GURU KASHI UNIVERSITY

Master of Science in Agriculture

(Soil Science) (SOIL)

Session:2026-27

Faculty of Agriculture

Graduate Attributes of the Programme: -

Type of learning outcomes	**The Learning Outcomes Descriptors**
Graduates should be able to demonstrate the acquisition of:	
Learning outcomes that are specific to disciplinary/interdisciplinary areas of learning	Develop proficiency in identifying the nutrient deficiency with reference to crop production. Capable to evaluate soil fertility status to check the availability of various plant essential nutrients before and after sowing of the crop
Generic learning outcomes	Inculcate rational thinking in the students by the introduction of the conditions of rationality in the areas of nutrient (macro and micro) management, integrated use of organic and inorganic fertilizers, management of problem soils, poor quality irrigation water and sewage waters, soil carbon management, air and soil pollution.

Element of the Descriptor	**Programme learning outcomes relating to Undergraduate Certificate**
The graduates should be able to demonstrate the acquisition of:	
Knowledge and understanding	Comprehend the principles and methodologies of soil and water testing, nutrient management, balance use of fertilizers and water management.
General, technical and professional skills required to perform and accomplish tasks	Possess deep insight of nutrient deficiencies symptoms identification, methods of nutrient determination, techniques to increase nutrient and water use efficiencies.
Application of knowledge and skills	Familiarize with various methods/techniques/instruments used in soil, water, fertilizer and plant/seed testing, soil physical properties. Management of problem soils.

<table>
<tr><td>Generic learning outcomes</td><td>Develop advanced understanding on characterization, identification of nutrient deficiencies, nutrient management through balance and integrated use of organic and inorganic fertilizers</td></tr>
<tr><td>Constitutional, humanistic, ethical, and moral values</td><td>Development of understating for efficient use of nutrient to reduce soil and gases pollution</td></tr>
<tr><td>Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset</td><td>Develop deep understanding of soil and water testing. Techniques to increase nutrient use efficiencies. Balanced and integrated use of nutrient to increase farmers income.</td></tr>
<tr><td>Credit requirements</td><td>
<table>
<tr><th></th><th>Masters' Programme</th></tr>
<tr><td>(i) Course work</td><td></td></tr>
<tr><td>Major courses</td><td>20</td></tr>
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<tr><td>Total</td><td>70</td></tr>
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</td></tr>
<tr><td>Entry requirements</td><td>A student with a Bachelor Degree subject to fulfillment of the eligibility conditions of a programme as specified by the University, shall be eligible for admission to a 2-year PG Programme.</td></tr>
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Program Structure

Semester I									
Course Code	**Course Title**	**Type of Course**	**(Hours Per Week)**			**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
			L	**T**	**P**				
SOIL501	Soil physics	Major	2	0	0	2	30	70	100
SOIL502	Soil Physics Lab	Major	0	0	2	1	30	70	100
SOIL503	Soil fertility and fertilizer use	Major	2	0	0	2	30	70	100
SOIL504	Soil fertility and fertilizer use Lab	Major	0	0	2	1	30	70	100
STAT501	Agriculture statistics	Supporting	3	0	0	3	30	70	100
STAT502	Agriculture statistics Lab	Supporting	0	0	2	1	30	70	100
AGRON507	Irrigation water Management	Minor (CBCS) (Choose any one)	2	0	0	2	30	70	100
AGRON509	Weed Management								
AGRON508	Irrigation water Management Lab	Minor (CBCS) (Choose any one	0	0	2	1	30	70	100
AGRON510	Weed Management Lab								
PGC501	Library and Information service lab	Common	0	0	2	1	30	70	100
PGC502	Agricultural Research, Research Ethics and Rural Development Programmes	Common	1	0	0	1	30	70	100
SOIL600	Master Research	Research	0	0	0	4	S/US	S/US	S/US
Total						**15+4**			

Semester II									
Course Code	**Course Title**	**Type of Course**	**(Hours Per Week)**			**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
			L	**T**	**P**				
SOIL505	Soil mineralogy, genesis and classification	Major	2	0	0	2	30	70	100
SOIL506	Soil mineralogy, genesis and classification Lab	Major	0	0	2	1	30	70	100
SOIL507	Soil erosion and conservation	Major	2	0	0	2	30	70	100
SOIL508	Soil erosion and conservation Lab	Major	0	0	2	1	30	70	100
SOIL509	Soil Chemistry	Major	2	0	0	2	30	70	100
SOIL510	Soil Chemistry Lab	Major	0	0	2	1	30	70	100
SOIL511	Radioisotopes in soil and plant studies	Major	1	0	0	1	30	70	100
SOIL512	Radioisotopes in soil and plant studies Lab	Major	0	0	2	1	30	70	100
CA501	Fundamentals of Computer Applications Lab	Supporting	0	0	4	2	30	70	100
PGC503	Basic Concepts in Laboratory Techniques Lab	Common	0	0	2	1	30	70	100
SOIL599	Seminar	Skill Dev.	0	0	2	1	30	70	100
SOIL600	Master Research	Research	0	0	0	5	S/US	S/US	S/US
Total						**15+5**			

Semester III									
Course Code	**Course Title**	**Type of Course**	**(Hours Per Week)**			**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
			L	**T**	**P**				
SOIL513	Soil Biology and Biochemistry	Major	1	0	0	1	30	70	100
SOIL514	Soil Biology and Biochemistry Lab	Major	0	0	2	1	30	70	100
SOIL515	Soil, water and air pollution	Major	2	0	0	2	30	70	100
SOIL516	Soil, water and air pollution Lab	Major	0	0	2	1	30	70	100
SOIL517	Analytical technique and instrumental methods in soil and plant analysis	Major	2	0	0	2	30	70	100
SOIL518	Analytical technique and instrumental methods in soil and plant analysis Lab	Major	0	0	2	1	30	70	100
AGRON503	Dryland farming and watershed management	Minor (CBCS) (Choose any one)	1	0	0	1	30	70	100
AGRON501	Agronomy of oilseed, fiber, sugar and important medicinal and aromatic crops								

AGRON504	Dryland farming and watershed management Lab	Minor (CBCS) (Choose any one)	0	0	2	1	30	70	100
AGRON502	Agronomy of oilseed, fiber, sugar and important medicinal and aromatic crops								
PGC504	Technical writing and communication skills Lab	Common	0	0	2	1	30	70	100
SOIL600	Master Research	Research	0	0	0	10	S/US	S/US	S/US
Total						**11+10**			

Semester IV										
Sr. No.	**Course Code**	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
37	SOIL521	Land degradation and restoration	Major	0	0	2	1	30	70	100
38	SOIL522	Land degradation and restoration Lab	Major	0	0	2	1	30	70	100
39	PGC505	Intellectual Property and its Management in Agriculture	Common	1	0	0	1	30	70	100
40	SOIL600	Master Research	Research	0	0	0	11	S/ US	S/ US	S/ US
	Total						**3+11**			
	Grand total						**44+30=74**			

Course Title: Soil Physics
Course Code: SOIL501

L	T	P	Credits
2	0	0	2

Total hours 30

Learning Outcomes:
After successful completion of this course, the students will be able to:
To impart basic knowledge about soil physical properties and processes in relation to plant growth.

