Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj

PG Degree Programme Syllabus as per ICAR

M. Sc. (Ag.) Soil Science

Department of Soil Science

Session: 2023-2024 onwards

- **Programme Structure**
- **Programme Outcomes (POs)**
- **Course Outcomes (COs)**
- **Detailed Syllabus (Course Contents)**

Contents

Framework of the courses

The following nomenclature and Credit Hrs. need to be followed while providing thesyllabus for all the disciplines

Courses	Credits
Major courses	20
Minor courses	08
Supporting courses	06
Common courses	05
Seminar	01
Thesis	30
Total	70

M. Sc. (Ag.) Soil Science Semester wise

Semester I

					EVALUATION (MM-100)		
					INTERNAL		EXTERNAL
Course Code	**Title of the Course**	**Type**	**Credits**	**T/P**	**CIE**	**PRACTICAL**	**ETE**
SOIL -504	Soil Mineralogy, Genesis and Classification	Major	3(2+1)	**T/P**	30	20	50
SOIL-510	Analytical Technique and Instrumental Methods in Soil and Plant Analysis	Major	2(0+2)	**P**	40+10*	50	00
PGS-501	Technical Writing and Communication Skills	Common	1(0+1)	**P**	40+10*	50	00
PGS-502	Library and Information services	Common	1(0+1)	**P**	40+10*	50	00
PP-501	Principles of Plant Physiology-I: Plant Water Relations and Mineral Nutrition	Minor	3(2+1)	**T/P**	30	20	50
HORT-521	Subtropical and Temperate Fruit Production						
HORT-514	Landscaping & Ornamental Garding	Minor	3(2+1)	**T/P**	30	20	50
PL PATH-510	Ecology of Soil Borne Plant Pathogens						

1. Select any two from PP-501, HORT-514, HORT-521 & PL PATH-510.
2. Minor course is taken from allied programme.

Semester II

					EVALUATION (MM-100)		
					INTERNAL		EXTERNAL
Course Code	**Title of the Course**	**Type**	**Credits**	**T/P**	**CIE**	**PRACTICAL**	**ETE**
SOIL -501	Soil Physics	Major	3(2+1)	**T/P**	30	20	50
SOIL -502	Soil Fertility & Fertilizer Use	Major	3(2+1)	**T/P**	30	20	50
STAT-511	Experimental Designs	Supporting	3(2+1)	**T/P**	30	20	50
STAT-502	Statistical Method for Applied Science						
PGS-503	Intellectual Property and its Management in Agriculture	Common	1(1+0)	**T**	40+ 10*	00	50
PGS-504	Basic Concepts in Laboratory Techniques	Common	1(0+1)	**P**	40+ 10*	50	00
AGM-502	Fundaments of Agricultural Meteorology	Minor	2(1+1)	**T/P**	30	20	50
AEC-502	Agricultural Production Economics						

1. Select any one from STAT-511 & 502.
2. Select any one from AGM-502 & AEC-502.
3. Minor course is taken from allied programme.

Semester III

					EVALUATION (MM-100)		
					INTERNAL		EXTERNAL
Course Code	**Title of the Course**	**Type**	**Credits**	**T/P**	**CIE**	**PRACTICAL**	**ETE**
SOIL -503	Soil Chemistry	Major	3(2+1)	**T/P**	30	20	50
SOIL -506	Soil Biology & Biochemistry	Major	3(2+1)	**T/P**	30	20	50
SOIL -505	Soil Erosion and Conservation	Major	3(2+1)	**T/P**	30	20	50
MCA-501	Computer Fundamentals and Programming	Supporting	3(2+1)	**T/P**	30	20	50
COMP	Computer Application for Agri-business & Economics						
PGS-505	Agriculture Research, Research Ethics and RuralDevelopment	Common	1(1+0)	**T**	40+10*	00	50

1. Select any one from MCA-501 & COMP.
2. Minor course is taken from allied programme.

Semester IV

Course Code	Title of the Course	Type	Credits	Internal	External
SOIL-591	Seminar	Compulsory	1(0+1)	100	-
SOIL-599	Thesis	Compulsory	30 (0+30)	-	100

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Thesis Guidelines:

1st Semester- a Supervisor/Advisor and a Topic/title allotment for his/her thesis.

2nd & 3rd Sem.-Synopsis presentation, Research field allotment, experimentation data collection etc.

4th Sem.- Seminar, Data Analysis, Thesis writing, Pre-submission, and Thesis Evaluation.

Criteria for Thesis Evaluation

1. Synopsis: There will be a research advisory committee also called (SAC) student advisory committee, at institutions level.
2. Synopsis presentation will be conducted in presence of SAC members sixty percent of members will form the quorum SAC members.
3. The research advisor of Student shall be convenor of this committee. This committee will have following responsibilities:
   I. To review the research title and finalize the topic of research.
   II. To guide the student to build up the study design and research methodology of research.
   III. To periodically review and guide in the progress of research work of the students.
4. There will be pre- submission presentation by the student before SAC at institution level.
5. After incorporation of suggestion final thesis will be submitted to the university for evaluation
6. Pannal of external & internal examiner will be appointed by the university.
7. The place of final presentation viva voice examination will be decided by the university.

