

# Course Curriculum of PG Programme

(Major, Minor, Supporting and Non-credit courses)

**MASTER OF SCIENCE IN SOIL  
SCIENCE**

**SEMESTER-II**



**SHRI VAISHNAV INSTITUTE OF  
AGRICULTURE, INDORE**

**SHRI VAISHNAV VIDYAPEETH  
VISHWAVIDYALAYA, INDORE**



**SYLLABUS**  
**MASTER OF SCIENCE IN SOIL SCIENCE**  
**SEMESTER-II**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>CREDITS</b>
<b>MAJOR</b>		
Soil 501	Soil Physics	2+1
Soil 502	Soil Fertility and Fertilizer use	3+1
Soil 509	Soil Water and Air Pollution	2+1
<b>MINOR</b>		
Agron 502	Principles and Practices of Soil Fertility	2+1
<b>SUPPORTING</b>		
Agron 503	Principles and Practices of Weed Management	2+1
<b>NON-CREDIT</b>		
PGS 504 (e-Course)	Basic Concepts in Laboratory Techniques	0+1
PGS 505 (e-Course)	Agricultural Research, Research Ethics and Rural Development Programmes	1+0





**Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore**  
**Shri Vaishnav Institute of Agriculture**  
**M.Sc. (Ag.) Soil Science**

Course Code	Course Name	TEACHING & EVALUATION SCHEME								
		Theory			Practical		Credits			
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total	
Soils 501	Soil Physics	50	30	00	15	05	2	1	3	

**1. Legends: L - Lecture; P – Practical**

**2. \*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.**

**Objective**

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

**Course outcome**

- Upon completion of this course, students will be able to apply the knowledge about the various physical processes and properties.
- Students will be able to understand soil structure-genesis, types, characterization and management soil structure
- Students will able to use various techniques used to analyze the physical properties.

**Theory**

**UNIT I**

Basic principles of physics applied to soils, soil as a three phase system.

**UNIT II**

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

**UNIT III**

Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts. Alleviation of soil physical constraints for crop production. Soil erosion and edibility. Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

**UNIT IV**

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

**UNIT V**

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

**Practical**

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

#### **Teaching methods/activities**

Classroom teaching with AV aids, group discussion, oral presentation by students.

#### **Learning outcome**

Experience on the knowledge of soil physical properties and processes in relation to plant growth.

#### **Suggested Readings**

- Baver LD, Gardner WH & Gardner WR. 1972. *Soil Physics*. John Wiley & Sons.
- Ghildyal BP & Tripathi RP. 2001. *Soil Physics*. New Age International.
- Hanks JR & Ashcroft GL. 1980. *Applied Soil Physics*. Springer Verlag.
- Hillel D. 1972. *Optimizing the Soil Physical Environment toward Greater Crop Yields*. Academic Press.
- Hillel D. 1980. *Applications of Soil Physics*. Academic Press.
- Hillel D. 1980. *Fundamentals of Soil Physics*. Academic Press.
- Hillel D. 1998. *Environmental Soil Physics*. Academic Press.
- Hillel D. 2003. *Introduction to Environmental Soil Physics*. Academic Press.
- Indian Society of Soil Science. 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.
- Kirkham D & Powers WL. 1972. *Advanced Soil Physics*. Wiley- Interscience.
- Kohnke H. 1968. *Soil Physics*. McGraw Hill.
- Lal R & Shukla MK. 2004. *Principles of Soil Physics*. Marcel Dekker.
- Oswal MC. 1994. *Soil Physics*. Oxford & IBH.

