Rama University Uttar Pradesh, Kanpur

Ref: RU/FASAI/Soil/02 **Dated: 24-05-2019**

Faculty of Agricultural Sciences and Allied Industries

Minutes of Meeting

Boards of Studies

A meeting of Boards of Studies of M.Sc. Agriculture (Soil Science) was held on 24-05-2019 in the Director's Office. The following members were present:

1. Dr. S. P. Singh - Chairperson
2. Dr. Arun Shankar - Member
3. Dr. K. K. Mishra - Member

The following members agreed to review the minutes in Kanpur.

1. Dr. U.S. Tiwari - External Member
2. Dr. S.B. Pandey. - External Member

Agenda:

1. Action Taken Report (ATR) on Minutes of Previous Meeting.

The BOS committee confirmed the minutes of the BOS meeting held on 04-06-2018.

2. Review of the existing programs and their curricula

S. No.	Item No.	Existing	Recommendation /Action Taken
1.	**a. Unit I:** MSS 102 Soil fertility and fertilizer use	The topic 'Historical view and future of soil fertility' was not included into the syllabus.	The topic 'Historical view and future of soil fertility' was added into the syllabus
	b. Practical: MSS-	The practical 'Determination	The practical

	101 Soil Physics	of Least Limiting Water Range' of a Soil was not included into the syllabus.	'Determination of Least Limiting Water Range of a Soil was included into the syllabus.

3. Recommendation on New courses/Short term training

S. No.	Item No.	Feedback from Faculty/Student	Recommendation /Action Taken
	A.	It was suggested to remove MSS-205: 'Field Plot Techniques' from the curriculum.	MSS-205: 'Field Plot Techniques' was decided to be removed from the curriculum for the next admissions (2020) onwards.

4. Consideration of the curricula of the new programs

S. No.	Item No.	Feedback from Faculty/subject experts/Industries	Recommendation /Action Taken
		N/A	N/A

5. Review of Teaching Process/Pedagogy

S. No.	Item No.	Existing	Recommendation /Action Taken
1	---	Classical modes of teaching and evaluating.	Use of modern methods viz. Flipped classroom, project based learning and online quizzes were made compulsory for the faculties.

6. Result Analysis: --- Summary of Result Analysis of the students' performance in the semester examination was presented and it was suggested that the course instructors should conduct remedial classes for the students whose performance was not found satisfactory.

7. Feedback Analysis: --- Analysis was performed based on summary of already collected feedback from BoS members, alumini and students regarding programme objective and programme outcome. It was suggested that feed back should also be taken from the concerned parents.

8. Any other issue with the permission of the Chair: ----N/A

The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and conveyed later

S.P. Singh

(Chairman)

Encl.: Recommended Curricula attached for consideration and approval.

CC:

1. Dean
2. Registrar Office

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Faculty of Agricultural Sciences and Allied Industries

Program: M.Sc. Agriculture (Soil Science)

Report on Feedback on Curriculum by Stakeholders (2019-2020)

- The external experts reviewed the syllabus and suggested that the topics 'Determination of Least Limiting Water Range of a Soil' and 'Historical view and future of soil fertility' were not included into the syllabus and it may be updated in the respective courses.
- The alumni recommended removing MSS-205: 'Field Plot Techniques'.
- The faculty suggested that classical modes of teaching and evaluating should be supplemented by modern methods like flipped classroom, project based learning and online quizzes.

S.P. Singh

BoS Chairman

S.P. Singh

Dean/Principal

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Faculty of Agricultural Sciences and Allied Industries

Program: M.Sc. Agriculture (Soil Science)

Action Taken Report based on Feedback at BoS held on 24-05-2019

- The topics 'Determination of Least Limiting Water Range of a Soil' and 'Historical view and future of soil fertility' were added into the respective courses.
- Use of modern methods like flip classroom, project based learning and online quizzes were made compulsory for the faculties.