Note:

- Total credits to be earned by a student for completion of the PG program: 40+30 (Master's research) =70
- Total Master's/Research credits [30(0+30)] can be completed in any two or more semesters depending upon university research progress committee.

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Detailed Syllabus:

Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Soil Mineralogy, Genesis, and Classification		
Course Code: SOIL-504	**Course Title: Soil Mineralogy, Genesis, and Classification**	
Credits: 3(2+1)	**Major Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1. Fundamentals of Crystallography and Coordination Theory: Students will have a solid understanding of the fundamentals of crystallography, including concepts such as space lattice, coordination theory, isomorphism, and polymorphism. They will be able to apply these principles to analyze and describe the structure of minerals.

Co2. Clay Minerals - Classification, Structure, and Properties: Students will be well-versed in the classification, structure, chemical composition, and properties of clay minerals. They will gain insights into the genesis and transformation of both crystalline and non-crystalline clay minerals. Additionally, students will learn identification techniques for clay minerals and non-crystalline silicate minerals. They will explore the presence and significance of clay minerals in Indian soils and their role in plant nutrition.

Co3. Amorphous Soil Constituents and Identification: Students will have a deep understanding of amorphous soil constituents and other non-crystalline silicate minerals, along with techniques for their identification. They will recognize the importance of these constituents in soil composition and properties.

Co4. Soil Formation and Weathering: Students will learn about the factors of soil formation, various soil formation models, and the processes involved in soil formation. They will understand the weathering of rocks, mineral transformations, and the development of soil profiles, with specific reference to Indian soils.

Co5. Soil Classification and Taxonomy: Students will comprehend the concept of a soil individual and the historical development of soil classification systems. They will explore modern systems of soil classification, with a special emphasis on soil taxonomy. Students will recognize the utility of soil classification, mineralogy, and soil maps in understanding and characterizing soils. Upon completing this course, students will be equipped with the knowledge and skills necessary to analyze soil mineral composition, formation processes, and classification. They will also understand the practical applications of this knowledge in agriculture, geology, and environmental science.

Unit	Course Content
I	Fundamentals of crystallography, space lattice, coordination theory, isomorphism, and polymorphism.

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.
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.
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.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Soil Mineralogy, Genesis, and Classification		
Course Code: SOIL-502	**Course Title: Soil Mineralogy, Genesis, and Classification**	
Credits: 3(2+1)	**Major Course**	**Practical**

Unit	Course Content
I	Separation of sand, silt, and clay fraction from soil.
II	Determination of specific surface area and CEC of clay.
III	Identification and quantification of minerals in soil fractions.
IV	Morphological properties of soil profile in different land forms.
V	Classification of soils using soil taxonomy.
VI	Calculation of weathering indices and its application in soil formation.
VII	Grouping soils using available database in terms of soil quality.

Reference Books:

Brady NC and Weil RR. 2002.	The Nature and Properties of Soils. 13th Ed. Pearson Edu.
Buol EW, Hole ED, MacCracken RJ and Southard RJ. 1997.	Soil Genes and Classification. 4th Ed. Panima Publ.
Dixon JB and 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. New Delhi
Sehgal J. 2002.	Pedology - Concepts and Applications. Kalyani.
USDA. 1999.	Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.
Wade FA and Mattox RB. 1960.	Elements of Crystallography and Mineralogy. Oxford & IBH.
Wilding LP and Smeck NE. 1983.	Pedogenesis and Soil Taxonomy: II. The Soil Orders. Elsevier.
Wilding NE and Holl GF. (Eds.). 1983.	Pedogenesis and Soil Taxonomy. I.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Analytical Technique and Instrumental Methods in Soil and Plant Analysis		
Course Code: SOIL-510	**Course Title: Analytical Technique and Instrumental Methods in Soil and Plant Analysis**	
Credits: 2(0+2)	**Major Course**	**Practical**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
C07.
Co8.

Unit	Course Content
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.
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.
III	Principles of visible, ultra violet 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, CHNS analyzer.
IV	Electrochemical titration of clays; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity.
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
VI	Drawing normalized exchange isotherms; measurement of redox potential.

Reference Books:	
Hesse P. 971.	Textbook of Soil Chemical Analysis. William Clowes & Sons.
Jackson ML. 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 AL, Miller RH and Keeney DR. 1982.	Methods of Soil Analysis. Part II. SSSA, Madison.
Piper CE.	Soil and Plant Analysis. Hans Publ.
Singh D, Chhonkar PK and 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.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Principles of Plant Physiology-I Plant Water Relation and Mineral Nutrition		
Course Code: PP-501	**Course Title: Principles of Plant Physiology-I Plant Water Relation and Mineral Nutrition**	
Credits: 3(2+1)	**Minor Course**	**Theory**

Unit	Course Content
I	**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; Water holding capacity and approaches to improve WHC; Concept of FC and PWP; Water holding polymers and their relevance.
II	**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
III	**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. Anti transpirants and their relevance in agriculture.
IV	**Water Productivity and Water Use Efficiency** WUE and its relevance in water productivity; Transpiration efficiency, a measure of intrinsic WUE; Approaches to measure WUE; Stomatal and mesophyll regulation on WUE; Passioura's yield model emphasizing WUE.
V	**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.
VI	**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.
VII	**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.
VIII	**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.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Principles of Plant Physiology-I Plant Water Relation and Mineral Nutrition		
Course Code: PP-501	**Course Title: Principles of Plant Physiology-I Plant Water Relation and Mineral Nutrition**	
Credits: 3(2+1)	**Major Course**	**Practical**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
C07.
Co8.