Course Contents

UNIT-I **7hours**

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

UNIT-II **8hours**

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-III **7hours**

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

UNIT-IV **8hours**

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. 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.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

Brady NC & Weil R.R 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.

Fageria NK, Baligar VC & Jones CA. 2004. 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. 2005. Soil Fertility Management for Sustainable Agriculture. CRC Press.

Yawalkar KS, Agrawal JP &Bokde S. 2000. Manures and Fertilizers. Agri-Horti Publ.

Web Sources

- https://www.academia.edu/41667742/Pdf_The_Nature_and_Properties_of_Soils_15th_Edition_by_Ray_R_Weil_Nyle_C_Brady_Emeritus_Professo
- https://epsc413.wustl.edu/TOC_Textbook.pdf
- https://agris.fao.org/agrissearch/search.do?recordID=US19970026628

Course Title: Lab - Soil Physics
Course Code: SOIL502

L	T	P	Credits
0	0	2	1

30hours

Learning Outcomes:
After successful completion of this course, the students will be able to:

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

Course Contents

- 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.

Suggested Readings

• *Baver LD, Gardner WH and Gardner WR. 1972. Soil Physics. John Wiley & Sons.*
• *Ghildyal BP and Tripathi RP. 2001. Soil Physics. New Age International.*
• *Hanks JR and 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.*

Course Title: Soil fertility and fertilizer use
Course Code: SOIL503

L	T	P	Credits
2	0	0	2

Total hours 32

Learning Outcomes:
After successful completion of this course, the students will be able to:

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 Contents

UNIT-I **7hours**
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 **8hours**
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 **7hours**
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-IV **10hours**
Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; speciality fertilizers concept, need and category. Current status of speciality fertilizers use in soil sand crops of India; Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS.

Transaction Mode
Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

Brady NC and Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.

• Kabata-Pendias A and Pendias H. 1992. Trace Elements in Soils and Plants. CRC Press.

• Kannaiyan S, Kumar K and Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.

• Leigh J G. 2002. Nitrogen Fixation at the Millennium. Elsevier.

• Mengel K and Kirkby EA. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland.

Course Title: Lab – Soil fertility and fertilizer use
Course Code: SOIL504

L	T	P	Credits
0	0	2	1

30hours

Learning Outcomes:
After successful completion of this course, the students will be able to:

Experience on the knowledge of soil fertility and fertilizers in relation to plant growth and development.

Course Contents

- 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
- Analysis of plants for essential elements (major and micro

Suggested Readings

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

Course Title: Agricultural Statistics
Course Code: STAT501

L	T	P	Credits
3	0	0	3

Total – 45hours

Learning Outcomes:
After successful completion of this course, the students will be able to:

1. Organize, manage and present data, analyze statistical data graphically using frequency distributions and cumulative frequency distributions
2. Analyze statistical data using measures of central tendency, dispersion and location
3. Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events
4. Translate real-world problems into probability models and derive the probability density function of transformation of random variables
5. Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables

Course Contents

UNIT-I **Hours-11**
Frequency distribution, standard error and deviation, correlation and regression analyses, co-efficient of variation

UNIT-II **Hours-12**
Hypothesis testing. Concept of p-value. Tests of significance-t, F and chi-square (X2); Data transformation and missing plot techniques;

UNIT-III **Hours-13**
Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip-plot, factorial and simple confounding designs

UNIT-IV **Hours-9**
Efficiency of designs; Methods of statistical analysis for cropping systems including intercropping; Pooled analysis.

Suggested Readings

Panse, V.G. and Sukhatme, P.V.2004. Statistical methods for agricultural workers. pp. 361.

Gupta, S.C. and Kapoor, V.K. 2014. Fundamentals of Mathematical Statistics.

Sultan Chand & Sons, New Delhi.pp. 230.

Snecdecor, G.W. and Cochran, W.G. 2005. Statistical Methods, 8th Edition. Wiley-Blackwell. Pp.524.

Rangaswamy, R. 2016. Textbook of Agricultural Statistics.New Age International (P) Ltd. New Delhi. pp. 531.

Web Sources

- https://www.cabdirect.org/cabdirect/abstract/19561604178
- https://agris.fao.org/agrissearch/search.do?recordID=US201300351448
- https://www.scirp.org/(S(351jmbntvnsjt1aadkozje))/reference/referencespapers.aspx?referenceid=869408

Course Title: Lab - Agricultural Statistics
Course Code: STAT502

L	T	P	Credits
0	0	2	1

30hours

Learning Outcomes:
After successful completion of this course, the students will be able to:

1. Statistical principles apply in all the areas of experimental work and they have a very important role in agriculture.
2. It is required at the national level and farm level for agriculture policy making, decision making, agriculture development and estimates agriculture and national income.
3. Statistics in agriculture are great importance in variety of area. One of the most important is to ascertain the volume of crop that needs to be produced based on output and demand of previous year.
4. It is helpful in land utilization and irrigation including the net area sown gross cultivated area, current follow, cultivable waste
5. Know how to analyze statistical data graphically using frequency distributions and cumulative frequency distributions

Course Contents

Correlation analysis. Regression analysis (exponential, power function, quadratic, multi- variate, selection of variables, validation of models, ANOVA and testing of hypothesis). Tests of significance (Z-test, t-test, F-test and Chi-square test). Analysis of variance. Completely randomized design. Randomized block and latin square designs. Missing plot and analysis of covariance. 23, 24 and 33 simple and confounded experiments. Split plot designs. Factorial in split plot designs.

Suggested Readings

Panse, V.G. and Sukhatme, P.V.2004. Statistical methods for agricultural workers. pp. 361.

Gupta, S.C. and Kapoor, V.K. 2014. Fundamentals of Mathematical Statistics.

Sultan Chand & Sons, New Delhi.pp. 230.

Snecdecor, G.W. and Cochran, W.G. 2005. Statistical Methods, 8th Edition. Wiley-Blackwell. Pp.524.