S.P. Singh

BoS Chairman

S.P. Singh

Dean/Principal

MSS-101: SOIL PHYSICS

	L	T	P	CR
Course objective:- To express basic information about physical soil properties and processes related to crop growth	2	0	1	3

Detail Contents

Unit 1:	**35%**
Unit 2:	**35%**
Unit 3:	**15%**
Unit 4:	**15%**

Theory

Unit-I: Scope of soil physics and its relation with other branches of soil science; soil as a three phase system. Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts. 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-II: 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. 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. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

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

Unit-IV: 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

- Mechanical analysis by pipette and international methods
- 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 • Estimation of water balance components in bare and cropped fields
- Determination of Least Limiting Water Range of a Soil

Course Learning Outcomes (CLO)
Through this course students should successfully:

- Hypothesize the basic concepts of soil physics
- Outline the physical characteristics of soils
- Illustrate the attributes of soil water and its movement
- Evaluate soil air composition, its movement and management
- Assess thermal properties of soils
- describe soil-plant-water relationship

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
CLO_4	3	2	-	1	3	3	2	-	3
CLO_5	3	2	-	1	3	3	2	-	3
CLO_6	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:- Hillel D. 1980. Fundamentals of Soil Physics. Academic Press.

Lal R & Shukla MK. 2004. Principles of Soil Physics. Marcel Dekker.

Reference books:-

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

Kirkham D & Powers WL. 1972. Advanced Soil Physics. Wiley-Interscience.

Kohnke H. 1968. Soil Physics. McGraw Hill.

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MSS- 102: SOIL FERTILITY AND FERTILIZER USE

L	T	P	CR
3	0	1	4

Course objective:- To inform students about soil fertility, and to recognize the role of fertilizers and manures in supplying plants with nutrients so that high fertilizer use efficiency is achieved.

Detail Contents

Unit 1:	**10%**
Unit 2:	**20%**
Unit 3:	**15%**
Unit 4:	**20%**
Unit 5:	**10%**
Unit 6:	**25%**

Theory

Unit-I: Historical view and future of soil fertility; soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms.

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

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

Unit-IV: Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions. Sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers.

Unit-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.

Unit-VI: Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions. Fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations; site-specific nutrient management; plant need based nutrient management; integrated nutrient management. Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

Practical

- Principles of colorimetry
- Flame-photometry and atomic absorption spectroscopy
- Chemical analysis of soil for total and available nutrients
- Analysis of plants for essential elements

Course Learning Outcomes (CLO)
Through this course students should successfully:

- Discuss soil fertility
- Analyze the role of manures and fertilizers as source of nutrients to plants
- Review nutrients' recycling in agro ecosystem
- Illustrate the critical concentration and forms of soil nutrients
- Explain the methods of soil fertility evaluation and fertilizer recommendation

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
CLO_4	3	2	-	1	3	3	2	-	3
CLO_5	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:-

Tisdale SL, Nelson SL, Beaton JD &Havlin JL. 1999. Soil Fertility and Fertilizers. 5th Ed. Prentice Hall of India.

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

Reference books:-

Kabata-Pendias A &Pendias H. 1992.Trace Elements in Soils and Plants.CRCPress.Kannaiyan S, Kumar K &

Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.

Leigh JG. 2002. Nitrogen Fixation at the Millennium. Elsevier.Mengel K &Kirkby EA. 1982.Principles of Plant Nutrition. International Potash Institute, Switzerland.

Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.

Pierzinsky GM, Sims TJ & Vance JF. 2002. Soils and Environmental Quality. 2nd Ed. CRC Press.

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MSS- 103: SOIL CHEMISTRY

L	T	P	CR
2	0	1	3

Course objective:- To present the concept of soil chemistry and to acclimate students with current advancements in soil chemistry with regard to utilizing soils as a medium for crop growth.

Detail Contents

Unit 1:	**10%**
Unit 2:	**25%**
Unit 3:	**25%**
Unit 4:	**10%**
Unit 5:	**15%**
Unit 6:	**15%**

Theory

UNIT-I: Chemical (elemental) composition of the earth's crust and soils. Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics.