Unit	Course Content
I	Standard solutions and preparation of different forms of solutions
II	Studies on the basic properties of water
III	Demonstration of surface tension of water and other solvents
IV	Determination of water potential through tissue volume and Chardakov's test
V	Determination of water potential using pressure bomb, osmometer, psychrometer
VI	Determination of soil moisture content and soil water potential
VII	Use of soil moisture probes and soil moisture sensors
VIII	Measurement of transpiration rate in plants; use of porometry
IX	Measurement of CCATD and its relevance
X	Demonstration and use of anti-transpirants to reduce transpiration
XI	Influence of potassium and ABA on stomatal opening and closing respectively
XII	Deficiency and toxicity symptoms of nutrients
XIII	Effect of water stress on plant growth and development

Reference Books:

Hodson RC and J Acuff. 2006.	Water transport in plants: anatomy and physiology. Pages 163-183, Tested Studies for Laboratory Teaching, Volume 27 (M.A. O'Donnell, Editor).
Pandey R. 2015.	Mineral Nutrition of Plants.
Barker AV and DJ Pilbeam. 2015.	Handbook of Plant Nutrition, Second Edition. Books in Soils, Plants, and the Environment Series, the 2nd Edition, CRC Press.
Vatansever R, Ozyigit II and Filiz E. 2017.	Essential and beneficial trace elements in plants,
Taiz T, Zeiger E and Max Mller IM, 2018.	Fundamentals of Plant Physiology
Taiz L and Zeiger E. 2015.	Plant Physiology and development.6th Ed
Salisbury FB and Ross C. 1992.	Plant Physiology (4th Ed.)
Epstein E and Bloom AJ. 2004.	Mineral nutrition of plants: principles and perspectives.2nd Ed.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Ecology of Soil Borne Plant Pathogens		
Course Code: PL PATH-510	**Course Title: Ecology of Soil Borne Plant Pathogens**	
Credits: 3(2+1)	**Minor Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
C07.
Co8.

Unit	Course Content
I	Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Interaction of microorganisms.
II	Types of biocontrol agents. Inoculum potential and density in relation to host and soil variables, competition, predation, antibiosis and fungistasis. Conducive and suppressive soils.
III	Biological control- concepts and potentialities for managing soil borne pathogens. Potential of *Trichoderma* and fluorescent *Pseudomonas* in managing plant diseases.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Ecology of Soil Borne Plant Pathogens		
Course Code: PL PATH-510	**Course Title: Ecology of Soil Borne Plant Pathogens**	
Credits: 3(2+1)	**Minor Course**	**Practical**

Unit	Course Content
I	Quantification of rhizosphere and rhizoplane microflora with special emphasis on pathogens;
II	Pathogenicity test by soil and root inoculation techniques, correlation between inoculum density of test pathogens and disease incidence, demonstration of fungistasis in natural soils;
III	Suppression of test soil-borne pathogens by antagonistic microorganisms;
IV	Isolation and identification of different biocontrol agents
V	Study of various plant morphological structures associated with resistance, testing the effect of root exudates and extracts on spore germination and growth of plant pathogens;
VI	Estimating the phenolic substances, total reducing sugars in susceptible and resistant plants;
VII	Estimating the rhizosphere and root tissue population of microorganisms (pathogens) in plants.

Reference Books:

Baker KF and Snyder WC. 1965.	Ecology of Soil-borne Plant Pathogens. John Wiley, New York.
Mondia JL and Timper P 2016.	Interactions of microfungi and plant parasitic nematodes. In: Biology of Microfungi (De-Wei-Lei Ed.). Springer Publications
Cook RJ and Baker KF. 1983.	The Nature and Practice of Biological Control of Plant Pathogens. APS, St Paul, Minnesota.
Hillocks RJ and Waller JM. 1997.	Soil-borne Diseases of Tropical Crops. CABI, Wallington
Garret SD. 1970.	Pathogenic Root-infecting Fungi. Cambridge Univ. Press,Cambridge, New York.
Parker CA, Rovira AD, Moore KJ and Wong PTN. (Eds). 1983.	Ecology and Management of Soil-borne Plant Pathogens. APS, St. Paul, Minnesota.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Technical Writing and Communications Skills		
Course Code: PGS-501	**Course Title: Technical Writing and Communications Skills**	
Credits: 1(0+1)	**Common Course**	**Practical**

Course Outcomes: After completion of the course, Student will be able to:

Co1. Acquired the skills and knowledge necessary to excel in various forms of scientific writing. They will be proficient in crafting theses, technical papers, reviews, manuals, and other types of scientific documents. Students will have a deep understanding of the specific conventions, formats, and styles associated with each type of scientific writing. They will also be equipped with the ability to effectively communicate complex scientific concepts, research findings, and technical information to diverse audiences. This proficiency in scientific writing will enable students to contribute to academic and professional discourse, disseminate their research, and excel in their scientific careers."

