



Course

M.Sc (Ag.) Soil Science
(A Two-Year Course)

Under

School of Advanced Agriculture Sciences and Technology
Department of Soil Science

Proposed by

Dr. Abhishek Tiwari

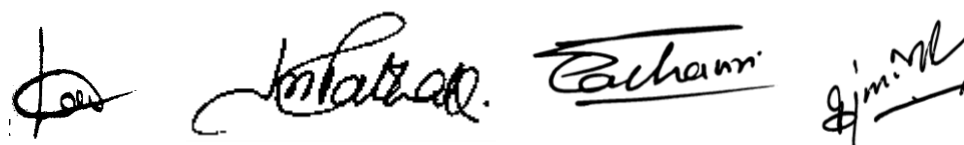
Course effective from : 2026-27

M.Sc (Ag.) Soil Science

Course code	Type	Course title	Min. credits
Soil 501*	Core	Soil Physics	3(2+1)
Soil 502*	Core	Soil Fertility and Fertilizer Use	3(2+1)
Soil 503*	Core	Soil Chemistry	3(2+1)
Soil 504*	Core	Soil Mineralogy, Genesis and Classification	3(2+1)
Soil 506	Core	Soil Biology and Biochemistry	3(2+1)
Soil 510	Core	Analytical techniques and instrumental methods in soil and plant analysis	2(0+2)
Soil 511	Core	Management of problematic soils and water	3(2+1)
Soil 591	Seminar	Master's Seminar	1(1+0)
Soil 599	Research	Master's Research (Thesis/Dissertation) Thesis Report, Viva-Voce Examination	30
AGRON 501	Minor	Modern Concept of Crop Production	3(3+0)
AGRON 504	Minor	Principles and Practices of Water Management	2(1+1)
AGRON 513	Minor	Principles and practices of organic farming	3(2+1)
STAT 511	Supporting	Experimental Designs	3(2+1)
PP 501	Supporting	Principles of Plant Physiology I - Plant Water Relations and Mineral Nutrition	3(2+1)
PGS 501	Compulsory Non-Credit	Library and Information Services	1(0+1)
PGS 502	Compulsory Non-Credit	Technical Writing and Communications Skills	1(0+1)
PGS 503	Compulsory Non-Credit	Intellectual Property and Its Management in Agriculture	1(1+0)
PGS 504	Compulsory Non-Credit	Basic Concepts in Laboratory Techniques	1(0+1)
PGS-505	Compulsory Non-Credit	Agricultural Research, Research Ethics and Rural Development Programmers	1(1+0)

• Credit requirements

S. No.	Courses	Credits
1.	Major courses	20
2.	Minor courses	08
3.	Supporting courses	06
4.	Common courses	05
5.	Seminar	01
6	Thesis Research	30
	Total	70