UNIT-II: Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions.

UNIT-III: 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 – innersphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition.

UNIT-IV: Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects.

UNIT-V: Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity. Chemistry and electrochemistry of submerged soils.

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

Practical

• 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

• 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 Ä (E4/E6) values at two pH values

• 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

• Determination of lime requirement of an acid soil by buffer method

• Determination of gypsum requirement of an alkali soil

Course Learning Outcomes (CLO)
Through this course students should successfully:

- illustrate the chemical composition of the earth's crust and soils
- review concepts in soil chemistry
- Associate soil chemical processes with nutrient availability.

- discuss mechanisms of fixation of nutrient in soil and its impact on nutrient availability
- assess the phenomena and models of cationic and anionic exchange

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
CLO_4	3	2	-	1	3	3	2	-	3
CLO_5	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:-

Bear RE. 1964. Chemistry of the Soil. Oxford & IBH.

Bolt GH &Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.

Sposito G. 1989. The Chemistry of Soils.Oxford Univ. Press.

Reference books:-

Stevenson FJ. 1994. Humus Chemistry. 2nd Ed. John Wiley & Sons.

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

Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons.

Greenland DJ & Hayes MHB.Chemistry of Soil Constituents.John Wiley & Sons.

McBride MB. 1994. Environmental Chemistry of Soils. Oxford Univ. Press.

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

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MSS- 104: SOIL MICROBIOLOGY

L	T	P	CR
2	0	1	3

Course objective:-

To impart knowledge on role of soil microbes in nutrient recycling and to give an overview on microbial ecology-microbial habitats, their interactions and plant-microbe relationship

Detail Contents

Unit 1:	**10%**
Unit 2:	**25%**
Unit 3:	**25%**
Unit 4:	**40%**

Theory

Unit-I: Soil biota, Soil microbial ecology, types of organisms in different soils; Soil microbial biomass; Microbial interactions: unculturable soil biota.

Unit-II: Microbiology and biochemistry of root - soil interface; phyllosphere, Biofertilizers, soil enzyme activities and importance.

Unit-III: Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil. Biochemical composition and biodegradation of soil organic matter and crop residues.

Unit-IV: Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures: Biotic factors in soil development.

Practical

- Determination of soil microbial population
- Determination of Soil microbial biomass
- Determination of Decomposition studies in soil
- Determination of Soil enzymes
- Measurement of important soil microbial processes such as ammonification, nitrification.N2 fixation, S oxidation, P solubilization and mineralization of other micro-nutrients
- Study of rhizosphere effect.

Course Learning Outcomes (CLO)
Through this course students should successfully:

- describe beneficial effects of soil microorganisms on soil health and balancing the soil ecosystem
- illustrate transformation of nutrients and humic substances by soil microorganisms
- review plant-microbe interactions

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:-

Introduction to soil microbiology. 1977. Martin Alexander. John Wiley Publication.

Subba Rao N S. Soil Microbiology. Enfield Science Publishers, 1999.

Reference books:-

Stevenson FJ. 1994. Humus Chemistry. 2nd Ed. John Wiley & Sons.

Paul EA. 2007. Soil Microbiology, Ecology and Biochemistry.3rd ed. Academic Press.

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MSS-201: SOIL MINERALOGY, GENESIS AND SURVEY

L	T	P	CR
2	0	1	3

Course objective:-

To familiarize students with genesis of soil and structure

of associated minerals and impart knowledge about conduction

of soil survey and interpretation of associated data for effective land use planning.

Detail Contents

Unit 1:	**20%**
Unit 2:	**20%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit 5:	**20%**

Theory

Unit-I: Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism. Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils.

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

Unit-IV: Soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps.

