practical:

Formation of frequency distribution. ; Diagrammatic and graphic representation.; Calculation of different measures of central tendency. ; Computation of various measures of dispersion. Calculation for r and b.; Probability problems.; Simple problems on distributions. ; t, Z, F and Chi-square tests problems.; Randomization and Layout of CRD, RBD and LSD.

Suggested reading:

Anderson, R.L. and Bancroft,T.A.(1952).Statistical Theory in Research. Mc. Graw Hill Book Co., NewYork.

Cochran,W.G and Cox, G.M.(1958).Experimental designs. Wiley, NewYork

Das,M.N.andGiri,N.C.(1986).DesignandAnalysisofExperiments.WileyEasternLtd.,NewDelhi.

Federer,W.T.(1955),Experimental Design. Macmillan, New York.

Gomez,K.A.andGomez,A.A.(1984).StatisticalProceduresforAgriculturalResearch.JohnWileyand Sons.NewYork.680p.

Kempthorne,O.(1952).Thedesignandanalysisofexperiments.Wiley,NewYork.

Nigam, A.K. and Gupta,V.K.(1979). Handbook on Analysis of Agricultural Experiments. IASRI.

Panse, V. G. and P. V.Sukhatme. (1967). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India.

PetersenRogerG.(1994)AgriculturalFieldExperiments:DesignandAnalysis.MarcelDekker,NewYor

BSH 2.8 PRINCIPLES OF PLANT CYTOLOGY AND GENETICS 3(2+1)

Theory :

History of genetics. Pre-Mendelian concepts – preformation – pangenesis. Mendel's principles of Inheritance – segregation – independent assortment. Cell – structure and functions. Cell organelles. Cell reproduction – mitosis – meiosis and its significance. Gametogenesis and syngamy in plants. Chromosome theory of inheritance. Evidences for chromosome as bearers of genes. Modification to Mendelian inheritance – multiple alleles – codominance – gene interaction

– epistasis –pleotrophy – polygenic inheritance – penetrance and expressivity – cytoplasmic inheritance. Linkage and crossing over – cytological consequence of crossing over. Detection of linkage and linkage maps. Sex determination – theories. Sex-linked and other sex-related inheritance. Evidence to prove DNA as genetic material. Structure of DNA and its replication. Chromosomes – its structure and function. Chromosomal aberrations-numerical and structural. RNA its structure function and types. Cytology of polyploids. Molecular structure of gene. Gene action – protein synthesis. Gene expression and their functions. Mutation, its classification and uses. Methods of inducing mutations and CIB technique.

Practical:

Study of fixatives and stains. Preparation of slides showing various stages of mitosis. Preparation of slides showing various stages of meiosis. Working out problems related to monohybrid cross, dihybrid cross, independent assortment, linkage, gene mapping, probability and chi-square, multiple alleles etc.

Suggested Readings:

Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science, 392p.
Garner, E. J., Simmons, M. J. and Sunstad, P. D. (2008). Principles of Genetics (8th edn.). Wiley India (P.) Ltd., Daryaganj, New Delhi.
Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut
Strickberger, M.W. (1996). Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
Tamarin, R. (2002). Principles of Genetic (7th Ed). Tata McGraw-Hill Education.
White, T.L., Adams, W.T., and Neale, D.B. (2007). Forest Genetics. CABI

BSH 6.9 ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT 2(1+1)

Theory:

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to forestry sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry. Social Responsibility of Business. Developing Leadership Skills, Encoding and decoding communication skills; Communication skills for entrepreneurship development, Developing Speaking Skills, Developing Listening Skills, Developing organizational skill , Developing Managerial skills, Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation.

Practical

SWOT analysis, developing leadership skills, developing managerial skills, problem solving skill, supply chain management and total quality management, project planning formulation and report preparation.

Suggested Readings:

Maslow, A.H (1970) Motivation and personality. Harper and Row publishers , New York.
Perelson, B and Steiner, G (1964) Human behaviour. Harcourt Brace Jovanovich , New York.