Co2. Thesis and Research Communication will be able to compose various components of a thesis, including the title page, authorship details, table of contents, preface, introduction, literature review, methodology section, presentation of experimental results, and discussion. They will have the competence to structure and organize these components effectively, ensuring a coherent and logical flow of information in their research documents.

Co3. Writing Skills will be proficient in writing abstracts, summaries, précis, and citations with precision and clarity. They will demonstrate the ability to summarize complex research findings concisely and accurately for different audiences and purposes.

Co4. Abbreviations Usage will be familiar with commonly used abbreviations in theses and research communications, using them appropriately and consistently throughout their documents.

Co5. Visual Communication will possess the skills to incorporate illustrations, photographs, and drawings into their documents, accompanied by suitable captions for clear explanation. They will be proficient in pagination and numbering of tables and illustrations for easy reference and comprehension.

Co6. Numerical Representation will be able to present numbers and dates in scientific write-ups following established conventions and guidelines, ensuring consistency and accuracy.

Co7. Editing and Proofreading: Students will excel in the critical tasks of editing and proofreading, ensuring the correctness, coherence, and readability of their scientific documents.

Co8. Review Article Writing will have the ability to synthesize existing research effectively and write comprehensive review articles that critically analyze and summarize scientific literature.

Co9. Communication Skills: Students will demonstrate proficiency in grammar, including tenses, parts of speech, clauses, and the appropriate use of punctuation marks. They will be skilled in error analysis, identifying and rectifying common writing errors, and achieving concord and collocation in their writing. Students will become familiar with phonetic symbols and transcription, enhancing their pronunciation and phonetic transcription abilities.

Co10. Accentual Patterns and Weak Forms will master accentual patterns and recognize weak forms in connected speech, improving their listening and spoken communication skills.

Co11. Group Discussion and Interview Skills will be effective participants in group discussions, demonstrating the ability to engage in meaningful dialogues and debates. They will be well-prepared to face

interviews confidently, presenting their ideas, experiences, and qualifications effectively.
Co12. Presentation Skills will have the capacity to deliver compelling and well-structured presentations of scientific papers, effectively conveying complex research findings to an audience. Overall, this course will equip students with a comprehensive skill set in scientific writing, communication, and presentation, enhancing their ability to communicate and disseminate research effectively in academic and professional settings.

Unit	Course Content
I	Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.
II	Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results, and discussion).
III	Writing of abstracts, summaries, précis, citations, etc.
IV	Commonly used abbreviations in the theses and research communications.
V	Illustrations, photographs, and drawings with suitable captions; pagination, numbering of tables and illustrations.
VI	Writing of numbers and dates in scientific write-ups.
VII	Editing and proof-reading.
VIII	Writing of a review article.
IX	Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
X	Error analysis (Common errors), Concord, Collocation, Phonetic symbols, and transcription;
XI	Accentual pattern: Weak forms in connected speech.
XII	Participation in group discussion.
XIII	Facing an interview.
XIV	Presentation of scientific papers.

Reference Books:

Barnes and Noble. Robert C. (Ed.). 2005.	Spoken English: Flourish Your Language.
Chicago Manual of Style. 14th Ed. 1996.	Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995	
Harper Collins. Gordon HM and Walter JA. 1970.	Technical Writing. 3rd Ed.
Holt, Rinehart and Winston. Hornby AS. 2000.	Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
James HS. 1994.	Handbook for Technical Writing. NTC Business Books.

Joseph G. 2000.	MLA **Handbook for Writers of Research Papers. 5th Ed. Affiliated** East-West Press.
Mohan K. 2005.	Speaking English Effectively. MacMillan India.
Richard WS. 1969.	Technical Writing.
Sethi J and Dhamija PV. 2004.	Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
Wren PC and Martin H. 2006.	High School English Grammar and Composition. S. Chand & Co.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-I
Subject: Library and Information Services		
Course Code: PGS-502	**Course Title: Library and Information Services**	
Credits: 1(0+1)	**Common Course**	**Practical**

Course Outcomes: After completion of the course, Student will be able to:

