SunRise University

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Scheme

For Two-year Course in M.Sc. (Agriculture) Soil Science and Agriculture Chemistry

2021-2022

COLLEGE OF AGRICULTURE

SUNRISE UNIVERSITY - ALWAR

SUNRISE UNIVERSITY – ALWAR

Campus: Bagad Rajput, Ramgarh, Alwar, Rajasthan 301028

M.Sc(Agriculture) Soil Science and Agriculture Chemistry
Ist Semester (Session - 2023-2024)

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
SOILS-511	SOIL CHEMISTRY	2	1	20	-	50	30	100
SOILS - 512	SOIL MINERALOGY,GENESIS, CLASSIFICATION AND SOIL SURVEY	2	1	20	-	50	30	100
SOILS - 513	ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS	1	2	20	-	50	30	100
SOILS - 514	RADIOISOTOPS IN SOIL AND PLANT STUDIES	1	1	20	-	50	30	100
	Total	6	5	-	-	-	-	400

Dean

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SunRise University, Alwar

SOILS 511 Soil Chemistry 3(2+1)

Objective

To introduce the classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plantgrowth

Theory

UNIT I
Chemical (elemental) composition of the earth's crust and soils.UNIT II
Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics.
UNIT III
Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero- charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions.
UNIT IV
Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement,; anion and ligand exchange – innersphere and outer-sphere surface complex formation, fixation of oxyanions,hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition.
UNIT V
Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects.
UNIT VI
Chemistry of acid soils; active and potential acidity; lime potential,; sub-soil acidity.UNIT VII
Chemistry of salt-affected soils and amendments;UNIT VIII
Chemistry and electrochemistry of submerged soils.

Practical

Determination of CEC and AEC of soils. Analysis of equilibrium soil solution for pH,EC, E_h by the use of E_h-pH meter and conductivity meter. Adsorption-desorption of phosphate/sulphate by soil using simple. Adsorption isotherm. Determination of titratableacidity of an acid soil by $BaCl_2$-TEA method.

Suggested Readings

Bear R.E. 1964. Chemistry of the Soil. Oxford and IBH.

Bolt G.H & Bruggenwert M.G.M. 1978. Soil Chemistry. Elsevier.

Greenland D.J & Hayes M.H.B. 1981. Chemistry of Soil Processes. John Wiley & Sons.
McBride M.B. 1994. Environmental Chemistry of Soils. Oxford Univ. Press.

Sposito G. 1981. The Thermodynamics of Soil Solutions. Oxford Univ.Press.
Sposito G. 1984. The Surface Chemistry of Soils. Oxford Univ. Press.

Sposito G. 1989. The Chemistry of Soils. Oxford Univ. Press. Stevenson
F.J. 1994. Humus Chemistry. 2nd Ed. John Wiley & Sons.

Van Olphan H. 1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons.

SOILS 512 Soil Mineralogy, Genesis, Classification and Survey 3(2+1)

Objective

To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning.

Theory

UNIT I

Fundamentals of crystallography, isomorphism and polymorphism.UNIT II

Structural chemistry, Classification of minerals, , chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; amorphous soil constituents and other non-crystalline silicate minerals; clay minerals in Indian soils.

UNIT III

Soil morphology and micromorphology, Factors of soil formation, soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils.

UNIT IV

Concept of soil individual; soil classification systems – historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

UNIT V

Soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps,

cartography, mapping units, techniques for generation of soil maps.

UNIT VI

Landform – soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT) – concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

Practical

Identification of rocks and minerals. Morphological properties of soil profile in different landforms. Classification of soils using soil taxonomy. Grouping soils using available data base in terms of soil quality. Aerial photo and satellite data interpretation for soil and land use. Cartographic techniques for preparation of base maps and thematic maps, processing of field sheets, compilation and obstruction of maps in different scales. Land use planning exercises using conventional and RS tools.

Suggested Readings

Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed.Pearson Edu.

Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesisand Classification. 4th Ed. Panima Publ.