M.Sc (Ag.) Soil Science						
IST YEAR / IST SEM						
Course code	Type	Course title	Min credits	CIA	ESE	Max. Marks
Soil 501*	Core	Soil Physics	3(2+1)	50	50	100
Soil 502*	Core	Soil Fertility and Fertilizer Use	3(2+1)	50	50	100
AGRON 501	Minor	Modern Concept of Crop Production	3(3+0)	50	50	100
PGS 501	Compulsory Non-Credit	Library and Information Services	1(0+1)	100	-	100
PGS 502	Compulsory Non-Credit	Technical Writing and Communications Skills	1(0+1)	100	-	100
TOTAL			11			500
IST YEAR / IIND SEM						
Soil 503*	Core	Soil Chemistry	3(2+1)	50	50	100
Soil 504*	Core	Soil Mineralogy, Genesis and Classification	3(2+1)	50	50	100
AGRON 504	Minor	Principles and Practices of Water Management	2(1+1)	50	50	100
STAT 511	Supporting	Experimental Designs	3(2+1)	50	50	100
PGS 503	Compulsory Non-Credit	Intellectual Property and Its Management in Agriculture	1(1+0)	50	50	100
PGS 504	Compulsory Non-Credit	Basic Concepts in Laboratory Techniques	1(0+1)	100	-	100
TOTAL			13			600
IIND YEAR / IIIRD SEM						
Soil 506	Core	Soil Biology and Biochemistry	3(2+1)	50	50	100
Soil 510	Core	Analytical techniques and instrumental methods in soil and plant analysis	2(0+2)	100	-	100
Soil 511	Core	Management of problematic soils and water	3(2+1)	50	50	100
AGRON 513	Minor	Principles and practices of organic farming	3(2+1)	50	50	100
PP 501	Supporting	Principles of Plant Physiology I - Plant Water Relations and Mineral Nutrition	3(2+1)	50	50	100
PGS-505	Compulsory Non-Credit	Agricultural Research, Research Ethics and Rural Development Programmers	1(1+0)	100	-	100
Soil 599	Research	Master's Research (Thesis/Dissertation)	10	-	-	S
TOTAL			25			600
IIND YEAR / IVTH SEM						
Soil 591	Seminar	Master's Seminar	1(1+0)	100	-	100
Soil 599	Research	Master's Research (Thesis/Dissertation) Thesis Report Viva-Voce Examination	20	-	-	S
TOTAL			21			100
GRAND TOTAL			70			1800

Course contents M.Sc. (Ag.) Soil Science

- I. **Course Title** : **Soil Physics**
II. **Course Code** : **Soil 501**
III. **Credit Hours** : **2+1**
IV. **Aim of the course**

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

• **Theory**

Unit I

Basic principles of physics applied to soils, soil as a three phase 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. Alleviation of soil physical constraints for crop production. Soil erosion and edibility

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

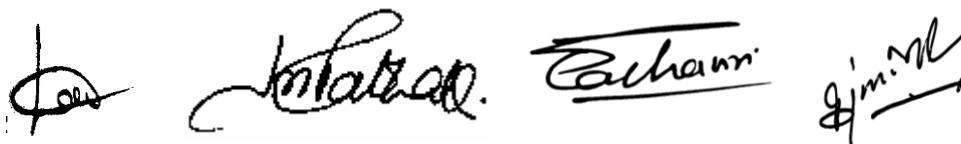
Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils.

Unit VII

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

Unit VIII

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

- **Practical**

➤ Determination of B.D, P.D and mass volume relationship of soil, Mechanical analysis by hydrometer and international pipette method, Measurement of Atterberg limits, Aggregate analysis - dry and wet, Measurement of soil-water content by different methods, Measurement of soil-water potential by using tensiometer and gypsum Blocks, Determination of soil-moisture characteristics curve and computation of pore-size, distribution, Determination of hydraulic conductivity under saturated and unsaturated conditions, Determination of infiltration rate of soil, Determination of aeration porosity and oxygen diffusion rate, Soil temperature measurements by different methods.

- I. **Course Title** : **Soil Fertility and Fertilizer Use**
- II. **Course Code** : **Soil 502**
- III. **Credit Hours** : **3+1**
- IV. **Aim of the course**

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

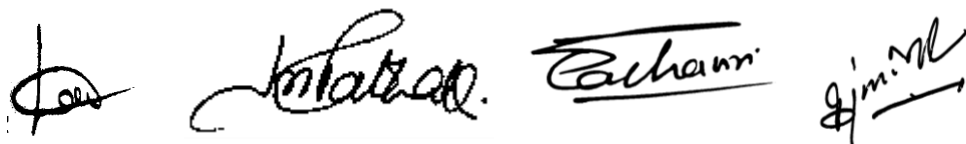
Soil fertility and soil productivity; fertility status of major soils group of India; nutrient sources – fertilizers and manures; Criteria of essentiality, classification, law of minimum and maximum, essential plant nutrients - functions and deficiency symptoms, Nutrient uptake, nutrient interactions in soils and plants; long term effect of manures and fertilizers on soil fertility and crop productivity.