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

Practical

• Identification and quantification of minerals in soil fractions

• Morphological properties of soil profile in different landforms

• Classification of soils using soil taxonomy

• Calculation of weathering indices and its application in soil formation

• Grouping soils using available data base in terms of soil quality

• Aerial photo and satellite data interpretation for soil and land use

• Cartographic techniques for preparation of base maps and thematic maps, processing of field sheets, compilation and obstruction of maps in different scales

• Land use planning exercises using conventional and RS tools

Course Learning Outcomes (CLO)
Through this course students should be able to:

- Illustrate factors and processes of soil formation.
- Assess structure and genesis of clay minerals.
- Review properties of clay minerals.
- Discuss soil classification and its importance.
- Explain soil survey and soil survey reports
- Describe major soil groups of India

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
CLO_4	3	2	-	1	3	3	2	-	3
CLO_5	3	2	-	1	3	3	2	-	3
CLO_6	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:-

Introductory pedology : soil genesis, survey and classification. 1986. Sehgal J L. Kalyani Publishers

Grim RE. 1968. Clay Mineralogy. McGraw Hill

Reference books:-

USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.

Wade FA & Mattox RB. 1960. Elements of Crystallography and Mineralogy. Harper & Brothers, New York.

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MSS-202: SOIL WATER AND AIR POLLUTION

L	T	P	CR
2	0	1	3

Course objective:- Making the students aware of the soil, water and air pollution problems involved with the use of soil for crop production.

Detail Contents

Unit 1:	**20%**
Unit 2:	**20%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit 5:	**20%**

Theory

Unit-I: Soil, water and air pollution problems associated with agriculture, nature and extent. Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.

Unit-II: Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal.

Unit-III: Pesticides – their classification, behavior in soil and effect on soil microorganisms. Toxic elements – their sources, behavior in soils, effect on nutrients availability, effect on plant and human health.

Unit-IV: Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases – carbon dioxide, methane and nitrous oxide.

Unit-V: Remediation/amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

Practical

• Sampling of sewage waters, sewage sludge, solid/liquid industrial wastes, polluted soils and plants

• Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), nitrate and ammoniacal nitrogen and phosphorus, heavy metal content in effluents

• Heavy metals in contaminated soils and plants

• Management of contaminants in soil and plants to safeguard food safety

• Air sampling and determination of particulate matter and oxides of sulphur

• Visit to various industrial sites to study the impact of pollutants on soil and Plants

Course Learning Outcomes (CLO)

Through this course students should successfully

- identify soil, water and air pollution problems
- interpret criteria of soil, water and air quality data
- assess transformations of pollutants

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	3	1	3	3	1	-	3
CLO_2	3	2	3	1	3	3	1	-	3
CLO_3	3	2	3	1	3	3	1	-	3
Average	3	2	3	1	3	3	1	-	3

Text books:-

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

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

Reference books:-

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

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MSS-203: MANAGEMENT OF PROBLEMATIC SOILS

L	T	P	CR
2	0	1	3

Course objective:-

To impart concepts of problematic soils, brackish water,

and their management with respect to crop production.

Detail Contents

Unit 1:	**15%**
Unit 2:	**35%**
Unit 3:	**25%**
Unit 4:	**25%**

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. Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.

Unit-III: Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

Unit-IV: 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 ground water and soil samples
• Determination of anions (Cl-, SO4 --, CO3 -- and HCO3 -) in ground waters and soil samples
• Lime and gypsum requirements of acid and sodic soils

Course learning outcomes (CLO)

Though this course the students should successfully:

- Examine soil quality and health
- identify distribution of Waste land and problem soils in India
- review reclamation and management of soils with physical, chemical and biological constraints
- Illustrate standards of quality of irrigation water and utilization of brackish water in agriculture.
- explain bio remediation of soils through Multipurpose tree species

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
CLO_4	3	2	-	1	3	3	2	-	3
CLO_5	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:-

Jurinak JJ. 1978. *Salt-affected Soils*. Department of Soil Science & Biometeorology. Utah State Univ.
Bear FE. 1964. *Chemistry of the Soil*. Oxford & IBH.