Dixon JB & Weed SB. 1989. Minerals in Soil Environments. 2nd Ed. Soil Science Society of America, Madison.

Grim RE. 1968. Clay Mineralogy. McGraw Hill.

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

Sehgal J. 2002. Introductory Pedology: Concepts and Applications. NewDelhi

Sehgal J. 2002. Pedology - Concepts and Applications. Kalyani.

USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS,Washington. Wade FA & Mattox RB. 1960. Elements of Crystallography andMineralogy. Oxford &IBH.

Wilding LP & Smeck NE. 1983. Pedogenesis and Soil Taxonomy: II. TheSoil Orders. Elsevier.

Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I.Concept and Interaction. Elsevier.

SOILS 513 Analytical Techniques and Instrumental Methods in Soil and PlantAnalysis 3(1+2)

Objective

To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil aswell as plant samples.

Theory

Principles of visible, ultraviolet and infrared spectrophotometery, atomic absorption, flame-photometry, inductively coupled plasma spectrometry;

chromatographic techniques, mass spectrometry and X-ray defractrometery; identification of minerals by X-ray by different methods.

Practical

UNIT I

Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.

UNIT II

Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.

UNIT III

Electrochemical titration of clays; determination of cation and anion exchange capacities of soils; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity.

UNIT IV

Analysis of soil and plant samples for N, P, K, Ca, Mg, S, Zn, Cu, Fe, Mn, B and Mo; analysis of plant materials by digesting plant materials by wet and dry ashing and soil by wet digestion methods.

UNIT V

Drawing normalized exchange isotherms; measurement of redox potential.

Suggested Readings

Hesse P. 1971. Textbook of Soil Chemical Analysis. William Clowes & Sons.

Jackson M.L. 1967. Soil Chemical Analysis. Prentice Hall of India.

Keith A Smith 1991. Soil Analysis; Modern Instrumental Techniques. Marcel Dekker. Kenneth Helrich 1990. Official Methods of Analysis. Association of Official Analytical Chemists.

Page A.L, Miller R.H & Keeney D.R. 1982. Methods of Soil Analysis. Part II.SSSA,Madison.

Piper C.E. Soil and Plant Analysis. Hans Publ.

Singh D, Chhonkar PK & Pandey RN. 1999. Soil Plant Water Analysis – A Methods Manual. IARI, New Delhi.

Tan KH. 2003. Soil Sampling, Preparation and Analysis. CRC Press/Taylor & Francis. Tandon HLS. 1993. Methods of Analysis of Soils, Fertilizers and Waters. FDCO, New Delhi.

Vogel AL. 1979. A Textbook of Quantitative Inorganic Analysis. ELBS Longman.

SOILS 514 Radioisotopes in Soil and Plant Studies 2(1+1)

Objective

To train students in the use of radioisotopes in soil and plant research

Theory

UNIT I

Atomic structure, radioactivity and units; radioisotopes - properties and decay principles;nature and properties of nuclear radiations; interaction of nuclear radiations with matter UNIT II

Principles and use of radiation monitoring instruments - proportional, Geiger Muller counter, solid and liquid scintillation counters; neutron moisture meter, mass spectrometry, auto radiography.

UNIT III

Isotopic dilution techniques used in soil and plant research; use of stable isotopes; application of isotopes in studies on organic matter, nutrient transformations, ion transport, rooting pattern and fertilizer use efficiency; carbon dating

UNIT IV

Doses of radiation exposure, radiation safety aspects regulatory aspects, collection, storage and disposal of radioactive wastes

Practical

Storage and handling of radioactive materials. Determination of half life and decay constant. Preparation of soil and plant samples for radioactive measurements. Setting up of experiment on fertilizer use efficiency and cation exchange. Equilibria using radioisotopes. Determination of A, E and L values of soil using $_{32}$P/ $_{65}$Zn. Use of neutron probe for moisture determination. Sample preparation and measurement of $_{15}$Nenrichment by mass. Spectrophotometery/ emission spectrometry.