BSH 8.10 FOREST TRIBOLOGY & ANTHROPOLOGY 2(2+0)

Theory:

Meaning, scope and development of Anthropology. Relationships with other disciplines. Main branches of Anthropology, their scope and relevance. Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution. Principles of Prehistoric Archaeology. Chronology: Relative and Absolute Dating methods. Culture, Society, Marriage, Family, Kinship, Economic and Political Organization, Social Control, Religion, Anthropological theories, Language and Communication, Research Methods in Anthropology. Race and Racism. Applications of Anthropology. Ethno-archaeology in India. Demographic profile of India. The structure and nature of traditional Indian social system. Caste system in India Definition and characteristics of a tribe. Tribes and aborigines- an anthropological perspective. Racial classification and distribution of tribes. Tribes in India and Kerala. Tribal economy. Tribals and Constitution of India Administration of tribal areas in independent India- appraisal of tribal development - problems of tribal identity and integration in the mainstream. Relation between tribes and forests- forest as their immediate environment. Forests as the means of livelihood. Girijan habitat - changes consequent to government control of forests. Forest management and tribal welfare- management conflicts and way forward. Role of forest department in tribal welfare. Role of Non wood Forest products in the economy of tribal's and Tribal cooperative societies. Social forestry and tribal welfare.

Suggested reading :

Furer-Haimendorf, C.V. 1985. Tribes of India - the struggle for survival. OUP. New Delhi
Hasnain, N. 2007. Tribal India. New Royal Book Company
Hasnain, N. 2011. Indian Anthropology. Palaka Prakashan
Sharma, R.N. and Bakshi, S. 1984. Tribes and tribal development. Uppal Publ. House, Delhi
Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.
Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi.
Vidyarthi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi

BSH 8.11 AGRICULTURAL INFORMATICS 2 (1+1)

Theory :

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, creating database, uses of DBMS in Agriculture, Internet and World Wide Web (WWW), Concepts, components and creation of web, HTML coding. Computer Programming, General Concepts, Documentation and Program Maintenance, Debugging programs, Errors. Introduction to Visual Basic concepts and standard input/output operations, Variables and Constants, Operators and Expressions, Flow of control,

Inbuilt and User defined functions, programming techniques for agriculture. e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in Agriculture. Smartphone mobile apps in Agriculture for farm advises, market price, postharvest management etc.

Practical:

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power point for creating, editing and presenting a scientific Document, Handling of Tabular data, animation, video tools, art tool, graphics, template & designs. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as Visual Basic and their components Hands on practice on writing small programmes. Use of smart phones and other devices in agro-advisory and dissemination of market information.

OTHER COURSES

NNP- NCC/NSS/ Physical Education NNP (1.1, 2.1, 3.1, 4.1,5.1, and 6.1)

NCC- Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill.

NSS- Aims and objectives of NSS. NSS logo, motto etc. Orientation of students in national problems, study of philosophy of NSS, fundamental rights, directive principles of state policy, Village adoption.

STUDENTS READY

(Rural Entrepreneurship Awareness Development Yojana)

DETAILS OF FORESTRY STUDENTS READY PROGRAMME (FRP)

FRP 4.1 **Study tour of state forests** **1 (0+1)**

- Study Tour of North Gujarat
- Study Tour of Middle Gujarat
- Study Tour of Saurashtra Forest
- Study Tour of South Gujarat

Experiential learning (Any one module) **5(0+5)**

FRP 5.2- Forest Nursery (0+5)
FRP 5.3- Apiculture (0+5)

Experiential learning (Any one module) **5(0+5)**

FRP 6.4- Forest Nursery (0+5)
FRP 6.5- Apiculture (0+5)

FRP 7.6	**Forestry Work Experience**	**20(0+20)**
FRP 7.6.1	Attachment with forest department- 8 Weeks	10 (0+10)
FRP 7.6.2	Industry /NGO Attachment- 3 weeks	4(0+4)
FRP 7.6.3	Socio-economic Surveys and Village Attachment- 2 weeks	3(0+3)
FRP 7.6.4	Weapon Training and First-Aid Training -1 week	1(0+1)
FRP 7.6.5	Report Wring & Presentation-1 week	2(2+0)
FRP 7.7	**All Indian Tour (3 weeks)**	**3(0+3)**
	Visit of different types of forest of India	
FRP 8.8	Project work and Dissertation	**10(0+10)**