Rangaswamy, R. 2016. Textbook of Agricultural Statistics.New Age International (P) Ltd. New Delhi. pp. 531.

Course Title: Irrigation Water Management
Course Code: AGRON507

L	T	P	Credits
2	0	0	2

Course Outcomes:
After successful completion of this course, the students will be able to:
1. Empower the farmers to adopt irrigated agricultural practices in place of traditional rainfed agriculture
2. Transfer the location specific technology/ research recommendations of SAUs to the grass root level farmers
3. Motivate the farmers for adoption of improved agricultural practices for enhancement of crop production and productivity
4. Create specific awareness among the farmers to achieve sustainable agricultural production while maintaining soil health & safe guarding environment.

Course Contents

UNIT-I **Hours-7**
History of irrigation in India; Major irrigation projects in India; Water resources development. Concepts of irrigation scheduling, Different approaches of irrigation scheduling. Drainage requirement of crops, methods of field drainage, their layout and spacing.

UNIT-II **Hours-8**
Soil water depletion, plant indices and climatic parameters; Concept of critical stages of crop growth in relation to water supplies; Crop modeling, crop coefficients, water production functions; Soil water movement in soil and plants, soil and plant relation, transpiration, soil-water-plant relationships and water absorption by plants.

UNIT-III **Hours-8**
Plant response to water stress. Methods of irrigation viz. surface methods, overhead methods, subsurface irrigation, drip irrigation, sprinkler irrigation, merits and demerits of various methods, design and evaluation of irrigation methods; Measurement of irrigation water, application and distribution efficiencies; Management of water resources (rain, canal and ground water) for agricultural production.

UNIT-IV **Hours-7**
Crop water requirements; Agronomic considerations in tile-design and operation of irrigation projects, characteristics of irrigation and family systems affecting irrigation management; irrigation legislation; Water quality, conjunctive use of water, irrigation strategies under different situation of water availability, optimum crop plans and cropping patterns in canal command areas.

Course Title: Lab-Irrigation Water Management
Course Code: AGRON508

L	T	P	Credits
0	0	2	1

Course Contents

- Measurement of soil water potential by using tensiometer, Neutron probe, pressure plate and membrane apparatus.
- Soil-moisture characteristics curve.
- Water flow measurements using different devices.
- Determination of irrigation requirements.
- Calculation of irrigation efficiency and crop coefficient.
- Determination of infiltration rate.
- Determination of saturated/ unsaturated hydraulic conductivity.
- Determination of Consumptive use,
- Calculation of water requirement of a given cropping pattern.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

Paliwal, K.V. 2021. Irrigation with Saline Water. WTC, IARI, New Delhi.
Panda, S. C. 2020. Principles and Practices of Water Management. Agrobios.
Prihar, S. S. and Sandhu.B.S.2021. Irrigation of Field Crops - Principles and practices, ICAR, New Delhi.
Sankara Reddi, G.H. and Yellamanda Reddy, T. 2020. Efficient Use of Irrigation Water. Kalyani , Ludhiana.
Singh, P. and Maliwal, P. L. 2019. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ.

Web Sources

https://saiplatform.org/wp-content/uploads/2019/02/principles-and practices- for-sustainable-water-management-_at-a-farm-level-final-2.pdf.
https://depws.nt.gov.au/water/water-management/water-management principles
https://www.shopconnecticutpostmall.com/shopnow/product/water conservation-and-management-principles-and-practices-by-vincent-ford-hardcover-target- 3b7036? model=0&variant=0.

Course Title: Weed Management
Course Code: AGRON509

L	T	P	Credits
2	0	0	2

Course Outcomes:
After successful completion of this course, the students will be able to:
1. Get knowledge about weed and its four stages of development
2. Understand the difference between annual, biennial and perennial weeds

3. Have knowledge about cultural weed controls
4. Know the advantages and disadvantages of the various method of herbicides applications
5. Understand herbicide carryover and how to prevent it

Course Contents

UNIT-I **Hours-7**

Weed biology, ecology and crop-weed competition including allelopathy Scope and principles of weed management and control/weed classification, biology, ecology and allopath, crop weed indices.

UNIT-II **Hours-8**

History and development of herbicide. Classification and selectivity of herbicides based on chemical, physiological application and selectivity. Mode and mechanism of action of important herbicides.

UNIT-III **Hours-8**

Herbicide structure- activity relationship and factors affecting the efficiency of herbicides. Herbicide formulations and mixtures. Weed control through herbicides in soil and plants. Herbicide resistance in weeds, herbicide interaction and crops herbicide rotations.

UNIT-IV **Hours-7**

Weed management in major crops and cropping systems. Management of parasitic weeds. Weed shifts in cropping systems. Aquatic and perennial weed control. Integrated weed management. Cost: benefit analysis of weed management.

Course Title: Lab-Weed Management
Course Code: AGRON510

L	T	P	Credits
0	0	2	1

Course Contents

1. Identification of important crops weed.
2. Preparation of a weed herbarium.
3. Weed survey in crops and cropping systems.
4. Crop-weed competition studies.
5. To study the Weed indices.
6. Preparation of spray solutions of herbicides for high and low-volume sprayers.
7. Study about the Use of various types of spray pumps and nozzles and calculation of swath width.
8. Economics of weed control.
9. Herbicide residue analysis in plant and soil.
10. Bioassay of herbicide residue.
11. Calculation of herbicidal requirement.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Mobile Teaching, Self-Learning,

Collaborative Learning and Cooperative Learning

Suggested Readings

- Aldrich RJ & Kramer RJ. 2020. Principles in Weed Management. Panima
- Publ. Ashton FM & Crafts AS. 2021. Mode of Action of Herbicides. 2nd Ed. Wiley Inter Science.
- Gupta OP. 2020. Weed Management – Principles and Practices. Agrobios.
- Mandal RC. 2021. Weed, Weedicides and Weed Control - Principles and Practices. Agro Botanical Publ.
- Rao VS. 2022. Principles of Weed Science. Oxford & IBH.
- Subramanian S, Ali AM & Kumar RJ. 2021. All About Weed Control.Kalyani.
- Zimdahl RL. 2019. Fundamentals of Weed Science. 2nd Ed. Academic Press.

Web Sources

- https://coabnau.in/uploads/1587052357_PrinciplesofWeedmanagement.pdf
- https://gardening.usask.ca/articles-and-lists/articles-weeds/basic principles - of - integrated-weed-management-iwm.php
- https://agriinfo.in/principles-of-weed-control-341/

Course Title: Lab - Library and Information Services
Course Code: PGC501

L	T	P	Credits
0	0	2	1

15hours

Learning Outcomes:

1. Identify library services and availability of resources in order to develop a realistic overall plan for research.

2. Use general information resources to increase familiarity with the topic and disciplinary vocabulary.

3. Define the research topic, question or thesis to achieve a manageable focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis.