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**M.Sc. (Ag.) Soil Science**

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
Soil 502	Soil Fertility and Fertilizer use	50	30	00	15	05	3	1	4

**1. Legends: L - Lecture; P – Practical**

**2. \*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.**

**Objective**

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

**Course outcomes**

- Describe the soil fertility and soil productivity, nutrient sources CO<sub>2</sub>
- Understand soil and fertilizer nitrogen – sources, forms and various processes involved.
- Describe fertilizer use efficiency and blanket fertilizer recommendations

**Theory**

**UNIT I**

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

**UNIT II**

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soil sand management under field conditions. Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

**UNIT III**

Sulphur - source, forms, fertilizers and their behavior in soils; role in crops and human health; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers. 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 IV**

Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions. Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; specialty fertilizers concept, need and category. Current status of specialty fertilizers uses in soils and crops of India

**UNIT V**

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

**Practical**

- Soil and plant sampling and processing for chemical analysis



- Determination of soil pH, total and organic carbon in soil
- Chemical analysis of soil for total and available nutrients(major and micro)
- Analysis of plants for essential elements(major and micro)

### **Suggested Readings**

- Brady NC & Weil RR. 2002. *The Nature and Properties of Soils*. 13<sup>th</sup> Ed. Pearson Edu.
- Kabata-Pendias A & Pendias H. 1992. *Trace Elements in Soils and Plants*. CRC Press.
- 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.
- Stevenson FJ & Cole MA. 1999. *Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients*. John Wiley & Sons.
- Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. *Soil Fertility and Fertilizers*. 5th Ed. Prentice Hall of India.
- Troeh FR & Thompson LM. 2005. *Soils and Soil Fertility*. Blackwell.

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**M.Sc. (Ag.) Soil Science and Agricultural Chemistry**

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
SOIL 508	Soil, Water and Air Pollution	50	30	00	15	05	2	1	3

**1. Legends: L - Lecture; P – Practical**

**2. \*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.**

**Objective**

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

**Course outcomes**

- Describe the soil fertility and soil productivity, nutrient sources.
- Understand soil and fertilizer nitrogen – sources, forms and various processes involved.
- Describe fertilizer use efficiency and blanket fertilizer recommendations.

**Theory**

**UNIT I**

Soil, water and air pollution problems associated with agriculture, nature and extent.

**UNIT II**

Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.

**UNIT III**

Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal. Pesticides – their classification, behavior in soil and effect on soil microorganisms.

**UNIT IV**

Toxic elements–their sources, behavior in soils, effect on nutrients availability, effect on land and human health. Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases–carbon dioxide, methane & nitrous oxide.

**UNIT V**

Risk assessment of polluted soil, 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 and their processing.
- Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), measurement of coliform (MPN), 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 safe guard food safety.
- Air sampling and determination of particulate matter and oxides of sulphur, NO<sub>2</sub> and O<sub>2</sub> conc.
- Visit to various industrial sites to study the impact of pollutants on soil and plants.

**Teaching methods/activities**

Classroom teaching with AV aids, group discussion, oral presentation by students.

**Learning outcome**

Management of soil and water pollution

## Suggested Readings

- Lal R, Kimble J, Levine E & Stewart BA. 1995. *Soil Management and Greenhouse Effect*. CRC Press.
- Middlebrooks EJ. 1979. *Industrial Pollution Control*. Vol. I. *Agro- Industries*. John Wiley Interscience. Ross SM. *Toxic Metals in Soil Plant Systems*. John Wiley & Sons.
- Vesilund PA & Pierce 1983. *Environmental Pollution and Control*. Ann Arbor Science Publ.

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment *	END SEM University Exam	Teachers Assessment *	L	P	Total
<b>Agron 502</b>	<b>Principle and Practices of Soil Fertility</b>	<b>50</b>	<b>30</b>	<b>00</b>	<b>15</b>	<b>05</b>	<b>2</b>	<b>1</b>	<b>3</b>

**1. Legends: L - Lecture; P – Practical**

**2. \*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.**

**Course outcome:**

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

**Theory**

**UNIT I:** Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming – basic concepts and definitions.

**UNIT II:** Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

**UNIT III:** Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

**UNIT IV:** Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

**UNIT V:** Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermicompost and residue wastes in crops.

**Practical**

- Determination of soil pH, ECe, organic C, total N, available N, P, K and S in soils
- Determination of total N, P, K and S in plants
- Interpretation of interaction effects and computation of economic and optimal yield

**Suggested Readings**

- Brady NC & Weil R.R 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
- Fageria NK, Baligar VC & Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
- Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
- Yawalkar KS, Agrawal JP & Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

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Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
Agron 503	Principles and Practices of Weed Management	50	30	00	15	05	2	1	3

**1. Legends: L - Lecture; P – Practical**

**2. \*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.**

## Objective

To familiarize the students about the weeds, herbicides and methods of weed control.