<u>FRP 5.2 (0+5) and FRP-6.4 (0+5) - Experiential learning –</u>

Raising Quality Planting Materials for forest regeneration

Project formulation, Identification of species (Trees, medicinal plants & wild fruits) for nursery raising, time of collection of plant material from selected seed sources, quantity of seed/plant material required, nursery area (open and protected),inputs required, schedule for intercultural operation-seed treatment, sowing, weeding, fertigation, root hardening treatments. Assessment of demand in local/potential markets and institutions. Collection,

Handling, Processing and storage of planting material. Identification of superior seed sources, seed collection, treatment and storage. Vegetative propagation under controlled and ambientconditions.Collectionofvegetativepropagules.Treatmentandprocessing of bare root and containerized seedlings. Project Report and Presentation, Final examination

Period	Major component and activity
1st Week	**Orientation and Fundamentals of nursery management** ❖ Orientation Orientation on various aspects of forest nursery.
2nd Week	❖ **Fundamentals of nursery management** ➢ Nursery site selection, layout and requirements. Production plan and nursery techniques
3rd week	**Field Exposure to nurseries** Visit to local nurseries and assessment of demand from potential stakeholders [Institutions, households (for medicinal and aromatic plants and plants of religious importance), farmers and households)].
4th week	Preparation of production and execution plan as per the outcome of the survey
5th to 45th week	**Project execution** ❖ **Quality nursery stock raising and marketing** ➢ Nursery preparatory activities • Procurement of seed, wildling and propagules etc. • Procurement of material (soil, sand and FYM/vermicompost/compost), implements, ploy bags, containers, instruments and chemicals for treatment of soil, cuttings etc. • Preparation of soil media. • Bed preparation, soil working and bag filling. ➢ **Raising seedlings and after care** • Seed/cutting/propagule treatment (Physical or chemical if required) • Sowing/planting in polybags/seedbeds • Intercultural operation (weeding, singling, fertilizer application etc.) and plant protection. ➢ **Data recording and other observations** • Growth data (Height and collar diameter, germination percent) • Disease incidence
24th/48th week	**Evaluation** The head of the department will form a committee of three members of the discipline and will evaluate the enrolled students based on the following aspects:

Sr. No.	Aspect of evaluation	Max. Marks
1	Project planning an writing	10
3	Presentation	10
4	Regularity	10
5	Regularity	10
6	Monthly assessment	10

7	Output delivery	10
8	Technical skill development	10
9	Entrepreneurship skill	10
10	Final presentation	10

FRP 5.3 (0+5) and FRP-6.5 (0+5)- Experiential learning -Apiculture

Project formulation, Apiculture-Scope and importance of beekeeping–Bees classification–Hives –Social organization–extraction of honey and other products. Marketing of honey and bee wax and their value addition. Cost Benefit analysis, Project Report and Presentation, Final examination.

Month	**Activity plan**
1st Month	Orientation of ELP program Skill and Entrepreneurship development in Beekeeping Ethics in business Preparation of the project in various situation and its implementation Introduction and importance of the Apiculture Study of important bee species :*Apis cerana indica, A.mellifera, A.florea, A.dorsata,* Non- *Apis* species **Regular activities** (on fortnightly or monthly basis throughout year) Observation of bee colonies and disease pest monitoring Cleaning of hives and nearby areas Bee-Flora survey and development of floral calendar Nectar and pollen study Honey processing, marketing and selling
2nd Month	Honey bee as biological indicators of ecosystem health, Study of bee flora and its importance. Bee floral park development Honey flow period and dearth period Seasonal management of bee colonies Site selection and establishment of apiary
3rd Month	Study of bee morphology, colony organization and life cycle Study of Honey bee boxes & tools for Apis cerana and A. mellifera, Selection of wood species for preparing Honey bee boxes. Study of bee anatomy, morphometrics and biology Social behavior of honey bee and stingless bees
4th Month	Survey for identifying Natural Bee Hives Pollen identification Study of insect pest and disease in honey bee Study of artificial feeding in food scarcity period
5th month	Study of bee equipments. Significance of bee migration and activities performed during during migration Study of pesticidal effect on Honey bee
6th month	Midterm Evaluation