4. Identify keywords, synonyms and related terms in order to flexibly search information resources.

5. Learn about how to search the research citations and research papers.

Course Contents

Introduction to Library and its services; five laws of library science; type of documents; classification and cataloguing; organization of documents; sources of information primary, secondary and tertiary; current awareness and SDI services; tracing information from reference sources; library survey; preparation of bibliography; use of Online Public Access Catalogue; use of CD-ROM databases and other computerized library services, CeRA, J-Gate; use of Internet including search engines and its resources; e-resources.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

Gita, S. 2012. Library and Information Services. LAP Lambert Academic Publishing.USA. pp. 76.

Kishore, A. 2021. A Conceptual approach to library and information science A complete self study guide.2nd edition. AKB Publication. Jaipur. pp. 250.

Pandey, D.K. 2004. Library and Information Science.Atlantic Publishers & Distributors. New Delhi. pp. 272.

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

Course Code: PGC502

L	T	P	Credits
1	0	0	1

Total Hours-15

Course Outcomes:

After successful completion of this course, the students will be able to:

1. To enlighten the students about the organization and functioning of agricultural research systems at national and international levels
2. To aware the students about research ethics, and rural development programmes and policies of Government.
3. Acquire knowledge on Concept and connotations of rural development
4. Constraints in implementation of rural policies and programmes

UNIT-I **3hours**

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

UNIT-II **4hours**

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

UNIT-III **4hours**

International fellowships for scientific mobility. Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme.

UNIT-IV

4hours 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.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- *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.*

Semester 2nd

Course Title: Soil Mineralogy, Genesis and Classification
Course Code: SOIL505

L	T	P	Credits
2	0	0	2

Total hours - 30

Learning Outcomes:

After successful completion of this course, the students will be able to:
1. Acquire the knowledge regarding genesis of soil
2. Get knowledge regarding the concept of mineralogy of soil
3. Attain knowledge regarding the classification of soil
4. Learn about the concept of soil survey

Course Content

UNITI **7hours**

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

UNIT II **8hours**

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, role of clay minerals in plant nutrition, interaction of clay with humus, pesticides and heavy metals.

UNIT III **8hours**

Factors of soil formation. Soil formation models. Soil forming processes, weathering of rocks and mineral transformations. Soil profile. Weathering sequences of minerals with special reference to Indian soils.

UNIT IV **7hours**

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.

Suggested Readings

- *Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.*

- *Dixon JB & Weed SB. 1989. Minerals in Soil Environments. 2nd Ed. Soil Science Society of America, Madison.*
- *Grim RE. 1968. Clay Mineralogy. McGraw Hill. Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi.*
- *Sehgal J. 2002. Introductory Pedology: Concepts and Applications. New Delhi*
- *Sehgal J. 2002. Pedology - Concepts and Applications. Kalyani.*
- *USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.*
- *Wade FA & Mattox RB. 1960. Elements of Crystallography and Mineralogy. Oxford & IBH.*
- *Wilding LP & Smeck NE. 1983. Pedogenesis and Soil Taxonomy: II. The Soil Orders. Elsevier.*

Course Title: Lab-Soil Mineralogy, Genesis and Classification
Course Code: SOIL506

L	T	P	Credits
0	0	2	1

30 hours

Learning Outcomes:

After successful completion of this course, the students will be able to:
1. Acquire the knowledge regarding genesis of soil
2. Get knowledge regarding the concept of mineralogy of soil
3. Attain knowledge regarding the classification of soil
4. Learn about the concept of soil survey

Course Content

Practical
- Separation of sand, silt and clay fraction from soil.
- Determination of specific surface area and CEC of clay.
- Identification and quantification of minerals in soil fractions.
- Morphological properties of soil profile in different land forms.
- Classification of soils using soil taxonomy.

Suggested Readings

- *Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.*
- *Dixon JB & Weed SB. 1989. Minerals in Soil Environments. 2nd Ed. Soil Science Society of America, Madison.*

- *Grim RE. 1968. Clay Mineralogy. McGraw Hill. Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi.*
- *Sehgal J. 2002. Introductory Pedology: Concepts and Applications. New Delhi*
- *Sehgal J. 2002. Pedology - Concepts and Applications. Kalyani.*

Course Title: Soil erosion and conservation
Course Code: SOIL507

L	T	P	Credits
2	0	0	2

Learning Outcomes:

After successful completion of this course, the students will be able to:
To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water.

Course Content

UNIT I **7hours**

History, distribution, identification and description of soil erosion problems in India. Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity - estimation as EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation.

UNIT II **8hours**

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country. Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout.

UNIT III **8hours**

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

UNIT IV **7hours**

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds, sediment measurement.

Suggested Readings

- *Biswas TD and Narayanasamy G. (Eds.) 1996. Soil Management in Relation to Land Degradation and Environment. Bull. Indian Society of Soil Science No. 17.*
- *Doran JW and Jones AJ. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.*
- *Gurmal Singh, Venkataramanan C, Sastry G and Joshi BP. 1990. Manual of Soil and Water Conservation Practices. Oxford & IBH.*
- *Hudson N. 1995. Soil Conservation. Iowa State University Press.*
- *Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi.*
- *Oswal MC. 1994. Soil Physics. Oxford & IBH.*

Course Title: Lab- Soil erosion and conservation
Course Code: SOIL508

L	T	P	Credits
0	0	2	1

Learning Outcomes:

After successful completion of this course, the students will be able to: Experience on the knowledge of soil conservation and their utility in research for solving field problem.

Course Content

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

Suggested Readings

- *Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.*
- *Dixon JB & Weed SB. 1989. Minerals in Soil Environments. 2nd Ed. Soil Science Society of America, Madison.*
- *Grim RE. 1968. Clay Mineralogy. McGraw Hill. Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi.*
- *Sehgal J. 2002. Introductory Pedology: Concepts and Applications. New Delhi*
- *Sehgal J. 2002. Pedology - Concepts and Applications. Kalyani.*

- *USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.*
- *Wade FA & Mattox RB. 1960. Elements of Crystallography and Mineralogy. Oxford & IBH.*

Course Title: Soil Chemistry
Course Code: SOIL509

L	T	P	Credits
2	0	0	2

Total hours - 30

Learning Outcomes:

After successful completion of this course, the students will be able to:

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

2. Acquent knowledge about inorganic and organic Soil colloids and their concept.

3. About sorption properties of soil colloids and Soil organic matter fractionation .

4 About adsorption desorption behavior of soil .

Course content

Theory:

UNIT I **7hours**

Chemical (elemental) composition of the earth's crust, soils, rocks and minerals. Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics.

