

✚ Course offered (Semester wise Course Distribution)

College of Agriculture

First Semester						
Sr. No.	Course No.	Title of course	Credit	Theory	Practical	Total
1.	Ag. Chem. 1.1	Fundamental of Soil Science	2+1	2	1	3
Second Semester						
2.	Ag. Chem. 2.2	Manures, Fertilizers and Soil Fertility Management	2+1	2	1	3
Third Semester						
3	Ag. Chem. 3.3	Problematic Soils and their Management	2+1	2	1	3
Eight Semester						
4	Ag. Chem. 8.5	Soil Management (Conservation, Problematic and Soil Quality)	1+2	1	2	3

Polytechnic in Agriculture

Second Semester						
Sr. No.	Course No.	Title of course	Credit	Theory	Practical	Total
1.	Ag. Chem. 2.1	Fundamental of Soil Science	2+1	2	1	3
Third Semester						
2.	Ag. Chem. 3.2	Manures, Fertilizers and Soil Fertility Management	2+1	2	1	3
Fourth Semester						
3	Ag. Chem. 4.3	Problematic Soils and their Management	2+1	2	1	3

Ag. Chem. 1.1

Fundamentals of Soil Science (2+1)

Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil texture- Methods of particle size analysis, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; soil air, composition; source, amount and flow of heat in soil; soil temperature and plant growth; Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects.

Practical

Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil profile in field. Study of soil forming rocks and minerals. Determination of particle density and bulk density of soil and computation of porosity, Determination of soil moisture content and maximum water holding capacity and computation of moisture constants. Determination of soil texture by feel and international pipette method. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Estimation of organic matter content of soil.

Contents

Sr. No.	Title and contents
1	SOILS – AN INTRODUCTION Defination of soil, Soil as a natural body, Functions of soil, Pedological and edaphological approaches of soil;
2	SOIL FORMING ROCKS AND MINERALS The earth’s crust and its composition, Atmosphere, Hydrosphere, Lithosphere, Biosphere, Rocks-classification-igneous, sedimentary and metamorphic rocks-occurrence of soil forming rocks-minerals-classification on the basis of their amounts, mode of origin, composition and specific gravity-clay minerals-relative occurrences of minerals in soil.
3	WEATHERING AND THE SOIL FORMATION Weathering of rocks and minerals-physical and chemical weathering-factors of soil formation-passive and active-soil forming processes (pedogenic processes)
4	SOIL PROFILE Soil profile-horizons in a given profile
5	SOIL TAXONOMY History of soil classification system, Comprehensive soil classification according to 7 th approximation- soil orders, its formative elements and their major characteristics-nomenclature in soil taxonomy-soils of Gujarat and India.
6	COMPONENTS OF SOIL Component of soils (volume basis)-Mineral matter – Organic matter – soil air-soil water
7	PHYSICAL PROPERTIES OF SOIL Soil physical properties-particle size analysis (Mechanical analysis)-Soil texture-classification of soil separates-characteristics and physical nature of soil separates-textural classes-soil structure-types of soil structure-structure formation-factors affecting soil structure-importance of soil structure- soil density-bulk density-particle density-porosity of soil- factors affecting the soil porosity- soil compaction-soil consistence-significance of soil consistence-soil crusting and crust formation -significance and manipulation of densities-soil colour.
8	SOIL WATER Structure and related properties of water, factors affecting soil water, water retention and potentials in soils-total soil water potential-gravitational, metric and osmotic-physical and biological classification of soil water- soil moisture constants-entry of water into soil-drainage- soil water movement- soil moisture determination.
9	SOIL AIR AND TEMPERATURE Soil air-composition of soil air-factors affecting composition of soil air -influence of soil air on plant growth-soil temperature-source of soil heat-loss of soil heat-thermal properties of soils- Factors affecting the soil temperature and its control-effect of soil temperature on plant growth.
10	SOIL REACTION Soil reaction - pH and its Method of Expression, influence of soil reaction on availability of nutrients, Buffering the Soil Reaction - Importance of Buffering in Agriculture