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



Unit V

Sulphur - source, forms, fertilizers and their behavior in soils; role in crops and human health; 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; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; speciality fertilizers concept, need and category. Current status of speciality fertilizers use in soils and crops of India;

Unit IX

Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS

Unit X

Definition and concepts of soil health and soil quality; Long term effects of fertilizers and soil quality.

- **Practical**
- Soil and plant sampling and processing for chemical analysis
- Determination of soil pH, total and organic carbon in soil
- Chemical analysis of soil for total and available nutrients (major and micro)
- Analysis of plants for essential elements (major and micro)

I. Course Title : Modern concept in Crop Production

II. Course Code : AGRON 501

III. Credit Hours : 3 (3+0)

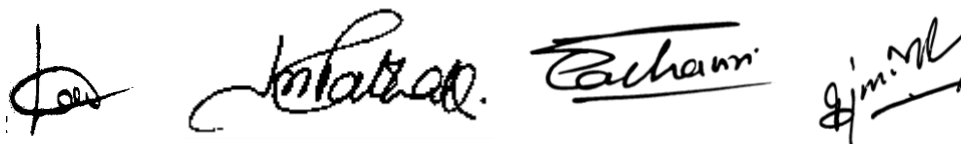
Theory

Unit I

Crop growth analysis in relation to environment; geo-ecological zones of India.

Unit II

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield



equation, its interpretation and applicability; Baule unit.

Unit III

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

Unit IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress, use of growth hormones and regulators for better adaptation in stressed condition.

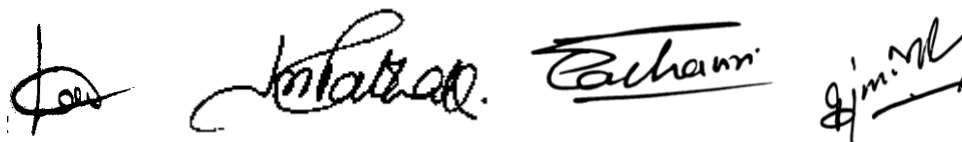
Unit V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture. Modern crop production concepts: soil less cultivation, Aeroponic, Hydroponic, Robotic and terrace farming. Use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.

I. Course Title	: LIBRARY AND INFORMATION SERVICES
II. Course Code	: PGS 501
III. Credit Hours	: 1 (0+1)

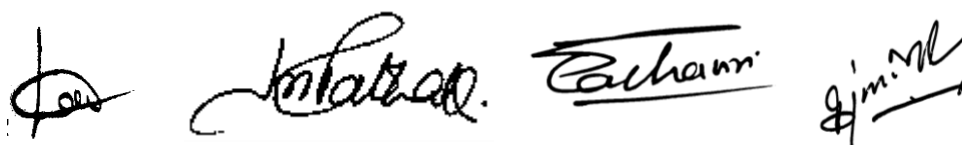
PRACTICAL

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



I. Course Title : Technical Writing and Communications Skills
II. Course Code : PGS 502
III. Credit Hours : 1 (0+1)

Technical Writing-Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface ,introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc. ; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions ;pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof reading; Writing of a review article. Communication Skills –Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Four handwritten signatures in black ink, arranged horizontally. The first signature is a stylized 'P' with a horizontal line. The second signature is 'Khatun'. The third signature is 'Bachann'. The fourth signature is 'Jimmi' with a horizontal line underneath.

2nd Semester

- I. **Course Title** : **Soil Chemistry**
II. **Course Code** : **Soil 503**
III. **Credit Hours** : **2+1**
IV. **Suggested Reading**

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 plant growth.

Theory

Unit I

Chemical (elemental) composition of the earth's crust, soils, rocks and minerals

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, Characterization of OM; clay-organic interactions.