7th month	Study of swarming Capturing bee colonies/ swarms from nature Study of bee pollination in various crops (I)
8th month	Queen production and rearing technique Artificial insemination in honeybees Separation of Bee colonies (multiplication) Study of bee pollination in various crops (II)
9th month	Study of bee pollination in various crops(III) Study of stingless bees and Meliponiculture Capturing and division of stingless bee colonies
10th month	Market study of Honey bee products Development of marketing skills Wax extraction Honey extraction Extraction of other bee products Honey processing and bottle filling
11th month	Value addition in honey and other bee products Study of honey processing Beekeeping and Ecotourism Visit to commercial apiary
12th month	Honey testing (nutritional analysis) Study of Quality standards for honey (testing of honey for its purity) Selling of bee products Study of Economics of Bee rearing (cost benefit analysis) Report writing and Evaluation

End of semester

Evaluation

The head of the department will form a committee of three members of the discipline and will evaluate the enrolled students based on the following aspects:

Sr. No.	Aspect of evaluation	Max. Marks
1	Project planning an writing	10
3	Presentation	10
4	Regularity	10
5	Regularity	10
6	Monthly assessment	10
7	Output delivery	10
8	Technical skill development	10
9	Entrepreneurship skill	10
10	Final presentation	10

FRP 7.6 - FORESTRY WORK EXPERIENCE 20 (0+20)

Orientation of the Forestry work experience and preparation- **1 week**

FRP 7.6.1- Forest department/ Forest Range Training Programme- Credits- (0+10)

- To addresses the forest department's basic rules and regulations **8 weeks**
- To brief students about the plan and programmes of attached forest divisions.
- Visit to modern forest nurseries, herbal gardens and watersheds in forest areas,
- Study the felling and logging operations
- Timber lots and important industrial products
- Study working plan and inputs for project formulations
- Enumeration of volume and yield calculation
- Study and documentation related to compartment history files
- Study the 'CAT' (Catchment Area Treatment Plan)
- FDA (Forest Development Agencies)
- Use of forestry equipments/instruments
- Study there generation and management of important forestry tree species
- Sample plots layout and studies of forest resource assessment
- Stump analysis, preparation of local volume tables
- Study the working of other Forestry related organizations/industries
- Study of Wildlife Sanctuaries/National Parks/Tiger Reserves
- To undertake and familiarize the various wildlife population enumeration techniques
- Preparation of the Management Plans/Conservation Plans
- Biodiversity assessment techniques
- To undertake pilot studies on the man-animal conflict and other issues in the forest areas
- To assess the Social Forestry / Farm forestry works by forest department
- To study and plan the Eco- tourism project in forest areas.
- To prepare the report of forest attachment

FRP 7.6.2 Industrial / NGO placement- 3 weeks Credits (0+4)

- Attachment with Forest Based Industries like Wood Workshop, Saw Mills, Wood seasoning and Preservation Treatment Plants, **3 weeks**
- Pulp and Paper Industries, Aromatic and Medicinal Plant Units including GSFDC, etc. Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP etc
- Works to be under taken includes study the nature of industrial and business organization–structure, raw material–collection and processing of raw-material, hands on practical, production and management process, marketing and financial management.
- Industries- GSFDC, Plywood industry, JK Paper Mill,
- NGOs- AKRSP, BAIF, Sadguru Foundation, GEER, CEE, Vikshat
- Institutes- DMAPR,

FRP 7.6.3 Socio economic surveys and village attachment- 3 weeks Credits (0+3)