UNIT II **8hours**

Soil colloids- inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils. Diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids. Electrometric properties of soil colloids, sorption properties of soil colloids. Soil organic matter - fractionation of soil organic matter and different fractions. Characterization of OM. Clay- organic interactions.

UNIT III **8hours**

Ion exchange processes in soil. Cation exchange- theories based on law of massaction (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement. Thermodynamics. Statistical mechanics. Anion and ligand exchange –inner sphere and outer-sphere surface complex formation. Fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions. Shift of PZC on ligand exchange,

AEC, CEC. Experimental methods to study ion exchange phenomena and practical implications in plant nutrition.

UNIT IV **7hours**

Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption. Precipitation-dissolution equilibria. Concept of quantity/intensity(Q/I) relationship. Step and constant-rate K. Management aspects. Chemistry of acid soils. Active and potential acidity. Lime potential, chemistry of acid soils, sub-soil acidity. Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments. Chemistry and electrochemistry of submerged soils, geochemistry of micronutrients, environmental soil chemistry.

Suggested Readings

- *Bear RE. 1964. Chemistry of the Soil. Oxford and IBH.*
- *Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.*
- *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.*
- *Sposito G. 1989. The Chemistry of Soils. Oxford Univ. Press.*
- *Stevenson FJ. 1994. Humus Chemistry. 2nd Ed. John Wiley & Sons.*
- *Van Olphan H. 1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons***.**

Course Title: Lab - Soil Chemistry
Course Code: SOIL510

L	T	P	Credits
0	0	2	1

30 hours

Learning Outcomes:

After successful completion of this course, the students will be able to:

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

2.Acquent knowledge about inorganic and organic soil colloids and their concept.

3.About sorption properties of soil colloids and Soil organic matter fractionation .

4 About adsorption desorption behavior of soil.

Course content

Practical

Preparation of saturation extract, measurement of pH, EC, CO, HCO, Ca, Mg, K and Na, Determination of CEC and AEC of soils, Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter and conductivity meter, Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method ,Extraction of humic substances, Potentiometric and conductometric titration of soil humic and fulvic acids,(E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the Δ(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 Q/I relationship of potassium, Determination of lime requirement of an acid soil by buffer method, Determination of gypsum requirement of an alkali soil.

Suggested Readings

- *Bear RE. 1964. Chemistry of the Soil. Oxford and IBH.*
- *Bolt GH&Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.*
- *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.*

- *Sposito G. 1989. The Chemistry of Soils. Oxford Univ. Press.*
- *Stevenson FJ. 1994. Humus Chemistry. 2nd Ed. John Wiley & Sons.*
- *Van Olphan H. 1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons***.**

Course Title: Radioisotopes in Soil and Plant Studies
Course Code: SOIL511

L	T	P	Credits
1	0	0	1

Total hours - 30

Learning Outcomes:
After successful completion of this course, the students will be able to:
Experience in the use of radio isotopes in soil and plant research.

Course content

UNIT I **7hours**
Atomic structure, radio activity and units; radio isotopes-properties and decay principles; nature and properties of nuclear radiations; interaction of nuclear radiations with matter, artificial radioactivity

UNIT II **8hours**
Principles and use of radiation monitoring instruments-proportional, Geiger Muller counter, solid and liquids cintillation counters; neutron moisture meter, mass spectrometry, autoradiography

UNIT III **8hours**
Isotopic dilution techniques used in soil and plant research; use of stable isotopes; application of isotopes in studies on organic matter, nutrient transformations, ion transport, rooting pattern and fertilizer use efficiency; carbon dating.

UNIT IV **7hours**
Doses of radiation exposure, radiation safety aspects regulatory aspects, collection, storage and disposal of radioactive wastes

Suggested Readings

- *Comer CL. 1955. Radioisotopes in Biology and Agriculture: Principles and Practice. Tata McGraw Hill.*
- *Glasstone S. 1967. Source Book on Atomic Energy. East West Press.*

- *Michael FL and Annunziata. 2003. Handbook of Radioactivity Analysis. Academic Press.*

Course Title: Lab–Radioisotopes in soil and plant studies
Course Code: SOIL512

L	T	P	Credits
0	0	2	1

30 hours

Learning Outcomes:
After successful completion of this course, the students will be able to:
Experience on the knowledge of radio activity and their utility in research for solving field problems.

Course content

- Storage and handling of radioactive materials
- Determination of half-life and decay constant
- Preparation of soil and plant samples for radioactive measurements
- Setting up of experiment on fertilizer use efficiency and cation exchange equilibria using radio isotopes
- Determination of A, E and L values of soil using 32P/65Zn
- Use of neutron probe for moisture determination
- Sample preparation and measurement of 15N enrichment by mass spectro-photometery/emission spectrometry

Suggested Readings

- *Comer CL. 1955. Radioisotopes in Biology and Agriculture: Principles and Practice. Tata McGraw Hill.*
- *Glasstone S. 1967. Source Book on Atomic Energy. East West Press.*
- *Michael FL and Annunziata. 2003. Handbook of Radioactivity Analysis. Academic Press.*

Course Title: Lab- Fundamental of Computer Application
Course Code: CA501

L	T	P	Credits
0	0	4	2

Total hours - 60

Learning Outcomes:

1. Learn and understand about basics of MS-Word, Excel, preparation of Graphs
2. Read, understand, and interpret material on technology. They will have an appreciation for some of the ideas, issues, and problems involved in writing about technology and in workplace writing.
3. Understand the operating systems, peripheral devices, networking, multimedia and internet
4. Familiarize with basic sources and methods of research and documentation on topics in technology, including on-line research.
5. Students will be able to synthesize and integrate material from primary and secondary sources with their own ideas in research papers.

Course Content

Ms-word: creating a document, saving and editing, use of options from tool bars, format, insert and tools (spelling and grammar), alignment of text, creating a table, merging cells, column and row width. Ms-excel: entering expressions through the formula tool bar and use of inbuilt functions, sum, average, max, min. Creating graphs and saving with and without data in Ms-excel.Ms-access: creating database, structuring with different types of fields. Ms-power point: preparation of slides on power point. Internet Browsing: browsing a web page and creating of E-Mail ID. Agri. net (ARIS).