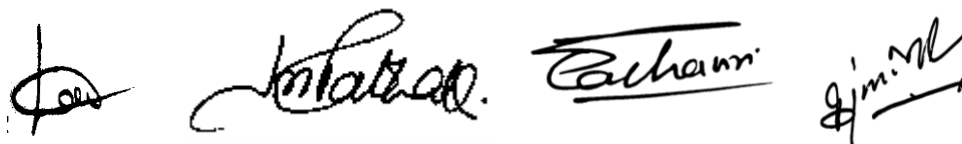
Unit IV

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, thermodynamics, statistical mechanics; anion and ligand exchange— inner-sphere 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; Concept of quantity/intensity(Q/ I) relationship; step and constant-rate K; management aspects.

Unit VI



Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity.

Unit VII

Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.

Unit VIII

Chemistry and electrochemistry of submerged soils, geochemistry of micronutrients, environmental soil chemistry

Practical

Preparation of saturation extract, measurement of pH, EC, CO_3^{2-} , HCO_3^- , Ca, Mg, K and Na, Determination of CEC and AEC of soils, Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter and conductivity meter, Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method, Extraction of humic substances, Potentiometric and conductometric titration of soil humic and fulvic acids, Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm, Determination of titratable acidity of an acid soil by BaCl₂-TEA method, Determination of lime requirement of an acid soil by buffer method, Determination of gypsum requirement of an alkali soil.

I. Course Title : Soil Mineralogy, Genesis and Classification

II. Course Code : Soil 504

III. Credit Hours : 2+1

IV. Aim of the course

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.

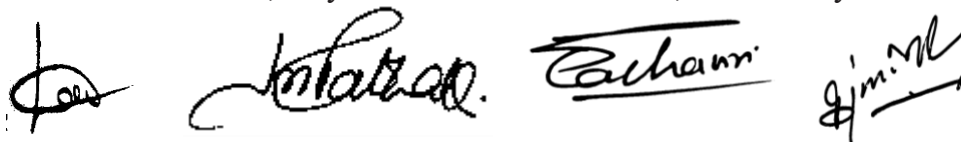
Theory

Unit I

Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism.

Unit II

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystal line and non-crystal line clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils, role of clay minerals in plant nutrition,



interaction of clay with humus, pesticides and heavy metals.

Unit III

Factors of soil formation, soil formation models; 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.

Practical

- Separation of sand, silt and clay fraction from soil
- Determination of specific surface area and CEC of clay
- Identification and quantification of minerals in soil fractions
- Morphological properties of soil profile in different land forms
- Classification of soils using soil taxonomy
- Calculation of weathering indices and its application in soil formation
- Grouping soils using available database in terms of soil quality

I. Course Title : Principles and Practices of Water Management

II. Course Code : AGRON 504

III. Credit Hours : 3 (2+1)

IV. Aim of the course : To teach the principles of water management and practices to enhance the water productivity

Theory

Unit I

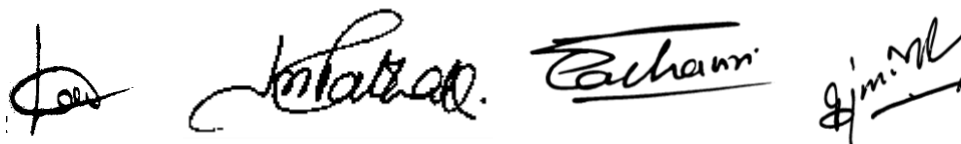
Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in of India and concerned state, major irrigation projects, extent of area and crops irrigated in India and in different states. 50 Physical Sciences: Agronomy

Unit II

Field water cycle, water movement in soil and plants; transpiration; soil-water plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Water availability and its relationship with nutrient availability and losses.

Unit III

Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and methods of irrigation; micro irrigation systems; deficit irrigation; fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.



Unit IV

Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency, Crop water requirement- estimation of ET and effective rainfall; Water management of the major crops and cropping systems. Automated irrigation system.