Co1. Introduction to Library and Services will help to be familiar with the fundamental functions and services offered by libraries, including lending services, reference assistance, and access to physical and digital collections.
Co2. Role of Libraries in Education and Research will help to understand the vital role that libraries play in supporting education, research, and the transfer of technology and knowledge within academic and professional contexts.
Co3. Classification Systems and Organization will help to be proficient in library classification systems and the organization of library materials, enabling them to locate resources efficiently.
Co4. Sources of Information will help to distinguish between primary sources, secondary sources, and tertiary sources, and recognize their importance in academic and research contexts.
Co5. Abstracting and Indexing Services will help to navigate abstracting and indexing services such as Science Citation Index, Biological Abstracts, Chemical Abstracts, and CABI Abstracts, gaining expertise in accessing and using these databases for research purposes.
Co6. Reference Source Retrieval will help to be skilled in retrieving information from various reference sources, including dictionaries, encyclopedias, handbooks, and other specialized references.
Co7. Literature Survey will help to be capable of conducting literature surveys to identify relevant research and gather information from existing scholarly works.
Co8. Citation Techniques and Bibliography Preparation, they will understand and apply citation techniques, ensuring the proper attribution of sources in their research work. They will also learn to prepare bibliographies in recognized citation styles.
Co9. Use of Digital Resources, Students will proficiently use CD-ROM databases, online public access catalogues, and other computerized library services for searching, retrieving, and managing digital resources.
Co10. Internet and E-resources, Students will have the skills to effectively use the internet, including search engines, online databases, and electronic resources, for research, reference, and information retrieval.
Co11. Accessing E-resources, Students will learn various methods for accessing electronic resources and databases available through libraries, enhancing their ability to access academic journals, e-books, and research materials online. Upon completing this course, students will have a strong foundation in library and information science, equipping them with valuable skills for conducting research, accessing information, and utilizing library services effectively in their academic and professional pursuits.

Unit	Course Content
I	Introduction to library and its services.
II	Role of libraries in education, research, and technology transfer.
III	Classification systems and organization of library.

IV	Sources of information- Primary Sources, Secondary Sources and Tertiary Sources;
V	Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);
VI	racing information from reference sources; Literature survey;
VII	Citation techniques/ Preparation of bibliography.
VIII	Use of CD-ROM Databases,
IX	Online Public Access Catalogue and other computerized library services;
X	Use of Internet including search engines and its resources; E-resources access methods.

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SECOND SEMESTER

Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Soil Fertility and Fertilizer Use		
Course Code: SOIL-502	**Course Title: Soil Fertility and Fertilizer Use**	
Credits: 3(2+1)	**Major Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1. Assessing Soil Fertility Status be proficient in assessing the fertility status of major soil groups in India, using soil testing and analysis techniques to determine nutrient levels and soil health.

Co2. Nutrient Sources - Fertilizers and Manures: Students will be well-versed in the various sources of nutrients, including chemical fertilizers and organic materials like manures, and understand their roles in soil enrichment and crop nutrition.

Co3. Essential Plant Nutrients: Students will have a detailed knowledge of essential plant nutrients, their functions in plant growth, and the symptoms of nutrient deficiencies. They will also be familiar with the concepts of nutrient classification, the law of minimum and maximum, and nutrient interactions in soils and plants.

Co4. Impact of Manures and Fertilizers: Students will understand the long-term effects of manures and fertilizers on soil fertility and crop productivity, including the benefits and potential drawbacks of their application.

Co5. Nitrogen Management: Students will gain expertise in nitrogen sources, forms, immobilization, mineralization, nitrification, denitrification, and biological nitrogen fixation. They will learn about nitrogenous fertilizers and how to manage fertilizer nitrogen effectively under various soil and environmental conditions.

Co6. Phosphorus and Potassium Management: Students will comprehend the forms, reactions, and factors affecting phosphorus and potassium availability in soils. They will also learn about the behavior of phosphatic and potassium fertilizers and their management in the field.

Co7. Sulphur, Calcium, and Magnesium: Students will acquire knowledge about sulphur, calcium, and magnesium sources, forms, behavior in soils, and their roles in plant growth and human health. They will understand how to manage these nutrient fertilizers effectively.

Co8. Micronutrients and Chelates: Students will be able to determine critical limits for micronutrients in soils and plants and understand factors affecting their availability. They will also explore the role of chelates in nutrient availability.

Co9. Soil Testing and Nutrient Management: Students will become proficient in common soil testing methods used for fertilizer recommendations, establishing quantity-intensity relationships, and making informed nutrient management decisions based on soil test results.

Co10. Fertilizer Use Efficiency and Specialty Fertilizers: Students will comprehend concepts of fertilizer use efficiency, site-specific nutrient management, and integrated nutrient management. They will also understand the concept and application of specialty fertilizers and their current status in Indian agriculture.

Co11. Soil Health and Quality: Students will be able to define soil health and soil quality and recognize their importance in sustainable agriculture. They will explore methods for determining critical limits and assessing soil quality.

Co12. Evaluation and Monitoring: Students will gain the skills to evaluate soil fertility using biological methods, soil, plant, and tissue tests. They will understand the relationship between fertilizer application and long-term soil health. Upon completion of this course, students will be well-equipped to manage soil fertility, optimize nutrient management practices, and contribute to sustainable and productive agriculture through informed decision-making and soil health assessment.

Unit	Course Content
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.
II	Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation -types, mechanism, micro-organisms, and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.
III	Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behaviour 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.
IV	Sulphur - source, forms, fertilizers, and their behaviour in soils; role in crops and human health; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium, and magnesium fertilizers.
V	Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.
VI	Common soil test methods for fertilizer recommendations; quantity– Intensity relationships; soil test crop response correlations and response functions.