Suggested Readings

Comer. 1955. Radioisotopes CL in Biology and Agriculture: Principles and Practice. Tata McGraw Hill.

Glasstone S. 1967. Source Book on Atomic Energy. East West Press.

Michael FL & Annunziata. 2003. Handbook of Radioactivity Analysis. Academic Press.

M.Sc(Agriculture) Soil Science and Agriculture Chemistry
IInd Semester (Session - 2023-2024)

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
SOILS - 521	SOIL FERTILITY AND FERTILIZER USE	3	1	20	-	50	30	100
SOILS - 522*	SOIL BIOLOGY AND BIOCHEMISTRY	2	1	20	-	50	30	100
SOILS - 523	REMOTE SENSING AND GIS TECHNIQUES FOR SOIL AND CROP STUDIES	2	0	20	-	80	-	100
SOILS - 524	SOIL,WATER AND AIR POLLUTION	2	1	20	-	50	30	100
SOILS - 525	FERTILIZER TECHNOLOGY	2	0	20	-	80	-	100
SOILS - 526	GEOMORPHOLOGY AND GEOCHEMISTRY	2	1	20	-	50	30	100
	Total	13	2	-	-	-	-	600

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SOILS 521 Soil Fertility and Fertilizer Use 4(3+1)

Objective

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

Theory

UNIT I

Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essentialplant nutrients - functions and deficiency symptoms.

UNIT II

Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation -types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

UNIT III

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions.

UNIT IV

Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers

Sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers.

UNIT VI

Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

UNIT VII

Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions.

UNIT VIII

Fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations; site-specific nutrient management; plant need based nutrient management; integratednutrient management.

UNIT IX

Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality inrelation to sustainable agriculture.

Practical

Chemical analysis of soil for total N, P & K and available nutrients (N, P, K, S, Cu, Fe,,Mn, Zn, Mo.B). Analysis of plants for essential elements (N, P, K, S, Cu, Fe,Mn,Zn,Mo.B)

Suggested Readings

Brady N.C & Weil R.R. 2002. The Nature and Properties of Soils. 13th Ed.Pearson Edu. Kabata-Pendias A & Pendias H. 1992. Trace Elements in Soils and Plants. CRC Press. Kannaiyan S, Kumar K & Govindarajan K. 2004. BiofertilizersTechnology. Scientific Publ.

Leigh J.G. 2002. Nitrogen Fixation at the Millennium. Elsevier.

Mengel K & Kirkby E.A. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland.

Mortvedt J.J, Shuman L.M, Cox F.R & Welch R.M. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.

Pierzinsky G.M, Sims T.J & Vance J.F. 2002. Soils and Environmental Quality. 2nd Ed. CRC Press.

Stevenson F.J & Cole M.A. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.

Tisdale S.L, Nelson S.L, Beaton J.D & Havlin J.L. 1999. Soil Fertility and Fertilizers. 5th Ed. Prentice Hall of India.

Troeh F.R & Thompson L.M. 2005. Soils and Soil Fertility. Blackwell.

SOILS 522 Soil Biology and Biochemistry 3(2+1)

Objective

of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable soil biota.

UNIT II

Microbiology and biochemistry of root-soil interface; phyllosphere; rhizoshpere, soil enzymes, origin, activities and importance; soil characteristics influencing growth andactivity of microflora.

UNIT III

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients.

UNIT IV

Biodegradation of organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil.

UNIT V

Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost.

UNIT VI

To teach students the basics of soil biology and biochemistry, including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities

Theory

UNIT I

Soil biota, soil microbial ecology, types

Biofertilizers – definition, classification, specifications, method of production and role incrop production, BIS standards for biofertilizer for quality control

Practical

Determination of soil microbial population.Soil microbial biomass (C N P). Fractionation of organic matter (HA, FA, Humin, Lignin and humus) and functional groups. Soil enzymes. Measurement of important soil microbial processes such as nitrification, N_2 fixation, S oxidation, P solubilization

Suggested Readings

Alexander M. 1977. Introduction to Soil Microbiology. John Wiley & Sons.