Unit V

Excess of soil water and plant growth; water management in problem soils, drainage requirement of crops and methods of field drainage, their layout and spacing; rain water management and its utilization for crop production.

Unit VI

Quality of irrigation water and management of saline water for irrigation, water management in problem soils

Unit VII

Soil moisture conservation, water harvesting, rain water management and its utilization for crop production.

Unit VIII

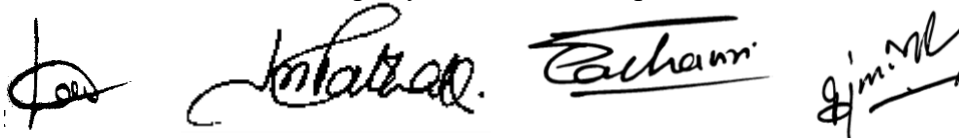
Hydroponics,

Unit IX

Water management of crops under climate change scenario.

Practical

- Determination of Field capacity by field method
- Determination of Permanent Wilting Point by sunflower pot culture technique
- Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus
- Determination of Hygroscopic Coefficient
- Determination of maximum water holding capacity of soil
- Measurement of matric potential using gauge and mercury type tensiometer • Determination of soil-moisture characteristics curves
- Determination of saturated hydraulic conductivity by constant and falling head method
- Determination of hydraulic conductivity of saturated soil below the water table by auger hole method
- Measurement of soil water diffusivity
- Estimation of unsaturated hydraulic conductivity
- Estimation of upward flux of water using tensiometer and from depth ground water table
- Determination of irrigation requirement of crops (calculations)
- Determination of effective rainfall (calculations)
- Determination of ET of crops by soil moisture depletion method



- Determination of water requirements of crops
- Measurement of irrigation water by volume and velocity-area method
- Measurement of irrigation water by measuring devices and calculation of irrigation efficiency
- Determination of infiltration rate by double ring infiltrometer

Course Title : Experimental Designs

Course Code : STAT-511

Credit Hours : 3(2+1)

THEORY

UNIT I:

Need for designing of experiments, characteristics of a good design. Basic principles of designs randomization, replication and local control.

UNITII:

Uniformity trials, size and shape of plots and blocks, Analysis of variance, completely randomized design, randomized block design and Latin square design.

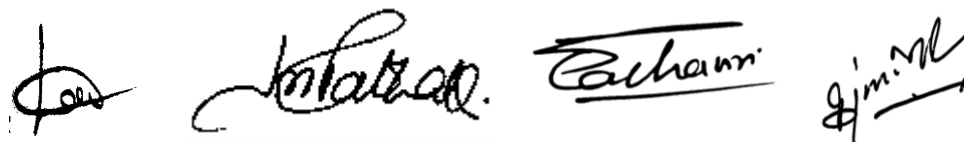
UNITIII: Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

UNITIV:

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

PRACTICAL

Uniformity trial data analysis, formation of plots and blocks, Fair field Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments; Analysis with missing data; Split plot and strip plot designs.



Course Title : Intellectual Property and Its Management in Agriculture

Course Code : PGS 503

Credit Hours : 1(1+0)

THEORY

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

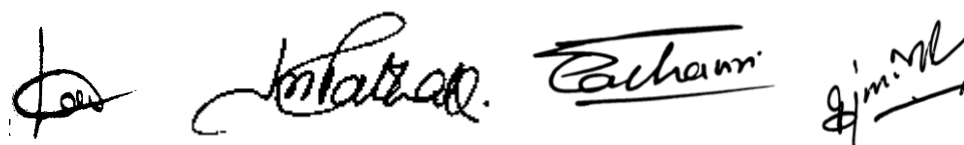
Course Title : Basic Concepts in Laboratory Techniques

Course Code : PGS 504

Credit Hours : 1(0+1)

PRACTICAL

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.