VII	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 uses in soils and crops of India;
VIII	Soil fertility evaluation - biological methods, soil, plant, and tissue tests; soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS
IX	Definition and concepts of soil health and soil quality; Long-term effects of fertilizers and soil quality.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Soil Fertility and Fertilizer Use		
Course Code: SOIL-502	**Course Title: Soil Fertility and Fertilizer Use**	
Credits: 3(2+1)	**Major Course**	**Practical**

Unit	Course Content
I	Soil and plant sampling and processing for chemical analysis.
II	Determination of soil pH, total and organic carbon in soil.
III	Chemical analysis of soil for total and available nutrients (major and micro).
IV	Analysis of plants for essential elements (major and micro).

Reference Books:

Brady NC and Weil RR. 2002.	The Nature and Properties of Soils. 13th Ed. Pearson Edu.
Kabata-Pendias A and Pendias H. 1992.	Trace Elements in Soils and Plants. CRC Press.
Kannaiyan S, Kumar K and Govindarajan K. 2004.	Biofertilizers Technology. Scientific Publ.
Leigh J G. 2002.	Nitrogen Fixation at the Millennium. Elsevier.
Mengel K and Kirkby EA. 1982.	Principles of Plant Nutrition. International Potash Institute, Switzerland.
Mortvedt JJ, Shuman LM, Cox FR and Welch RM. 1991.	Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.
Pierzinsky GM, Sims TJ and Vance JF. 2002.	Soils and Environmental Quality. 2nd Ed. CRC Press.
Stevenson FJ and Cole MA. 1999.	Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.
Tisdale SL, Nelson SL, Beaton JD and Havlin JL. 1999.	Soil Fertility and Fertilizers. 5th Ed. Prentice Hall of India.
Troeh FR and Thompson LM. 2005.	Soils and Soil Fertility. Blackwell.

Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj

Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Soil Physics		
Course Code: SOIL-501	**Course Title: Soil Physics**	
Credits: 3(2+1)	**Major Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Basic principles of physics applied to soils, soil as a three -phase system.
II	Soil texture, textural classes, mechanical analysis, specific surface.
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
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.
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.
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.
VII	Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

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.
IX	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.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Soil Physics		
Course Code: SOIL-501	**Course Title: Soil Physics**	
Credits: 3(2+1)	**Major Course**	**Practical**

Unit	Course Content
I	Determination of B.D, P.D and mass volume relationship of soil, Mechanical analysis by hydrometer and international pipette method,
II	Measurement of Atterberg limits, Aggregate analysis - dry and wet,
III	Measurement of soil-water content by different methods, Measurement of soil-water potential by using tensiometer and gypsum Blocks,
IV	Determination of soil-moisture characteristics curve and computation of pore-size distribution,
V	Determination of hydraulic conductivity under saturated and unsaturated conditions,
VI	Determination of infiltration rate of soil, Determination of aeration porosity and oxygen diffusion rate,
VII	Soil temperature measurements by different methods, Estimation of water balance components in bare and cropped fields.

Reference Books:

Baver LD, Gardner WH and Gardner WR. 1972.	Soil Physics. John Wiley & Sons.
Ghildyal BP and Tripathi RP. 2001.	Soil Physics. New Age International.
Indian Society of Soil Science. 2002.	Fundamentals of Soil Science. ISSS, New Delhi.
Hillel D. 2003.	Introduction to Environmental Soil Physics. Academic Press.
Lal R and Shukla MK. 2004.	Principles of Soil Physics. Marcel Dekker.
Oswal MC. 1994.	Soil Physics. Oxford & IBH.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Experimental Designs		
Course Code: STAT-511	**Course Title: Experimental Designs**	
Credits: 3(2+1)	**Supporting Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication, and local control.
II	Uniformity trials, size and shape of plots and blocks, Analysis of variance, completely randomized design, randomized block design and Latin square design.
III	Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.
IV	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.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Experimental Designs		
Course Code: STAT-511	**Course Title: Experimental Designs**	
Credits: 3(2+1)	**Supporting Course**	**Practical**

Unit	Course Content
I	Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
II	Analysis with missing data,
III	Split plot and strip plot designs.

Reference Books:

Cochran WG and Cox GM. 1957.	Experimental Designs. 2nd Ed. John Wiley.
Dean AM and Voss D. 1999.	Design and Analysis of Experiments. Springer.
Montgomery DC. 2012.	Design and Analysis of Experiments, 8th Ed. John Wiley.
Federer WT. 1985.	Experimental Designs. MacMillan.
Fisher RA. 1953.	Design and Analysis of Experiments. Oliver & Boyd.
Pearce SC. 1983.	The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Intellectual Property and Its Management in Agriculture		
Course Code: PGS-503	**Course Title: Intellectual Property and Its Management in Agriculture**	
Credits: 1(1+0)	**Common Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

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

Reference Books:

Erbisch FH and Maredia K.1998.	Intellectual Property Rights in Agricultural Biotechnology. CABI.
Ganguli P. 2001.	Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
Ministry of Agriculture, Government of India. 2004.	State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Basic Concepts in Laboratory Techniques		
Course Code: PGS-504	**Course Title: Basic Concepts in Laboratory Techniques**	
Credits: 1(0+1)	**Common Course**	**Practical**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;
II	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;
III	Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values;
IV	Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath; Electric wiring and earthing; Preparation of media and methods of sterilization;
V	Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Reference Books:

Furr AK. 2000.	CRC Hand Book of Laboratory Safety. CRC Press.
Gabb MH and Latchem WE. 1968.	A Handbook of Laboratory Solutions. Chemical Publ. Co.

Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj

Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Fundamentals of Agricultural Meteorology		
Course Code: AGM-502	**Course Title: Fundamentals of Agricultural Meteorology**	
Credits: 2(1+1)	**Minor Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Meaning and scope of agricultural meteorology; components of agricultural meteorology; role and responsibilities of agricultural meteorologists.
II	Importance of meteorological parameters in agriculture; efficiency of solar energy conversion into dry matter production; meteorological factors in photosynthesis, respiration and net assimilation; basic principles of water balance in ecosystems; soil-water balance models and water production functions.
III	Crop weather calendars; weather forecasts for agriculture at short, medium and long range levels; agromet advisories, preparation, dissemination and economic impact analysis; use of satellite imageries in weather forecasting; synoptic charts and synoptic approach to weather forecasting.
IV	Concept, definition, types of drought and their causes; prediction of drought; crop water stress index, crop stress detection; air pollution and its influence on vegetation, meteorological aspects of forest fires and their control.
V	Climatic change, green house effect, CO2 increase, global warming and their impact on agriculture; climate classification, agro-climatic zones and agro-ecological regions of India.

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Programme: M. Sc. Ag. Soil Science	Year-I	Semester-II
Subject: Fundamentals of Agricultural Meteorology		
Course Code: AGM-502	**Course Title: Fundamentals of Agricultural Meteorology**	
Credits: 2(1+1)	**Minor Course**	**Practical**

Unit	Course Content
I	Preparation of crop weather calendars
II	Development of simple regression models for weather, pest and disease relation in different crops.
III	Preparation of weather based agro-advisories
IV	Use of automated weather station (AWS)

Reference Books:

Bishnoi OP. 2007.	Principles of Agricultural Meteorology. Oxford Book Co.
Kakde JR. 1985.	Agricultural Climatology. Metropolitan Book Co.
Mahi and Kingra. 2014.	Fundamentals of agrometeorology. Kalyani publishers.
Mavi HS and Tupper. 2004.	Principles and applications of climate studies in agriculture. CRC Press
Varshneya MC and Pillai PB. 2003.	Text Book of Agricultural Meteorology. ICAR.

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Third Semester

Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Soil Erosion and Conservation		
Course Code: SOIL-505	**Course Title: Soil Erosion and Conservation**	
Credits: 3(2+1)	**Major Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	History, distribution, identification, and description of soil erosion problems in India.
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 EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation.
III	Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.
IV	Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout.
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.
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, sediment measurement

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Soil Erosion and Conservation		
Course Code: SOIL-505	**Course Title: Soil Erosion and Conservation**	
Credits: 3(2+1)	**Major Course**	**Practical**

Unit	Course Content
I	Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index
II	Computation of kinetic energy of falling rain drops
III	Computation of rainfall erosivity index (EI30) using rain gauge data
IV	Land capability classification of a watershed
V	Visits to a watershed

Reference Books:

Biswas TD and Narayanasamy G. (Eds.) 1996	Soil Management in Relation to Land Degradation and Environment. Bull. Indian Society of Soil Science No. 17.
Gurmal Singh, Venkataramanan C, Sastry G and Joshi BP. 1990.	Manual of Soil and Water Conservation Practices. Oxford & IBH.
Indian Society of Soil Science 2002.	Fundamentals of Soil Science. ISSS, New Delhi.

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Soil Chemistry		
Course Code: SOIL-503	**Course Title: Soil Chemistry**	
Credits: 3(2+1)	**Major Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Chemical (elemental) composition of the earth's crust, soils, rocks and minerals
II	Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics.
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.
IV	Ion exchange processes in soil; cation exchange- theories based on law of massaction (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorptionisotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionicactivity measurement, thermodynamics, statistical mechanics; anion and ligand exchange innersphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresisin 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.
V	Potassium, phosphate and ammonium fixation in soils covering specificand nonspecific sorption; precipitation-dissolution equilibria; Conceptof

	quantity/intensity(Q/I) relationship; step and constant-rate K; managementaspects.
VI	Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity.
VII	Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.
VIII	Chemistry and electrochemistry of submerged soils, geochemistry of micronutrients, environmental soil chemistry.