Reference books:-

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

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

ISSS (2009) Fundamentals of Soil Science, Div. of Soil Science, IARI, New Delhi.

Cirsan Paul, J.(1985) Principles of remote sensing. Longman, New York. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, New Delhi.

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MSS-204: Crop Physiology

L	T	P	CR
2	0	1	3

Course objective:-

To impart knowledge about crop growth, development and interaction with environment with respect to physiological processes.

Detail Contents

Unit 1:	**10%**
Unit 2:	**15%**
Unit 3:	**15%**
Unit 4:	**15%**
Unit 5:	**15%**
Unit 6:	**15%**
Unit 7:	**15%**

Theory

Unit I

Cell organelles and their physiological functions, structure and physiological functions of cell wall, cell inclusions; cell membrane structure and functions.

Unit II

Soil and plant water relations, water and its role in plants, properties and functions of water in the cell water relations-cell water terminology, water potential of plant cells. Mechanism of water uptake by roots-transport in roots, aquaporins, movement of water in plants – Mycorrhizal association on water uptake. Water loss from plants-Energy balance-Solar energy input-energy dissipation at crop canopy level- evapotranspiration, transpiration –Driving force for transpiration, plant factors influencing transpiration rate.

Unit III

Stomata structure and function – mechanism of stomatal movement, antitranspirants.

Physiology of water stress in plants: Influence of water stress at cell, organ, plant and canopy levels. Indices for assessment of drought resistance. The role of mineral nutrients in plant metabolism: Essential elements, classification based on function of elements in plants.

Unit IV

Uptake of mineral elements in plants –Mechanisms of uptake-translocation of minerals in plants.Physiological and metabolic functions of mineral elements, critical levels, deficiency symptoms, nutrient deficiency and toxicity.Foliar nutrition.

Unit V

Photosynthesis and its importance in bio productivity.Photochemical process, photochemical reactions, CO2 reduction in Calvin cycle, supplementary pathway of C fixation in C4 and CAM plants and its significance.Photorespiration and its relevance.Photosynthesis as a diffusive process, effect of environmental factors on photosynthetic rates.Synthesis of sucrose, starch, oligo and polysaccharides (composition of cell wall). Translocation of photosynthates and its importance in sink growth. Mitochondrial respiration, growth and maintenance respiration, cyanide resistant respiration and its significance.

Unit VI

Nitrogen metabolism: Inorganic nitrogen species (N2 , NO3 and NH3) and their reduction to amino acids, protein synthesis and nucleic acids. Lipid metabolism- Storage, protective and structural lipids.Biosynthesis of fatty acids, diacyl and triacyl glycerol, fatty acids of storage lipids. Secondary metabolites and their significance in plant defense mechanism. Growth and differentiation.

Unit VII

Hormonal regulation of growth and differentiation, plant growth hormones and their physiological role, synthetic growth regulators, growth retardants, apical dominance, senescence, fruit growth, abscission. Photomorphogenesis: Photoreceptors, phytochrome, cryptochrome. Physiology of flowering: Photoperiodism and vernalization.

Practicals

- Estimation of plant water status: Relative water content,water potential estimation by pressure chamber/ psychrometer
- Growth parameters: Growth parameters measurement
- Photosynthesis and related parameters:Estimation of chlorophyll/ carotenoid content, separation of photosynthetic pigment using paper chromatography, photosynthesis measurements by IRGA, respiration rate measurement.
- Amino Acid and proteins: Estimation of total free amino acids, estimation of proteins by Lowry/ Bradford method.

- Nitrogen metabolism: *In vivo* nitrate reductase activity assay, nitrogenase activity assay by gas chromatography.