3rd Semester

- I. Course Title : Soil Biology and Biochemistry**
II. Course Code : Soil 506
III. Credit Hours : 2+1
IV. Aim of the course : 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.
V. Theory

Unit I

Soil biota, soil microbial ecology, types of organisms indifferent soils; soil microbial biomass; microbial interactions; un-culturable soil biota.

Unit II

Microbiology and biochemistry of root-soil interface; phyllosphere; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora; Root rhizosphere and PGPR.

Unit III

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, microbiology and biochemistry of decomposition of carbonaceous and protenaceous materials, cycles of important organic nutrients.

Unit IV

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

Unit V

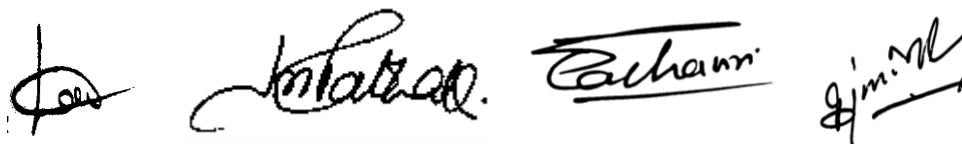
Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost.

Unit VI

Biofertilizers—definition, classification, specifications, method of production and role in crop production; FCO specifications and quality control of biofertilizers.

Unit VII

Biological indicators of soil quality; bioremediation of contaminated soils; microbial transformations of heavy metals in soil; role of soil organisms in pedogenesis important mechanisms and controlling factors; soil genomics and bioprospecting; soil



sickness due to biological agents; xenobiotics; antibiotic production in soil.

Practical

- Determination of soil microbial population
- Soil microbial biomass carbon
- Elemental composition, fractionation of organic matter and functional groups
- Decomposition of organic matter in soil
- Soil enzymes

- I. **Course Title** : **Analytical Technique and Instrumental Methods in Soil and Plant Analysis**
- II. **Course Code** : **Soil 510**
- III. **Credit Hours** : **0+2**
- IV. **Aim of the course**

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

Practical

Unit I

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

Unit II

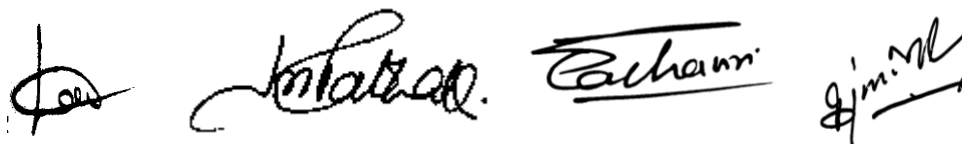
Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.

Unit III

Principles of visible, ultra violet and infrared spectrophotometry, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry and X-ray diffractometry; identification of minerals by X-ray by different methods, CHNS analyzer.

Unit IV

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



Unit V

Wet digestion/fusion/extraction of soil with aquaregia with soil for elemental analysis; triacid/di-acid digestion of plant samples; determination of available and total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in soils; determination of total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in plants

Unit VI

Drawing normalized exchange isotherms; measurement of redox potential.

- I. Course Title : Management of Problem Soils and Water**
- II. Course Code : Soil 511**
- III. Credit Hours : 2+1**
- IV. Aim of the course**

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 degraded soils; origin and basic concept of problematic soils, and factors responsible.

Unit II

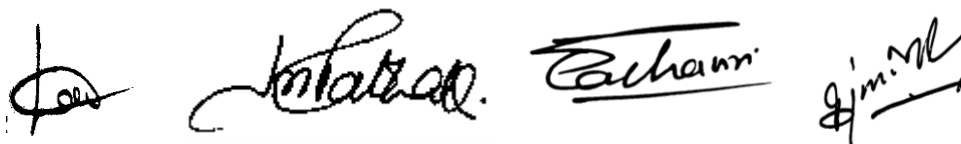
Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils-soluble salts, ESP, pH; physical, chemical and microbiological properties.