Burges A & Raw F. 1967. Soil Biology. Academic Press.

McLaren A.D & Peterson G.H. 1967. Soil Biochemistry. Vol. XI. Marcel Dekker.

Metting F.B. 1993. Soil Microbial Ecology – Applications in Agricultural and Environmental Management. Marcel Dekker.

Paul E.A & Ladd J.N. 1981. Soil Biochemistry. Marcel Dekker.

Reddy M.V. (Ed.). Soil Organisms and Litter in the Tropics. Oxford & IBH.

Russel R.S. 1977. Plant Root System: Their Functions and Interaction with the Soil.ELBS & McGraw Hill.

Stotzky G & Bollag J.M. 1993. Soil Biochemistry. Vol. VIII. MarcelDekker. Sylvia D.N. 2005. Principles and Applications of Soil Microbiology. Pearson Edu. Wild A. 1993. Soil and the Environment - An Introduction. CambridgeUniv. Press.

SOILS 523 Remote Sensing and GIS Techniques for Soil, Water and Crop Studies 2(2+0)

Objective

To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation; application of remote sensing in general and with special reference to soil, plants and yield forecasting; to impart knowledge about geo- statistical techniques with special reference to krigging, and GIS and applications in agriculture.

Theory

UNIT I

Introduction and history of remote sensing; sources, propagation of radiations in

atmosphere; interactions with matter.
UNIT II
Sensor systems - camera, microwave radiometers and scanners; fundamentals of aerialphotographs and image processing and interpretations.
UNIT III
Application of remote sensing techniques - land use soil surveys, crop stress and yield forecasting, prioritization in watershed and drought management, wasteland identification and management, remote sensing applications in monitoring and management of soil and water pollution.
UNIT IV
Significance and sources of the spatial and temporal variability in soils; variability in relation to size of sampling; classical and geo-statistical techniques of evolution of soil variability.
UNIT V
Introduction to GIS and its application for spatial and non-spatial soil and land attributes.

Suggested Readings

Brady N.C & Weil R.R. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.

Elangovan K. 2006. *GIS Fundamentals, Applications and Implementations*. New IndiaPubl. Agency.

Lillesand T.M & Kiefer R.W. 1994. *Remote Sensing and Image Interpretation*. 3rd Ed.Wiley.

Nielsen D.R & Wendroth O. 2003. *Spatial and Temporal Statis*tics. Catena Verloggmbh.Star J & Esles J. 1990. *Geographic Information System: An Introduction*. Prentice Hall.

SOILS 524 Soil, Water and Air Pollution 3(2+1)

Objective

To make the students aware of the problems of soil, water and air pollution associatedwith use of soils for crop production.

Theory
UNIT I
Soil, water and air pollution problems associated with agriculture, nature and extent.UNIT II
Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.
UNIT III
Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste

disposal.
UNIT IV
Pesticides – their classification, behavior in soil and effect on soil microorganisms.UNIT V
Toxic elements – their sources, behavior in soils, effect on nutrients availability, effect on plant and human health.
UNIT VI
Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases – carbon dioxide, methane and nitrous oxide.
UNIT VIII
Remediation/amelioration of contaminated soil and water; soil as a sink for waste disposal, soil and water quality standards.

Suggested Readings

Lal R, Kimble J, Levine E & Stewart B.A. 1995. Soil Management and Greenhouse Effect. CRC Press.

Middlebrooks E.J. 1979. Industrial Pollution Control. Vol. I. Agro-Industries. John Wiley Interscience.

Ross S.M. Toxic Metals in Soil Plant Systems. John Wiley & Sons.

Vesilund P.A & Pierce 1983. Environmental Pollution and Control. Ann Arbor Science Publ.

SOILS 525 Fertilizer Technology 2(2+0)

Objective

To impart knowledge about how different fertilizers are manufactured using differentkinds of raw materials and handling of fertilizers and manures.