Course Learning Outcomes (CLO)

Through this course students should successfully:

- distinguish physiological processes involved in the formation of seedlings
- review the factors regulating growth and developmental processes of crop plants
- evaluate strategies used by plants with repect to nutrient uptake and utilization
- Illustrate the significance of assimilate translocation and partitioning.
- Associate crop-environment interaction and crop growth, yield

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	-	-	3	3	3	-	3	2
CLO_2	3	-	-	3	3	3	-	3	2
CLO_3	3	-	-	3	3	3	-	3	2
CLO_4	3	-	-	3	3	3	-	3	2
Average	3	-	-	3	3	3	-	3	2

Text books:-

- Salisbury, F.B. and Ross, C.W. 1986. Plant Physiology, CBS Publishers & Distributors, New Delhi.
- Taize, L. and Zeiger, E. 2006. Plant Physiology. Sinauer Associates, Inc, Publishers, Sunderland, Massachusetts, USA.

Reference books:-

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MSS- 205: FIELD PLOT TECHNIQUES

L	T	P	CR
2	0	1	3

Course objective:-

To inform students about planning and designing of field experiments and analysis of experimental data.

Detail Contents

Unit 1:	**10%**
Unit 2:	**15%**
Unit 3:	**15%**
Unit 4:	**15%**
Unit 5:	**15%**
Unit 6:	**15%**
Unit 7:	**15%**

Theory

Unit I
Historical aspects, principles and practices of field experimentation

Unit II
Identification of research problem and preparation of research project proposal. Presentation of data and report writing.

Unit III
Planning of experiments, recording of data - before layout of experiment, during crop growth and after harvest. Selection of experimental design, layout of experiment, number of treatments / replications, plot size, border effect etc. Techniques for increasing the precision for an experiment.

Unit IV

Interpretation of data from weed control, irrigation, fertilizer and cropping system experiments.Interactions in factorial experiments.

Unit V

Contrast analysis, pooled analysis and data transformation. Evaluation of direct, residual and cumulative effects of treatments.

Unit VI

Correlation and regression analysis, and their application.Energetics and economic analysis.

Unit VII

Analysis of data of typical agronomic experiments. Nutrient and water balance sheets. Statistical softwares and their application.

Practicals

- Practical considerations in field experimentation.
- Analysis of data of field experiments. Use of excel in data analysis.
- Statistical analysis of data using statistical softwares.
- Calculation and interpretation of interaction of factorial experiments.
- Calculation of direct, residual and cumulative effects of treatments in cropping systems.
- Exercise on confounding designs.
- Exercise on contrast analysis.
- Exercise on data transformation. Exercise on missing plot analysis.
- Exercise on pooled analysis of data over years/locations.
- Exercise on linear regression equation.
- Exercise on quadratic regression equation.
- Exercise on computation of energy requirement in agricultural production.
- Economic analysis of field crop production.
- Exercise on determination of optimum economic dose of fertilizers.
- Exercises on interpretation of data from different types of experiments.

Course Learning Outcomes (CLO)

Through this course students should successfully:

- plan and design field experiments
- analyse experimental data of field experiments

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	-	1	-	3	1	-	1	1	-
CLO_2	-	1	-	3	1	-	1	1	-
Average	-	1	-	3	1	-	1	1	-

Text books:-

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. John Wiley and Sons, Singapore.

Rangaswamy, R.A. 2006. Text Book of Agricultural Statistics. New Age International (P) Limited, New Delhi.

Reference books:-

Clewer, A.G. and Scarisbrick, D.H. 2001. Practical Statistics and Experimental Design for Plant and Crop Science. John Wiley and Sons Ltd. West Sussex, England

Cochran, W.G. and Cox, G.M. 1992. Experimental Designs. John Wiley and Sons, Inc. Toranto, New York, USA.

DarmarajuRaghavarao. 1983. Statistical Techniques in Agricultural and Biological Research. Oxford and IBH Publishing Co. New Delhi.

Das, N.R. 2008. Agronomic Research Management. Agrotech Publishing Academy, Udaipur.