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Soil Chemistry		
Course Code: SOIL-503	**Course Title: Soil Chemistry**	
Credits: 3(2+1)	**Major Course**	**Practical**

Unit	Course Content
I	Preparation of saturation extract, measurement of pH, EC, CO, HCO, Ca, Mg, K and Na,
II	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,
III	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, (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the D (E4/E6) values at two pH values,
IV	Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm, Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved, Determination of titratable acidity of an acid soil by BaCl2-TEA method,
V	Determination of Q/I relationship of potassium, Determination of lime requirement of an acid soil by buffer method, Determination of gypsum requirement of an alkali soil.

Reference Books:

Bear RE. 1964.	Chemistry of the Soil. Oxford and IBH.
Bolt GH and Bruggenwert MGM. 1978.	Soil Chemistry. Elsevier.
Greenland DJ and Hayes MHB. 1981.	Chemistry of Soil Processes. John Wiley & Sons.
Greenland DJ and Hayes MHB.	Chemistry of Soil Constituents. John Wiley & Sons.
McBride MB. 1994.	Environmental Chemistry of Soils. Oxford University Press.
Sposito G. 1981.	The Thermodynamics of Soil Solutions. Oxford University Press.
Sposito G. 1984.	The Surface Chemistry of Soils. Oxford University Press.

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Soil Biology and Biochemistry		
Course Code: SOIL-506	**Course Title: Soil Biology and Biochemistry**	
Credits: 3(2+1)	**Major Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Soilbiota, soil microbialecology, types of organisms indifferent soils; soil microbial biomass; microbial interactions; un-culturable soilbiota.
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.
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.
IV	organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil.
V	Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost.
VI	Biofertilizers–definition, classification, specifications, method of production and role in crop production; FCO specifications and quality control of biofertilizers.
VII	Biological indicators of soil quality; bioremediation of contaminated soils; microbial transformations of heavy metals in soil; role of soil organisms inpedogenesis – important mechanisms and controlling factors; soil genomics and bioprospecting; soil sickness due to biological agents; xenobiotics; antibiotic production in soil.

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Soil Biology and Biochemistry		
Course Code: SOIL-506	**Course Title: Soil Biology and Biochemistry**	
Credits: 3(2+1)	**Major Course**	**Practical**

Unit	Course Content
I	Determination of soil microbial population
II	Soil microbial biomass carbon
III	Elemental composition, fractionation of organic matter and functional groups
IV	Decomposition of organic matter in soil
V	Soil enzymes
VI	Measurement of important soil microbial processes such as ammonification, nitrification, N2 fixation, S oxidation, P solubilization and mineralization of other micronutrients

Reference Books:

Paul EA and Clark FE.	Soil Microbiology and Biochemistry.
Lynch JM.	Soil Biotechnology
Willey JM, Linda M. Sherwood and Woolverton CJ.	Prescott's Microbiology.
Subba Rao NS.	Advances In Agricultural Microbiology.

Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj

Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Computer Fundamentals and Programming		
Course Code: MCA-501	**Course Title: Computer Fundamentals and Programming**	
Credits: 3(2+1)	**Supporting Course**	**Theory**

Course Outcomes: After completion of the course, Student will be able to:

Co1.
Co2.
Co3.
Co4.
Co5.
Co6.
Co7.
Co8.

Unit	Course Content
I	Functional units of computer, I/O devices, primary and secondary memories. Number systems: decimal, octal, binary and hexadecimal; Representation of integers, fixed and floating point numbers, Operator precedence, character representation; ASCII, Unicode.
II	Programming Fundamentals with C - Algorithm, techniques of problem solving, flowcharting, stepwise refinement; Constants and variables; Data types: integer, character, real, data types; Arithmetic expressions, assignment statements, logical expressions. Control flow
III	Arrays and structures. Pointers, dynamic memory allocations
IV	Program Structures – functions, subroutines
V	I/O operations, Program correctness; Debugging and testing of programs.

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Computer Fundamentals and Programming		
Course Code: MCA-501	**Course Title: Computer Fundamentals and Programming**	
Credits: 3(2+1)	**Supporting Course**	**Practical**

Unit	Course Content
I	Conversion of different number types;
II	Creation of flow chart, conversion of algorithm/flowchart to program;
III	Mathematical operators, operator precedence;
IV	Sequence, control and iteration;
V	Arrays and string processing;
VI	Matrix operations, Sorting, Pointers and File processing – Reading and writing text files.

Reference Books:

Balaguruswamy E. 2019.	Programming with ANSI C. Tata McGraw Hill.
Gottfried B. 2017.	Programming with C, Schaum Outline Series. Tata McGraw Hill.
Kanetkar Y. 1999.	Let Us C. BPB Publ.

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Programme: M. Sc. Ag. Soil Science	Year-II	Semester-III
Subject: Agricultural Research, Research Ethics and Rural Development Programmes		
Course Code: PGS-505	**Course Title: Agricultural Research, Research Ethics and Rural Development Programmes**	
Credits: 1(1+0)	**Common Course**	**Theory**

Unit	Course Content
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.
II	Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.
III	Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Reference Books:

Bhalla GS and Singh G. 2001.	Indian Agriculture - Four Decades of Development. Sage Publ.
Punia MS.	Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
Rao BSV. 2007.	Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
Singh K. 1998	Rural Development - Principles, Policies and Management. Sage Publ.