Theory
UNIT I
Fertilizers – production, consumption and future projections with regard to nutrient use inthe country and respective states; fertilizer control order.
UNIT II
Manufacturing processes for different fertilizers using various raw materials, characteristics and nutrient contents.
UNIT III
Recent developments in secondary and micronutrient fertilizers and their quality controlas per fertilizer control order.
UNIT IV
New and emerging issues in fertilizer technology – production and use of slow and controlled release fertilizers, supergranules fertilizers and fertilizers for specific

crops/situations.

Suggested Readings

Brady N.C & Weil R.R. 2002. The Nature and Properties of Soils. Pearson. Edu. Fertilizer (Control) Order, 1985 and the Essential Commodities Act. FAI. New Delhi. Kanwar J.S. (Ed.). 1976. Soil Fertility: Theory and Practice. ICAR.

Olson R.A, Army T.S, Hanway J.J & Kilmer V.J. 1971. Fertilizer Technology and Use.

2nd Ed. Soil Sci. Soc. Am. Madison.
Prasad R & Power J.F. Soil Fertility Management for Sustainable Agriculture. CRC Press.

Tisdale S.L, Nelson S.L, Beaton J.D & Havlin J.L. 1999. Soil Fertility and Fertilizers.

McMillan Publ.

SOILS 526 Geomorphology and Geochemistry 2(2+0)

Objective

To impart knowledge about the landforms, physiography and morphology of the earthsurface, and distribution and weathering elements in the earth crust.

Theory

UNIT I

General introduction to geology and geochemistry, major and minor morphogenic and genetic landforms, study of schematic landforms and their elements with special referenceto India.

UNIT II

Methodology of geomorphology, its agencies, erosion and weathering; soil and physiography relationships; erosion surface of soil landscape.

UNIT III

Geochemical classification of elements; geo-chemical aspects of weathering and migration of elements; geochemistry of major and micronutrients and trace elements.

Suggested Readings

Brikland P.W. 1999. Soils and Geomorophology. 3rd Ed. Oxford Univ. Press.
Likens G.E & Bormann F.H. 1995. Geochemistry. 2nd Ed. Springer Verlag.

Mortvedt J.J, Shuman L.M, Cox FR & Welch RM. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.

Brikland P.W. 1999. Soils and Geomorophology. 3rd Ed. Oxford Univ. Press.
Likens G.E & Bormann F.H. 1995. Geochemistry. 2nd Ed. Springer Verlag.

Mortvedt J.J, Shuman L.M, Cox FR & Welch RM. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.

M.Sc(Agriculture) Soil Science and Agriculture Chemistry
IIIrd Semester (Session - 2023-2024)

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
SOILS - 531*	SOIL PHYSICS	2	1	20	-	50	30	100
SOILS - 532	MANAGEMENT OF PROBLAM SOILS AND WATERS	2	1	20	-	50	30	100
SOILS - 533	SOIL EROSION AND CONSERVATION	2	1	20	-	50	30	100
SOILS - 534	LAND DEGRADATION AND RESTORATION	2	1	20	-	50	30	100
SOILS - 535	SYSTEM APPROCHES IN SOIL AND CROP STUDIES	2	1	20	-	50	30	100
	Total	10	5	-	-	-	-	500

Dean

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SOILS 531 Soil Physics 3(2+1)

Objective

To impart basic knowledge about soil physical properties and processes in relation toplant growth.

Theory

UNIT I

Scope of soil physics and its relation with other branches of soil science; soil as a threephase system.

UNIT II

Soil texture, textural classes, mechanical analysis, specific surface.UNIT III

Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts.

UNIT IV

Soil structure - genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation.

UNIT V

Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

UNIT VI

Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils.

UNIT VII

Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

UNIT IX

Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management.

UNIT X

Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

Suggested Readings

Baver L.D, Gardner W.H & Gardner W.R. 1972. Soil Physics. John Wiley & Sons.
Ghildyal B.P & Tripathi R.P. 2001. Soil Physics. New Age International.
Hanks J.R & Ashcroft G.L. 1980. Applied Soil Physics. Springer Verlag.