Suggested Readings:

Salaria, R.S. 2017. *Computer Fundamentals*.Daryaganj, New Delhi. pp. 486.
Manish, S. and Bhatt, A. 2016. *Computers in Agriculture: Fundamentals and Applications.* New India Publishing Agency.New Delhi. pp. 190.
Manjunath, B.E. 2010.*Computer Basics*.Vasan Publications, Bengaluru, Karnataka. pp. 356.

Course Title: Lab- Basic concepts in laboratory techniques
Course Code: PGC503

L	T	P	Credits
0	0	2	1

Course Outcomes:

On successful completion of this course, the students will able to:

1. To acquaint the students about the basics of commonly used techniques in laboratory.
2. Preparation of solutions of acids
3. Get knowledge on Drying of solvents/chemicals
4. Electric wiring and earthing.

Course Content

1. Safety measures while in Lab
2. Handling of chemical substances
3. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware
4. Drying of solvents/chemicals Weighing and preparation of solutions of different strengths and their dilution
5. Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications
6. Preparation of solutions of acids, Neutralization of acid and bases
7. Preparation of buffers of different strengths and pH values
8. 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.
9. Preparation of media and methods of sterilization
10. Seed viability testing, testing of pollen viability
11. Tissue culture of crop plants;
12. Description of flowering plants in botanical terms in relation to taxonomy

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Furr AK. 2000. CRCH and Book of Laboratory Safety. CRC Press.
- Gabb MH & Lat chem. WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Course Title: Seminar-I
Course Code: SOIL599

L	T	P	Credits
0	0	0	1

Total hours - 30

Learning Outcomes:

On successful completion of this course, the students willable to:

1. Show competence in identifying relevant information, defining and explaining topics under discussion
2. Present the classical and innovative work related to plant pathology subject.
3. Reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem
4. Judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject
5. To ask appropriate questions, use evidence to support claims, respond to a range of questions

Course Content

Seminar topic will be suggested by faculty

Semester 3rd

Course Title: Soil Biology and Biochemistry
Course Code: SOIL513

L	T	P	Credits
1	0	0	1

Total hours - 30

Learning Outcomes:

After successful completion of this course, the students will be able to:

1. Understand Types of organisms in different soils. Soil microbial biomass, microbial interactions.
2. Microbial transformation of different nutrients.
3. Uses of organic waste
4. Preparation of farmyard manure, animal manures, rural and urban composts and vermicompost and biofertilizers.

Course content

Theory:

UNIT I **8hours**

Soil biota, soil microbial ecology, types of organisms in different soils. Soil microbial biomass, microbial interactions, un-culturable soil biota. Microbiology and biochemistry of root-soil interface. Phyllosphere, soil enzymes, origin, activities and importance. Soil characteristics influencing growth and activity of microflora. Root rhizosphere and PGPR.

UNIT II **7hours**

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil. Biochemical composition and biodegradation of soil organic matter and crop residues, microbiology and biochemistry of decomposition of carbonaceous and proteinaceous materials.

UNIT III **8hours**

Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost. Biofertilizers-definition, classification, specifications, method of production and role in crop production. FCO specifications and quality control of biofertilizers.

UNIT IV **7hours**

Biological indicators of soil quality. Bioremediation of contaminated soils. Microbial transformations of heavy metals in soil. Role of soil organisms in pedogenesis–important mechanisms and controlling factors. Soil genomics and bioprospecting. Soil sickness due to biological agents. Xenobiotics. Antibiotic production in soil.

Suggested Readings

- *Alexander M. 1977. Introduction to Soil Microbiology. John Wiley & Sons.*
- *Burges A & Raw F. 1967. Soil Biology. Academic Press.*
- *McLaren AD & Peterson GH. 1967. Soil Biochemistry. Vol. XI.*
- *Marcel Dekker. Metting FB. 1993. Soil Microbial Ecology – Applications in Agricultural and Environmental Management.*
- *Marcel Dekker. Paul EA & Ladd JN. 1981. Soil Biochemistry.*
- *Marcel Dekker. Reddy MV. (Ed.). Soil Organisms and Litter in the Tropics. Oxford & IBH.*
- *Russel RS. 1977. Plant Root System: Their Functions and Interaction with the Soil. LBS & McGraw Hill.*
- *Stotzky G &Bollag JM. 1993. Soil Biochemistry. Vol. VIII.*
- *Marcel Dekker. Sylvia DN. 2005. Principles and Applications of Soil Microbiology. Pearson Edu.*
- *Wild A. 1993. Soil and the Environment - An Introduction. Cambridge Univ. Press.*

Course Title: Lab- Soil Biology and Biochemistry
Course Code: SOIL514

L	T	P	Credits
0	0	2	1

30 hours

Learning Outcomes:

After successful completion of this course, the students will be able to:

1.Understand Types of organisms in different soils. Soil microbial biomass, microbial interactions.

2. Microbial transformation of different nutrients.

3. Uses of organic waste

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

Course content

Practical

Determination of soil microbial population. Soil microbial biomass carbon. Elemental composition, fractionation of organic matter and functional groups. Decomposition of organic matter in soil. Soil enzymes. Measurement of important soil microbial processes such as ammonification, nitrification, N_2 fixation, S oxidation, P solubilization and mineralization of other micronutrients.

Suggested Readings

- *Alexander M. 1977. Introduction to Soil Microbiology. John Wiley & Sons.*
- *Burges A & Raw F. 1967. Soil Biology. Academic Press.*
- *McLaren AD & Peterson GH. 1967. Soil Biochemistry. Vol. XI.*
- *Marcel Dekker. Metting FB. 1993. Soil Microbial Ecology – Applications in Agricultural and Environmental Management.*
- *Marcel Dekker. Paul EA & Ladd JN. 1981. Soil Biochemistry.*
- *Marcel Dekker. Reddy MV. (Ed.). Soil Organisms and Litter in the Tropics. Oxford & IBH.*
- *Russel RS. 1977. Plant Root System: Their Functions and Interaction with the Soil. LBS & McGraw Hill.*
- *Stotzky G &Bollag JM. 1993. Soil Biochemistry. Vol. VIII.*
- *Marcel Dekker. Sylvia DN. 2005. Principles and Applications of Soil Microbiology. Pearson Edu.*

Course Title: Soil, Water and Air Pollution
Course Code: SOIL515

L	T	P	Credits
2	0	0	2

Total hours - 30

Learning Outcomes:

After successful completion of this course, the students will be able to:
To make the student saw are of the problems of soil, water and air pollution associated with use of soils for crop production.

Course Content

UNITI **7hours**

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 **8hours**

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, behaviour in soil and effect on soil microorganisms.