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PGS 301 HISTORY OF AGRICULTURE

L	T	P	CR
1	0	0	1

Course objective:-

To inform students about history of agriculture and developments in agriculture in pre and post independence era.

Detail Contents

Unit 1: **25%**

Unit 2: **25%**

Unit 3: **25%**

Unit 4: **25%**

UNIT-I
Agriculture in ancient India: archaeological findings and literature.

UNIT-II
Ancient literature on: farm implements, forecast of weather and rains, types of lands, manure, irrigation, seed and sowing, pests and their management, horticulture and arboriculture, cattle management etc.

UNIT-III
Agricultural research, education and extension in pre-and post-independent India. Green revolution, success, associated problems, lessons learnt.

UNIT-IV
Challenges to Indian agriculture: future needs and capabilities, environmental problems, international agriculture and partnership. Emerging scenario and expectations.

Course Learning Outcomes (CLO)

Through this course students should successfully:

- describe relevance of agricultural heritage in current times
- review developments in agriculture with time

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	2	-	2	2	-	1	-	3	1
CLO_2	2	-	2	2	-	1	-	3	1
Average	2	-	2	2	-	1	-	3	1

Text books:-

- Saxena, R.C., Choudhary, S.L. and Nene, Y.L. 2009. A Text Book on Ancient History of Indian Agriculture. Asian Agri-History Foundation, Secundarabad, 148 pp.
- Nene, Y.L. (Ed.) 2007. Glimpses of the Agricultural Heritage of India. Asian Agri-History Foundation, Secundarabad, 912 pp

Reference books:-

- Jain, H.K. 2010. The Green Revolution: History, Impact and Future. Studium Press LLc, Houston USA, 276 pp.

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MSS-302: BASIC STATISTICAL METHODS IN AGRICULTURE

L	T	P	CR
2	0	1	3

Course objective:- To impart knowledge about basic statistics and its applications to research.

Detail Contents

Unit 1: **25%**

Unit 2: **25%**

Unit 3: **25%**

Unit 4: **25%**

Theory

UNIT I

Classification, tabulation and graphical representation of data. Levels of measurement.Descriptive statistics.Theory of probability.Random variable and mathematical expectation. Probability distributions: Binomial, Poisson, Normal distributions and their applications. Concept of sampling distribution: t, $\chi 2$ and F distributions. Tests of significance based on ormal, t, $\chi 2$ and F distributions. Non-parametric tests.

UNIT II

Correlation and regression: Correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, simple and multiple linear regression model. Estimation of parameters.Coefficient of determination. Introduction to multivariate analytical tools: Principal component analysis and cluster analysis.

UNIT III

Planning of an experiment and basic principles of design of experiments. Analysis of variance. Completely randomized design (CRD), Randomized complete block design (RCBD), Latin square design (LSD). Randomization procedure, analysis and interpretation of results. Concept of factorial experiments.

UNIT IV

Planning of sample surveys. Sampling *vs* complete enumeration, Simple random sampling, Stratified sampling.

Practical

- Exercises on probability distributions.
- Correlation and regression analysis.
- Large sample tests, testing of hypothesis based on $\chi 2$, t and F.
- Exercises on non-parametric tests.

- Principal component analysis and cluster analysis.
- Analysis of data obtained from CRD, RBD, LSD.
- Analysis of data of factorial experiments.
- Selection of a random sample, estimation using simple random sampling.
- Exercises on stratified sampling.

Course learning outcomes (CLO)

Through this course students should successfully:

- Illustrate the basics of statistical theory used in agriculture.
- Compute and apply measures of location and measures of dispersion of data.
- Explain the different hypothesis testing methods.
- Apply the statistical techniques in agricultural experimental designs.

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1		2		3	3		2	3	1
CLO_2		2		3	3		2	3	1
CLO_3		2		3	3		2	3	1
CLO_4		2		3	3		2	3	1

Text books:-

Campbell, R.A. 1974. *Statistics for Biologists.* Cambridge University Press.

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research.* John Wiley.