Hillel D. 1972. Optimizing the Soil Physical Environment toward Greater Crop Yields. Academic Press.

Hillel D. 1980. Applications of Soil Physics. Academic Press.
Hillel D. 1980. Fundamentals of Soil Physics. Academic Press.
Hillel D. 1998. Environmental Soil Physics. Academic Press.

Hillel D. 2003. Introduction to Environmental Soil Physics. Academic Press.

Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS, New Delhi.
Kirkham D & Powers W.L. 1972. Advanced Soil Physics. Wiley-Interscience.

Kohnke H. 1968. Soil Physics. McGraw Hill.

Lal R & Shukla M.K. 2004. Principles of Soil Physics. Marcel Dekker.
Oswal M.C. 1994. Soil Physics. Oxford & IBH.

Saha A.K. 2004. Text Book of Soil Physics. Kalyani.

SOILS 532 Management of Problem Soils and Water 3(2+1)

Objective
To educate students about basic concepts of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production.

Theory
UNIT I
Area and distribution of problem soils – acidic, saline, sodic and physically degradedsoils; origin and basic concept of problematic soils, and factors responsible**.**
UNIT II
Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils - soluble salts, ESP, pH; physical, chemical and microbiological properties. UNIT III
Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.
UNIT IV
Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.
UNIT V
Quality of irrigation water; management of brackish water for irrigation; salt balance

under irrigation; characterization of brackish waters, area and extent; relationship in wateruse and quality.

UNIT VI

Agronomic practices in relation to problematic soils; cropping pattern for utilizing poorquality ground waters.

Practical

Characterization of acid, acid sulfate, salt-affected and calcareous soils. Determination of cations (Na^{+}, K^{+}, Ca^{++} and Mg^{++}) in ground water and soil samples. Determination of anions (Cl^{-}, SO_4^{--}, CO_3^{--} and HCO_3^{-}) in ground waters and soil samples. Lime requirements of acid soil and gypsum requirements of sodic soil.

Suggested Readings

Bear F.E. 1964. Chemistry of the Soil. Oxford & IBH.

Jurinak J.J. 1978. Salt-affected Soils. Deptt. of Soil Science & Biometeorology. Utah State Univ.

USDA Handbook No. 60. 1954. Diagnosis and improvement of Saline and Alkali Soils. Oxford & IBH.

SOILS 533 Soil Erosion and Conservation 3(2+1)

Objective

To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water

Theory

UNIT I

History, distribution, identification and description of soil erosion problems in India.

UNIT II

Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity - estimation as EI_{30} index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses inrelation to soil properties and precipitation.

UNIT III

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

UNIT IV

Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout.

UNIT V

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

UNIT VI

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds.

Practical

Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index. Computation of kinetic energy of falling rain drops Computation of rainfall erosivity index (EI_{30}) using rain gauge data. Visits to a watersheds.

Suggested Readings

Biswas T.D & Narayanasamy G. (Eds.) 1996. *Soil Management in Relation to Land Degradation and Environment*. Bull. Indian Society of Soil Science No. 17.
Doran J.W & Jones A.J. 1996. *Methods of Assessing Soil Quality*. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.
Gurmal Singh, Venkataramanan C, Sastry G & Joshi B.P. 1990. *Manual of Soil and Water Conservation Practices*. Oxford & IBH. Hudson N. 1995. *Soil Conservation*. Iowa State Univ.Press.
Indian Society of Soil Science 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.
Oswal M.C. 1994. *Soil Physics*. Oxford & IBH.

SOILS 534 Land Degradation and Restoration 3(2+1)

Objective

To impart knowledge related to various factors and processes of land degradation and their restoration techniques.

Theory

UNIT I

Type, factors (natural and anthropogenic) processes of soil/land degradation and its impact on soil productivity, including soil fauna, biodegradation and environment.

UNIT II

Soil health, indicators for determining soil health, soil quality management and sustainability.