UNIT III **8hours**

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

UNIT IV **7hours**

Risk assessment of polluted soil, Remediation/ amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

Suggested Readings

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

Course Title: Lab-Soil, Water and air pollution
Course Code: SOIL516

L	T	P	Credits
0	0	2	1

30 hours

Learning Outcomes:

After successful completion of this course, the students will be able to:
Management of soil and water pollution.

Course Content

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, NO2 and O2 conc**.** Visit to various industrial sites to study the impact of pollutants on soil and plants.

Suggested Readings

- *Lal R, Kimble J, Levine E and 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 and Pierce 1983. Environmental Pollution and Control. Ann Arbor Science Publ.*
- *Wilding LP & Smeck NE. 1983. Pedogenesis and Soil Taxonomy: II. The Soil Orders. Elsevier.*
- *Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I. Concept and Interaction. Elsevier.*

Course Title: Analytical techniques and instrumental methods in soil and plant analysis
Course Code: SOIL517

L	T	P	Credits
2	0	0	2

Total hours- 30

Learning Outcomes: After successful completion of this course, the students will be able to:
To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

Course Content

UNIT I **Hours- 8**

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

UNIT II **Hours- 7**

Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils. Principles of visible, ultra violet and infrared spectrophotometery, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry and X-ray defractrometery; identification of minerals by X-ray by different methods, CHNS analyzer.

UNIT III **Hours- 8**

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

UNIT IV **7 Hours**

Methods for different nutrients estimation i.e., Wet digestion/fusion/extraction of soil with aquaregia with soil for elemental analysis; triacid/di-acid digestion of plant samples.

Suggested Readings

- *Hesse P. 971. Textbook of Soil Chemical Analysis. William Clowes & Sons.*
- *Jackson ML. 1967. Soil Chemical Analysis. Prentice Hall of India.*
- *Keith A Smith 1991. Soil Analysis; Modern Instrumental Techniques. Marcel Dekker.*
- *Kenneth Helrich 1990. Official Methods of Analysis. Association of Official Analytical Chemists.*
- *Page AL, Miller RH and Keeney DR. 1982. Methods of Soil Analysis. Part II. SSSA, Madison.*
- *Piper CE. Soil and Plant Analysis. Hans Publ.*

- *Singh D, Chhonkar PK and Pandey RN. 1999. Soil Plant Water Analysis - A Methods Manual. IARI, New Delhi.*

Course Title: Lab- Analytical technique and instrumental methods in soil and plant analysis
Course Code: SOIL518

L	T	P	Credits
0	0	2	1

Total hours 30

Learning Outcomes: After successful completion of this course, the students will be able to:
Development of confidence for setting soil testing laboratory.

Course Content

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

Suggested Readings

- *Hesse P. 971. Textbook of Soil Chemical Analysis. William Clowes & Sons.*
- *Jackson ML. 1967. Soil Chemical Analysis. Prentice Hall of India.*
- *Keith A Smith 1991. Soil Analysis; Modern Instrumental Techniques. Marcel Dekker.*
- *Kenneth Helrich 1990. Official Methods of Analysis. Association of Official Analytical Chemists.*
- *Page AL, Miller RH and Keeney DR. 1982. Methods of Soil Analysis. Part II. SSSA, Madison.*
- *Piper CE. Soil and Plant Analysis. Hans Publ.*
- *Singh D, Chhonkar PK and Pandey RN. 1999. Soil Plant Water Analysis - A Methods Manual. IARI, New Delhi.*

Course Title: Dryland farming and watershed management
Course Code: AGRON503

L	T	P	Credits
1	0	0	1

Course Outcomes:
After successful completion of this course, the students will be able to:
1. Acquire knowledge about the concept of dry farming
2. Get knowledge about the constraints limiting crop production in dry land areas
3. Learn about the types of the drought and stress physiology and registrants to drought
4. Attain knowledge about the soil moisture conservation and crop production technology in dry land
5. Know about the concept of watershed resource management, problems, approach and components

Course Contents

UNIT-I **Hours-3**
Definition, concept and characteristics of dry land farming. Dry land versus rainfed farming. Significance and dimensions of dry land farming in Indian agriculture. Soil and climatic parameters with special emphasis on rainfall characteristics.

UNIT-II **Hours-4**
Constraints limiting crop production in dry land areas. Types of drought. Characterization of environment for water availability. Crop planning for erratic and aberrant weather conditions. Anti-transpirants, soil and crop management techniques, seeding and efficient fertilizer use. Fertilizer placement top dressing and foliage application.

UNIT-III **Hours-4**
Stress physiology and resistance to drought, adaptation of crop plants to drought and drought management strategies. Preparation of appropriate crop plans for dry land areas, contingent plan for aberrant weather conditions.

UNIT-IV **Hours-4**
Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage, concept of conservation tillage, tillage in relation to weed control and moisture conservation, techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics).

Course Title: Lab-Dryland farming and watershed management
Course Code: AGRON504

L	T	P	Credits
0	0	2	1

Course Contents

- Study about the Seed treatment.

- To study about the seed germination and crop establishment in relation to soil moisture contents
- Effect of moisture stress and recovery behaviour of important crops,
- Estimation of moisture index and aridity index;
- Spray of anti-transpirants and their effect on crops,
- Collection and interpretation of data for water balance equations,
- Study about water use efficiency,
- Preparation of crop plans for different drought conditions.
- Visit to dryland farming unit at farmer's field.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- Dhopte. A.M. 2020. Agro technology for Dry Land Farming. Scientific Publ.
- Dhruv Narayana, V.V. 2022. Soil and Water Conservation Research in India.
- ICAR.
- Rao, S.C. and Ryan, J. 2022. Challenges and Strategies of Dryland Agriculture. Scientific Publishers.
- Singh, P. and Maliwal, P.L. 2021. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.
- Singh, R.P. 2020. Improved Agronomic Practices for Dryland Crops. CRIDA.
- Singh, R.P. 2018. Sustainable Development of Dryland Agriculture in India. Scientific Publ.
- Venkateshwarlu, J. 2019. Rainfed Agriculture in India. Research and Development Scenario. ICAR.

Web Sources

- https://www.agrifarming.in/a-guide-to-dryland-farming-techniques-benefits-and- example crops #:~:text=Dryland %20farming%20 techniques%20 include%20planting,degradation%20and%20decreased%20crop%20yields.
- https://agritech.tnau.ac.in/agriculture/agri_majorareas_dryland_drylandtechnologies.html
- https://prepp.in/news/e-492-dry-land-farming-agriculture-notes

Course Title: Agronomy of oilseed, fiber, sugar and important medicinal and aromatic crops
Course Code: AGRON501

L	T	P	Credits
1	0	0	1

Course Outcomes

After successful completion of this course, the students will be able to:
1. Learn introduction and evaluation of new improved lines of spice crops and medicinal crops.
2. Know about the improved agronomic practice
3. Get knowledge about improved cultivars and productivity.
4. Attain knowledge about Management of pest and diseases.
5. Learn about improved post-harvest techniques for major medicinal and aromatic crops.