Unit III

Management of salt-affected soils; salt tolerance of crops- mechanism and ratings; salt stress meaning and its effect on crop growth, monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dryland soils.

Unit IV

Acid soils-nature of soil acidity, sources of soil acidity; effect on plant growth, lime

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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 water use and quality. Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters.

Practical

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

Course Title : Principles and Practices of Organic Farming

Course Code : AGRON 513

Credit Hours : 2+1

Aim of the course : To study the principles and practices of organic farming for sustainable crop production.

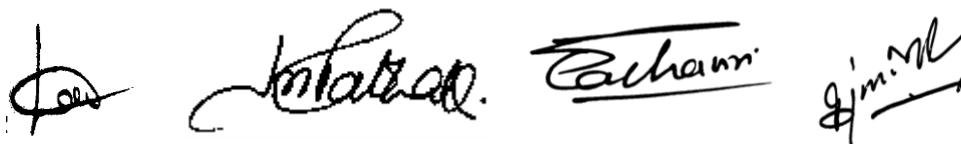
Theory

Unit I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organics and farming standards; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.

Unit II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms



and vermicompost, green manures, bio-fertilizers and biogas technology.

Unit III

Farming systems, selection of crops and crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit IV

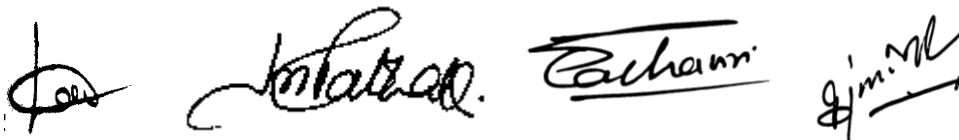
Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

Unit V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

- Method of making compost by aerobic method
- Method of making compost by anaerobic method
- Method of making vermicompost
- Identification and nursery raising of important agro-forestry trees and trees for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures in field
- Visit to a biogas plant
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

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Course Title : Principles of Plant Physiology I - Plant Water Relations and Mineral Nutrition

Course Code : PP 501

Credit Hours : 3 (2+1)

Theroy

Block 1: Plant Water Relations

Unit 1:

Soil and Plant Water Relations Water and its importance; Molecular structure of water; Properties and functions of water. Concept of water potential; Plant cell and soil water potential and their components; Methods to determine cell and soil water potential; Concept of osmosis and diffusion. Soil physical properties and water availability in different soils; Basic Sciences: Plant Physiology Water holding capacity and approaches to improve WHC; Concept of FC and PWP; Water holding polymers and their relevance.

Unit 2:

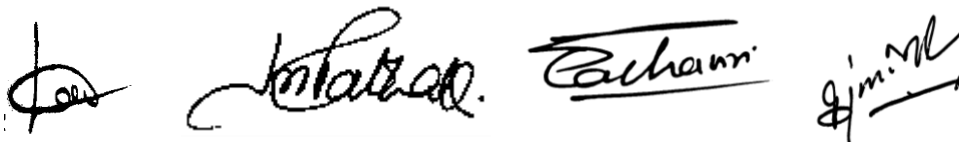
Water Absorption and Translocation Root structure and functions; Root architecture and relevance in water mining; Mechanism of water absorption and translocation; Theories explaining water absorption and translocation; Aquaporins. Mycorrhizal association and its relevance in water mining.

Unit 3:

Transpiration and Evaporative Cooling Evaporation and transpiration; relevance of transpiration; factors regulating transpiration; Measurement of transpiration; approaches to minimize evaporation and transpiration; Concept of CCATD and its relevance. Energy balance: Solar energy input and output at crop canopy level. Stomata- its structure, functions and distribution; Molecular mechanisms of stomatal opening and closing; Concept of guard cell turgidity; role of K and other osmolytes; role of ABA in stomatal closure; Guard cells response to environmental signals; Signaling cascade associated with stomatal opening and closure. Antitranspirants and their relevance in agriculture.