UNIT III

Soil sickness and clinical approaches for sustainable agriculture

UNIT IV

Soil physical environment ,alleviation of soil physical constraints for sustainable crop production

UNIT V

Land restoration and conservation techniques - erosion control, reclamation of salt-affected soils; mine land reclamation, aforestation, organic products.

UNIT VI

Extent, diagnosis and mapping of land degradation by conventional and modern RS-GIS tools; monitoring land degradation by fast assessment, modern tools, land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

Practical

Soil and water sampling over adjoining to mining industries. Analysis of effluents for different heavy metals. Observations, examinations and identification of plant for diagnostic techniques for micronutrients and development of guide for plant diagnosis. Assessment of degraded lands by GIS techniques . Assessment of soil loss by water erosion. Assessment of soil loss by wind erosion.

Suggested Readings

Biswas T D & Narayanasamy G. (Eds.). 1996. *Soil Management in Relation to Land Degradation and Environment. Bull. Indian Soc. Soil Sci.*17, New Delhi.
Doran.J.W & Jones A.J. 1996. *Methods of Assessing Soil Quality*. Soil Science Society of America, Madison.
Greenland D.J & Szabolcs I. 1994. *Soil Resilience and Sustainable Land Use*. CABI.
Lal R, Blum W.E.H, Vailentine C & Stewart B.A. 1997. *Methods for a.ssessment of Soil Degradation.* CRC Press.
Sehgal J & Abrol I.P. 1994. *Soil Degradation in India - Status and Impact*.

Oxford & IBH.

SOILS 535 System Approaches in Soil and Crop Studies 3(2+1)

Objective
To train the students in concepts, methodology, technology and use of systems simulation in soil and crops studies.

Theory
UNIT I
Systems concepts - definitions, general characteristics; general systems theory; systems thinking, systems dynamics, systems behavior and systems study.
UNIT II
Model: definition and types; mathematical models and their types; modeling: concepts, objectives, processes, abstraction techniques; simulation models, their verification and validation, calibration; representation of continuous systems simulation models - procedural and declarative.
UNIT III
Simulation - meaning and threats; simulation experiment, its design and analysis.
UNIT IV
Application of simulation models in understanding system behavior, optimizing system performance, evaluation of policy options under different soil, water, nutrient, climatic and cultural conditions; decision support system, use of simulation models in decision support system.

Practical]
Use of flow chart or pseudo-code in the program writing. Writing a small example simulation model program - declarative (in Vensim PLE, Stella or Simile) and procedural (in Java, Fortran, QBasic or V Basic).
Conducting simulation experiments in DSSAT, WOFOST or EPIC with requirement of report and conclusion

Suggested Readings
Benbi D.K & Nieder R. (Eds.). 2003. *Handbook of Processes and Modelling in the Soil - Plant System*. Haworth Press.
Hanks J & Ritchie J.T. (Eds.). 1991. *Modelling Plant and Soil System. Agronomy***.** Bull. No 31. Soil Sci. Society of America, Madison.
Rajaraman V. 2004. *Computer Programming in Fortran 90 and 95*. PHI.
Tsuji G.Y, Gerrit H & Philip T. 1998. *Understanding Options for Agricultural Production.* Kluwer.
von Bertalanffy Ludwig 1969. *General Systems Theory: Foundation,Development and Application*. Revised Ed. George Braziller. Reprint 1998.

M.Sc(Agriculture) Soil Science and Agriculture Chemistry
IVth Semester (Session - 2023-2024)

Course No	Course Title	Credit Hours	Maximum Marks				
			Theory			Practical	G. Total
			Mid Term	Internal Assessment	External Theory		
SOILS - 541	SEMINAR	1	-	-	-	-	100
SOILS - 542	COMPREHENSIVE	2	-	-	-	-	100
SOILS - 543	RESEARCH	15	-	-	-	-	100
	Total	-	-	-	-	-	300

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College of Agriculture

SunRise University, Alwar

Suggested Readings