11	<p>SOIL COLLOIDS</p> <p>Colloidal system, Properties and importance of soil colloids-nature of colloids-chemical composition and structure of colloids-colloids other than silicate clay minerals-genesis of soil colloids-sources of negative charges on silicate minerals-ion exchange-cation exchange-factors affecting the cation exchange-significance of cation exchange-anion exchange-importance of anion exchange-CEC of plant roots.</p>
12	<p>SOIL ORGANIC MATTER</p> <p>Composition of plant residues-decomposition of organic matter- decomposition of soluble substances-ammonification-nitrification-decomposition of insoluble substances- breakdown of protein-cellulose-hemicellulose-starch-decomposition of ether soluble-decomposition of lignin-simple decomposition products-humus-humus fractions-carbon cycle-C:N ratio- consistency of C: N ratio</p>
13	<p>SOIL ORGANISMS</p> <p>Soil biology-Soil microorganism-classification-soil microorganism of plant nature-soil organism of animal nature-function of soil microorganism-beneficial and harmful function of soil microorganism.</p>

Suggested Reference Books:

1. The Nature and Properties of Soils by Brady, N.C. & Weil, R.R. 15th Edition (2016), Pearson Education, London. ISBN: 978-0133254488
2. Fundamentals of Soil Science (2009), Published by Indian Society of Soil Science, New Delhi
3. Introductory Soil Science, by D.K. Das, Kalyani Publishers, Ludhiana (2015) 3rd Edition, ISBN: 8127267481
4. Fundamentals of Soil by V. N. Sahai, Kalyani Publishers Ludhiana (2013) ISBN:9789327212778
5. Textbook of Soil Science by R. K. Mehra, Published by DIPA, ICAR, Pusa, New Delhi (2006)
6. Physical Properties of Soils by N. Narayana and C. C. Shah, Manaktalas Pub., Mumbai.
7. Fundamentals of Soil Science - A Text Book by V. D. Patil and C. V. Mali, Phoenix Pub., Parbhani.

Practical Outline

Practical No.	Title of the Experiment
A. SOIL PHYSICAL PROPERTIES	
1	Collection and processing of soil for analysis
2	Study of soil profile and Its characteristics
3	Study of soil forming rocks
4	Study of soil forming minerals
5	Determination of densities of soil
6	Determination of moisture content from soil and plant
7	Determination of maximum water holding capacity (MWHC) of soil
8	Determination of hydraulic conductivity of soil
9	Determination of texture of soil
10	Measurement of soil temperature and calculation of soil heat flux
B. ANALYTICAL CHEMISTRY: BASIC CONCEPTS, TECHNIQUES AND CALCULATION	
11	Determination of EC and pH of soil
12	Determination of cation exchange capacity of soil
13	Estimation of organic carbon content in soil

Ag. Chem. 2.2
Manures, Fertilizers and Soil Fertility
Management (2+1)

Theory

Classification and importance of organic manures, properties and methods of preparation of bulky manures. Green/leaf manuring. Transformation reactions of organic manures in soil and importance of C:N ratio in rate of decomposition. Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano-fertilizers, Soil amendments, Fertilizer Storage, Fertilizer Control Order. History of soil fertility and plant nutrition. Criteria of essentiality. Role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Practical

Determination of moisture and organic matter content from manures samples. Estimation of N, P, K & S from manure sample. Determination of N from urea fertilizers. Determination of NH₄-N, NO₃-N from nitrogenous fertilizers. Determination of P from phosphatic fertilizer. Determination of K from potassic fertilizer. Determination of S from sulphur fertilizer. Estimation of available N, P, K, S and micro nutrient (Fe, Mn, Zn, Cu) from soil sample.

Contents

Sr. No.	Title
1	Soil Fertility and Plant Nutrition
2	Chemistry of nutrients in soils
3	Soil fertility evaluation
4	Organic Manures
5	Transformation of organic manures
6	Chemical Fertilizers
7	Soil amendments
8	Fertilizer storage and Fertilizer Control Order
9	Fertilizer Recommendations and Application

Suggested Reference Books:

1. Manures and Fertilizers (2002) by K. S. Yawalkar, J. P. Agarwal and S. Bokde , Agri-Horticultural Publishing House, Nagpur.
2. Manures and Fertilizers (2009) by P. C. Das, Kalyani Publishers, New Delhi
3. Soil Fertility and Nutrient Management (2011) by S. S. Singh, Kalyani Publishers, New Delhi
4. Soil and Fertilizers at a glance (2004) by L. L. Somani and P. C. Kanthaliya, Agrotech Publishing Academy, Udaipur
5. Textbook of Soil Science (2017) by R. K. Mehra, ICAR, New Delhi
6. Soil Fertility and Fertilizers (2010) by Havlin, Beaton, Tisdale and Nelson, PHI Learning Private Ltd, New Delhi
7. Introductory Soil Science (2013) by D.K. Das, Kalyani Publishers, New Delhi
8. Fundamentals of Soil (2000) by V.N. Sahai, Kalyani Publishers, New Delhi