- Orientation with students regarding village survey and questionnaire preparation. **3 weeks**
- Data collection, use of PRA techniques with respect to village profile including socio-economic and cultural status, farm technology used, homesteads, agroforestry, biodiversity etc.,
- Bench Mark survey of plant resources (cropping pattern, homesteads, agroforestry, biodiversity, yield system etc.),
- Schedule development, tabulation, analysis and preparing plan of work.
- Understanding local forestry and other village level institutions (Panchayat,Village Forest Committees, corporations, youth/women groups etc.),
- People's participation in developmental programmes with special reference to forestry.
- Exercises on the use of extension methods and teaching aids for Transfer of Technology.
- Report preparation

FRP 7.6.4 Weapon Training and First-Aid Training – 1.5 weeks Credits (0+1)

- Orientation with students regarding the first aid **1 week**
- Hands on training in the handling of various kinds of weapons and their operation, limitations and precautions during their use.
- Getting basic knowledge on different first aid practices which are required in as of field emergencies, like snakebite, animal attack, poachers and accidents. **0.5 week**
- To learn about the first aid to be given to wild animals in distress and volunteering in rural health services.
- To acquaint with national disaster management plan

FRP 7.6.5 Report writing and presentation– 1.5 weeks Credits (0+1)

- Compilation of the work/experience detailing the objectives **1.5 weeks**
- Places and persons visited, work done, experiences/skills gained and suggestions for improvement of training.
- Presentation of the report before faculty committee
- The assessment will be based on Project Report evaluation and viva-voce.

FRP 8.8 - Project Work & Dissertation **20 Weeks** **Credits Hrs 10 (0+10)**

This course shall provide the B.Sc. (Hons) Forestry students an understanding of the principles and procedures of the experimental design, layout, analysis and interpretation of data and technical writing.

• Each student shall work on a specific research project to be identified with the help of the supervising teacher. • They shall also prepare and present a proposed plan of work (PPW) specifying the objectives and procedures of the study and present the same before an audience consisting of faculty and students.	**1 week**
• Execution of plan of work- procedures of the experimental design, layout etc. • Analysis and interpretation of data and technical writing.	**16-17 week**
• The research work will be conducted leading to the preparation of a project report in the format and style of M.Sc. Thesis.	**1 week**
• Evaluation will be done based on the quality of work, quality of report and its presentation before an audience consisting of faculty and students. A committee of faculty will evaluate the project work on different parameters.	**1 week**

"Transform the Forest and Agriculture landscapes through Forest science"

Examination and Evaluation System (Faculty of Forestry)

1. Examination (100%)

- Internal Theory as well as Internal Practical (50%)
- External Theory (50%)

Sr. No.	Nature of Exam/Categories of Course	Courses with theory and Practical		Courses with theory only		Courses with Practical only	
		Marks	Duration	Marks	Duration	Marks	Duration
1	Mid-term Exam	30 (10-Objective and 20 Subjective)	One Hour	40+10* (15-objective and 25 subjective)	One and half hour	---	---
2	Internal Practical	15+5* (3- viva voce, 2- journal and 10 Practical)	Two Hour	---	---	100#	Three hours
3	Semester end Theory Exam	50 (15-Objective and 35 Subjective)	Tow Hour	50 (15-objective and 35 subjective)	Two hours	---	---
	Total	100	--	100	--	100	--

*__Marks of assignments__

For PCP (80 Marks for periodical operation, 15 Marks for practical works and 05 Marks for report) for other courses (80 Marks for actual practical, 10 Marks for viva voce and 10 Marks for Journal)

2. Evaluation

Degree	Percentage of Marks Obtained	Conversion into Points
All	100	10 Points
	90 to <100	9 to <10
	80 to <90	8 to <9
	70 to <80	7 to <8
	60 to <70	6 to <7
	50 to <60	5 to <6
	<50 (Fail)	<5
	Eg. 80.76	8.076
	43.60	4.360
	72.50 (but shortage in attendance)	**Fail (1 point)**

Allotment of division

OGPA	Division
5.000-5.999	Pass
6.000-6.999	II division
7.000-7.999	I division
8.000 and above	I division with distinction

GPA= Total points scored/Total credits (for 1 semester)
CGPA=∑ Total points scored/Course credits
OGPA= ∑ Total points scored (after excluding failure points)/Course credits
% of Marks = OGPA x 100/10

भाकृअनुप
ICAR