## Theory

### Unit I

Weed biology, and ecology and classification, crop-weed competition including allelopathy; principles and methods of weed control and classification management; weed indices, weed shift in different eco-systems.

### Unit II

Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.

### Unit III

Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures, sequential application of herbicides, rotation; weed control through use of nano-herbicides and bio-herbicides, myco-herbicides bio-agents, and allelochemicals; movement of herbicides in soil and plant, Degradation of herbicides in soil and plants; herbicide resistance, residue, persistence and management; development of herbicide resistance in weeds and crops and their management, herbicide combination and rotation.

### Unit IV

Weed management in major crops and cropping systems; alien, invasive and parasitic weeds and their management; weed shifts in cropping systems; aquatic and perennial weed control; weed control in non-crop area.

### Unit V

Integrated weed management; recent development in weed management- robotics, use of drones and aeroplanes, organic etc., cost: benefit analysis of weed management.

## Practical

- Identification of important weeds of different crops, Preparation of a weed herbarium, Weed survey in crops and cropping systems, Crop-weed competition studies, Weed indices calculation and interpretation with data, Preparation of spray solutions of herbicides for high and low-volume sprayers, Use of various types of spray pumps and nozzles and calculation of swath width, Economics of weed control, Herbicide resistance analysis in plant and soil,
- Bioassay of herbicide resistance residues,

- Calculation of herbicidal herbicide requirement

### **Teaching methods/activities**

Classroom teaching with AV aids, group discussion, field visit to identify weeds.

### **Learning outcome**

Basic knowledge on weed identification and control for crop production.

### **Suggested Reading**

- Böger, Peter, Wakabayashi, Ko, Hirai, Kenji (Eds.). 2002. Herbicide Classes in Development. Mode of Action, Targets, Genetic Engineering, Chemistry. Springer.
- Chauhan B and Mahajan G. 2014. Recent Advances in Weed Management. Springer.
- Das TK. 2008. Weed Science: Basics and Applications, Jain Brothers (New Delhi).
- Fennimore, Steven A and Bell, Carl. 2014. Principles of Weed Control, 4th Ed, California Weed Sci. Soc.
- Gupta OP. 2007. Weed Management: Principles and Practices, 2nd Ed.
- Jugulan, Mithila (ed). 2017. Biology, Physiology and Molecular Biology of Weeds. CRC Press
- Monaco TJ, Weller SC and Ashton FM. 2014. Weed Science Principles and Practices, Wiley
- Powles SB and Shaner DL. 2001. Herbicide Resistance and World Grains, CRC Press.
- Walia US. 2006. Weed Management, Kalyani. • Zimdahl RL. (ed). 2018. Integrated Weed Management for Sustainable Agriculture, B. D. Sci. Pub.

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PGS 504 (e-Course)	Basic Concepts in Laboratory Techniques	00	00	00	60	40	0	1	1

1. **Legends:** L - Lecture; P – Practical

2. \*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

**Objective**

To acquaint the students about the basics of commonly used techniques in laboratory.

**Practical**

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

**Suggested Readings**

- Furr AK. 2000. *CRC HandBook of Laboratory Safety*. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemica IPubl. Co.

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PGS 505 (e-Course)	Agricultural Research, Research Ethics and Rural Development Programmes	50	40	10	00	00	1	0	1

**1. Legends:** L - Lecture; P – Practical

**2. \*Teacher Assessment shall be based on following components:** Quiz / Assignment / Project / Participation in Class.

**Objective**

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

**Theory**

**UNIT I:** History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems(NARS) and Regional Agricultural Research Institutions;

**UNIT II:** Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

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

**UNIT IV:** Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme,

**UNIT V:** 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.

**Suggested Readings**

- Bhalla GS & 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.

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