Practical Outline

Practical No.	Title of the Experiment
1	Determination of moisture and organic matter content from manure sample.
2	Estimation of nitrogen from manure sample
3	Estimation of total phosphorus, potassium and sulphur from manure sample
4	Determination of nitrogen from urea fertilizer: $[\text{NH}_2\text{-CO-NH}_2]$
5	Determination of $\text{NH}_4\text{-N}$ from ammonical nitrogenous fertilizers: $[(\text{NH}_4)_2\text{SO}_4]$
6	Determination of $\text{NO}_3\text{-N}$ from nitrogenous fertilizers: $[\text{KNO}_3, \text{NaNO}_3]$
7	Determination of phosphorus from phosphatic Fertilizer: [DAP]
8	Determination of potassium from potassic fertilizer: [KCl]
9	Determination of sulphur from sulphate fertilizer: $[(\text{NH}_4)_2\text{SO}_4]$
10	Estimation of available nitrogen from soil
11	Estimation of available phosphorus from soil
12	Estimation of available potassium from soil
13	Estimation of available sulphur from soil
14	Estimation of DTPA extractable micronutrients (Fe, Mn, Zn, Cu) from soil

Ag. Chem. 3.3
Problematic Soils and their Management
(2+1)

Theory

Soil quality and health, Distribution of Waste land and problem soils in Gujarat and India. Their categorization based on properties. Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils. Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils. Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro-climatic zones of Gujarat.

Practical

Preparation of saturated paste of problematic soil. Determination of pHs and E_ce of saturation extract of problematic soil. Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO₃, HCO₃, Cl, SAR and RSC).

Contents

Sr. No.	Title
1	Soil Quality and Soil Health
2	Distribution of Waste Land and Problem soils in India
3	Salt affected Soils, Problems, Reclamation and Management of Saline and Sodic Soils
4	Acid and Acid Sulphate Soils
5	Eroded Soil, Water logged Soil and Compacted Soils and Management
6	Polluted Soils, Problems and Management
7	Quality of Irrigation Water
8	Remote Sensing and GIS techniques
9	Land capability Soil Classification
10	Multipurpose Trees: Their selection and role in land-use systems

Suggested Reference Books:

1. Problematic soils and their management (2019), D.K. Das, Kalyani Publishers, Delhi
2. Textbook of Soil Science (2017) by R. K. Mehra, ICAR, New Delhi
3. Introductory Soil Science (2013) by D.K. Das, Kalyani Publishers, New Delhi
4. Fundamentals of Soil (2000) by V.N. Sahai, Kalyani Publishers, New Delhi
5. Soil science An introduction (2010) by ISSS, New Delhi
6. Concept of Soil Science (2012) by S.G. Rajput, , Kalyani Publishers, New Delhi
7. Alkali Soils their Reclamation and management (1990) by L.L. Somani, Divyajoyti Prakashan, Jodhpur
8. The Nature and Properties of Soil (1990) by N.C. Brady, Macmillan Publishing Company, New York (USA).

Practical Outline

Practical No.	Title of the Experiment
1	Preparation of saturation paste, saturation extract of problematic soil
2	Determination of pHs of problematic soil
3	Determination of E _c e of saturation extract of problematic soil
4	Determination of water soluble cations (Ca ⁺² , Mg ⁺² , Na ⁺ & K ⁺) From the soil
5	Determination of exchangeable cations (Ca ⁺² , Mg ⁺² , Na ⁺ & K ⁺) From the soil
6	Computation of CEC, SAR and ESP and characterization of problematic soil
7	Determination of gypsum requirement of alkali/sodic soil (Schoonover, 1952)
8	Determination of lime requirement of acid soils
9	Determination of quality of irrigation water (pH, EC, Ca ⁺² , Mg ⁺² , Na ⁺ , CO ₃ ²⁻ , HCO ₃ ⁻ , Cl ⁻ , SAR and RSC)