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

COURSE CODE	COURSE TITLE	CREDITS
MAJOR		
SOIL 501	Soil Physics	2+1
SOIL 502	Soil Fertility and Fertilizer use	2+1
SOIL 508	Soil Water and Air Pollution	2+1
MINOR		
AGRON 502	Principles and Practices of Soil Fertility	2+1
AGRON 503	Principles and Practices of Weed Management	2+1
SUPPORTING		
STAT 511	Experimental Designs	2+1
NON-CREDIT		
*PGS 504	Basic Concepts in Laboratory Techniques	0+1
*PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0

***Non-Credit Courses.**

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'slaw; 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 Physi*cs.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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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
SOILS 502	Soil Fertility and Fertilizer use	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 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 CO2
- 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*. 13th Ed. Pearson Edu.
- Kabata-Pendias A & Pendias H. 1992. *Trace Elements in Soils and Plants*. CRC Press.
- Kannaiyan S, Kumar K & Govindarajan K. 2004. *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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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
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
SOILS 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_2 and O_2 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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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Agriculture
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
AGRON 502	Principle and Practices of Soil Fertility	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.

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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M.Sc. (Ag.) Soil Science

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
STAT 511	Experimental Designs	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

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I

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

UNIT II

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

UNIT III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V

Bioassays- direct and indirect, indirect assays based on quantal doseresponse, parallel line and slope ratio assays potency estimation.

Practical

- Uniformity trial data analysis, formation of plots and blocks, FairfieldSmith Law
- Analysis of data obtained from CRD, RBD, LSD.
- Analysis of factorial experiments without and with confounding
- Analysis with missing data
- Split plot and strip plot designs
- Transformation of data
- Analysis of resolvable design
- Fitting of response surfaces.

Suggested Readings

1. Cochran WG & Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
2. Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
3. Federer WT. 1985. *Experimental Designs*. MacMillan.
4. Fisher RA. 1953. *Design and Analysis of Experiments*.
5. Oliver & Boyd. Nigam AK & Gupta VK. 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.
6. Pearce SC. 1983. *The Agricultural Field Experiment: A StatisticalExamination of Theory and Practice*. John Wiley.
7. Design Resources Server: www.iasri.res.in/design.

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PGS 504	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 vaccupets; 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 lPubl. Co.

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PGS 505	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.