Reference books:-

Wiley. Cochran, W.G. 1959. *Sampling Techniques*. John Wiley.

Das, M. N. and Giri, N.C. 1986. *Design and Analysis of Experiments.* New Age International.

Dillon, W.R. and Goldstein, M. 1984. *Multivariate Analysis: Methods and Applications.* John Wiley.

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MSS-303: LIBRARY AND INFORMATION SERVICES

L	T	P	CR
0	0	1	1

Course objective:

To teach students the concepts and principles of library and information services

Detail Contents

Unit 1: **100%**

Unit I:

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

Course learning outcomes (CLO)

Through this course students should successfully:

- Trace information from libraries efficiently.
- Appraise the information and knowledge resources
- Illustrate on modern tools like internet, OPAC, search engines etc for information searching.

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	1	1	1	1	1	1	1	1	1
CLO_2	1	1	1	1	1	1	1	1	1
CLO_3	1	1	1	1	1	1	1	1	1
Average	1	1	1	1	1	1	1	1	1

Text books:-

Library and information science. 2004. Pandey D K. Atlantic publishers and dist.

Reference books:-

Basic research methods for librarians. Lynn Silipigni Connaway and Ronald R Powell.2010.Santa Barbara, Calif. : Libraries Unlimited.

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MSS-400: Credit Seminar

L	T	P	CR
0	0	1	1

Course objective:

Making and delivering presentation by student and holding questions and answering sessions.

Course learning outcomes (CLO)

Through this course students should successfully:

- Test their knowledge by reviewing the literature and question answer session.

  Develop their communication skills

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	2	1	-	1	1	2	-	1	1
CLO_2	2	1	-	1	1	2	-	1	1
Average	2	1	-	1	1	2	-	1	1

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MSS- 401: Comprehensive Exam and Masters Research Work and Thesis/Project

	L	T	P	CR
Course Objective:	0	0	20	20

- To evaluate the knowledge gained by student
- To enable the student to gain deeper knowledge, understanding, capabilities and attitudes in the context of the programme of study.

Course learning outcomes (CLO)

Through this course students should be able to:

- apply the theoretical information achieved during the programme
- collect and interpret data
- assess the analytical methods during the programme
- solve problems in soil science and plant nutrition

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	1	3	-	3	3	1	3	3	3
CLO_2	1	3	-	3	3	1	3	3	3
CLO_3	1	3	-	3	3	1	3	3	3
CLO_4	1	3	-	3	3	1	3	3	3
Average	1	3	-	3	3	1	3	3	3

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Programme Objectives

1. Construct and communicate knowledge to the students about soil related problems with respect to crop production.

2. Teach instrumentation and analytical techniques for analysis of physiochemical and biological properties of soil.

3. Solve problems limiting successful production of crops.

4. Associate knowledge for efficient decision-making, management, sustainable agriculture and soil science.

5. Develop skill in students for successful career in concerned departments, research institutes, industries, consultancy and NGOs, etc.

Program Outcomes

After completion of the program, the students should be able to:

1. Illustrate fundamental knowledge of different aspects of soil science

2. Validate their research skills, including soil testing, conduct of experiments and data analysis.

3. Review the environmental pollution control technologies.

4. Plan, prepare and implement projects related to plants and soil.

5. Develop skills to get job and services in the field of Teaching, Researches, Projects, Municipal Councils/Corporations, National Research Institutes/Organizations/Laboratories, NGO's and other sectors related to the field of soil science.

PROGRAM SPECIFIC OUTCOMES

After completion of the program, the students should be able to:

1. Illustrate the basic concepts of soil and its components along with their interactions with regard to crop production through study of related courses.

2. Analyze and determine soil physicochemical and biological properties using analytical and statistical techniques to resolve constrains in crop production.

3. Review different technologies from courses from programs like agronomy, crop physiology and statistics etc. to solve problems in soil science to manage soil productivity.

4. Solve problems pertaining to soil science.

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