Unit 4:

Water Productivity and Water Use Efficiency WUE and its relevance in water productivity; Transpiration efficiency, a measure of intrinsic WUE; Approaches to measure WUE;

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Stomatal and mesophyll regulation on WUE; Passioura's yield model emphasizing WUE.

Unit 5:

Moisture Stress and Plant Growth Physiology of water stress in plants; Effect of moisture stress at molecular, cellular, organ and plant level. Drought indices and drought tolerance strategies. Drought tolerance traits.

Block 2: Mineral Nutrition

Unit 1:

Nutrient Elements and Their Importance Role of mineral nutrients in plant's metabolism; Essential elements and their classification; Beneficial elements; factors influencing the nutrients availability; critical levels of nutrients. Functions of mineral elements in plants. Deficiency and toxicity symptoms in plants.

Unit 2:

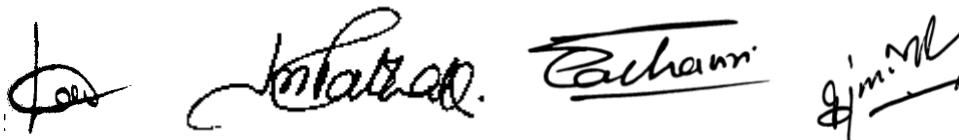
Nutrient Acquisition Mechanism of mineral uptake and translocation; Ion transporters; genes encoding for ion transporters; localization of transporters; xylem and phloem mobility; Nutrient transport to grains at maturity; Strategies to acquire and transport minerals under deficient levels. Role of mycorrhiza, root exudates and PGPRs in plant nutrient acquisition.

Unit 3:

Concept of Foliar Nutrition Foliar nutrition; significance and factors affecting total uptake of minerals; Foliar nutrient droplet size for effective entry; role of wetting agents in entry of nutrients.

Practicals:

- Standard solutions and preparation of different forms of solutions
- Studies on the basic properties of water
- Demonstration of surface tension of water and other solvents
- Measurement of plant water status: Relative water content and rate of water loss
- Determination of water potential through tissue volume and Chardakov's test
- Determination of water potential using pressure bomb, osmometer, psychrometer

Four handwritten signatures in black ink, likely belonging to the authors or reviewers of the document. The signatures are stylized and difficult to read, but they appear to be written in a cursive or semi-cursive script.

- Determination of soil moisture content and soil water potential
- Use of soil moisture probes and soil moisture sensors
- Measurement of transpiration rate in plants; use of porometry
- Measurement of CCATD and its relevance
- Demonstration and use of anti-transpirants to reduce transpiration
- Influence of potassium and ABA on stomatal opening and closing respectively
- Deficiency and toxicity symptoms of nutrients
- Effect of water stress on plant growth and development

Course Title: Agricultural Research, Research Ethics and Rural Development Programmes

Code code: PGS: 505

Course credit: 1(1+0)

Theory

UNIT I:

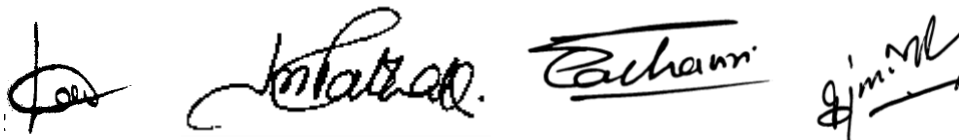
History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II:

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III:

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group Area Specific Programme, Integrated Rural



Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Course Title : Master's Research (Thesis/Dissertation)
Code code : Soil 599
Course credit : 10

4th Semester

Course Title : Master seminar
Code code : Soil 591
Course credit : 1(1+0)

**Course Title : Master's Research (Thesis/Dissertation/
Thesis Report/ Viva-Voce Examination)**
Code code : Soil 599
Course credit : 20