Course content

UNIT-I **Hours-4**

Origin and history, area and production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of kharif oilseed crops (Groundnut, sesame, soybean), fiber crops (Cotton, jute, sunn hemp) and sugar crops- sugarcane.

UNIT-II **Hours-3**

Origin and history, area and production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of rabi oilseed crops (rapeseed and mustard, linseed).

UNIT-III **Hours-4**

Description, distribution, climate, soil requirements, cultural practices, processing and important constituents/ quality of medicinal, aromatic, plantation and under- utilized crops, viz., Isabgol, Mentha, Lemongrass, Lathyrus, Sesbania.

UNIT-IV **Hours- 4**

Description, distribution, climate, soil requirements, cultural practices, processing and important constituents/ quality of medicinal, aromatic, plantation and under-utilized crops Cluster bean, French bean, Grain Amaranth, Coffee and Tea.

Course Title: Lab- Agronomy of oilseed, fiber, sugar and important medicinal and aromatic crops
Course Code: AGRON502

L	T	P	Credits
0	0	2	1

Course content

1. Study about the Planning and layout of field experiments.
2. Cultivation of sugarcane crop and estimation of its quality parameters.
3. Intercultural operations in different crops;
4. Study about Cotton seed treatment;
5. Working out growth indices of prominent intercropping systems;
6. Judging of physiological maturity in different crops and working out harvest index;
7. Working out cost of cultivation of different crops;
8. Estimation of crop yield on the basis of yield attributes;
9. Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities;
10. Determination of oil content in oilseeds and computation of oil yield;
11. Estimation of quality of fiber of different fiber crops;
12. Study of seed production techniques in various crops;
13. Identification of crops based on morphological and seed characteristics;
14. Raising of herbarium of medicinal, aromatic and under-utilized plants.
15. Visit of field experiments.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Das NR. 2020. Introduction to Crops of India. Scientific Publ.
- Das PC. 2019. Oilseed Crops of India. Kalyani Publisher, New Delhi.
- Lakshmikantam N. 2021. Technology in Sugarcane Growing. 2ndEd. Oxford & IBH.
- Prasad, Rajendra. 2020. Text Book of Field Crop Production. ICAR.
- Singh C, Singh P & Singh R. 2021. Modern Techniques of Raising Field Crops. Oxford & IBH.
- Singh SS. 2020. Crop Management. Kalyani Publisher, New Delhi.

Web Sources

- https://www.scientificpubonline.com/bookdetailintroduction-crops-india-2nd- ed/9789386652294/0
- https://www.bagchee.com/books/BB40303/introduction-to-crops-of india https://www.indianjournals.com/ijor.aspx?target=ijor:ija&type=home

Course Title: Technical Writing and Communication Skills
Course Code: PGC504

L	T	P	Credits
0	0	2	1

Total hours- 30

Learning Outcomes:

After successful completion of this course, the students will be able to:

1. Understand and know how to follow the stages of the writing process prewriting/writing/rewriting) and apply them to technical and workplace writing tasks.

2. Produce a set of documents related to technology and writing in the or place and will have improved their ability to write clearly and accurately.

3. Understand the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

4. Familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.

5. Learn about how to do writing of abstracts, summaries and what are citations etc.

Course Contents

Various forms of scientific writings: thesis, technical papers, review, manuals etc., various parts of thesis and research communications: title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion; writing of abstracts, summaries, précis, citations etc. commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; paginations, numbering of tables and illustrations; writing of numbers and dates in scientific write-ups; editing and proof reading; writing a review article, access methods..

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Day, R.A. and Gastel, B. 2011. How to Write and Publish a Scientific Paper, 7th Edition. GreenwoodPress,United States. pp. 300.*
- *Laplante, P.A. 2011. Technical Writing: A Practical Guide for Engineers and Scientists. CRC Press, London. pp. 250.*
- *Greenlaw,R. 2012. Technical Writing, Presentational Skills and Online Communication: Professional Tools and Insights. Idea Group, U.S. pp. 247.*

Semester 4th

Course Title: Land degradation and restoration
Course Code: SOIL521

L	T	P	Credits
2	0	0	1

Total hours - 30

Learning Outcomes:

After successful completion of this course, the students will be able to:

Course Outcomes:

1. Have knowledge regarding basic concept of problematic soils
2. Learn about the knowledge regarding the diagnosis and reclamation of saline - alkaline soils
3. Attain the knowledge regarding the diagnosis and reclamation of acidic soils
4. Learn regarding the management of sandy, clayey, compact and waterlogged soils
5. Acquire knowledge about the diagnosis and management of poor-quality irrigation water

Course content

Theory:

UNIT I **8hours**

Type, factors and processes of soil/land degradation and its impact on soil productivity including soil fauna, biodegradation and environment.

UNIT II **7hours**

Land restoration and conservation techniques-erosion control, reclamation of salt affected soils; Mineral and reclamation, afforestation, organic products.

UNIT III **8hours**

Extent, diagnosis and mapping of land degradation by conventional and modern RS- GIS tools; monitoring land degradation by fast assessment.

UNIT IV **7hours**

Modern tools, land use policy, incentives and participatory approach for reversing and degradation; global issues for twenty first century.

Suggested Readings

- *Biswas TD and Narayanasamy G. (Eds.). 1996. Soil Management in Relation to Land Degradation and Environment. Bull. Indian Soc. Soil Sci. 17, New Delhi.*
- *Doran JW and Jones AJ. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Madison.*
- *Greenland DJ and Szabolcs I. 1994. Soil Resilience and Sustainable Land Use. CABI.*
- *Lal R, Blum WEH, Vailentine C and Stewart BA. 1997. Methods for Assessment of Soil Degradation. CRC Press.*
- *Sehgal J and Abrol IP. 1994. Soil Degradation in India - Status and Impact. Oxford & IBH.*

Course Title: Lab- Land degradation and restoration
Course Code: SOIL522

L	T	P	Credits
0	0	2	1

30 hours

Learning Outcomes:

After successful completion of this course, the students will be able to:
Attain the knowledge regarding the diagnosis and reclamation of acidic soils.

Course content

- Experience on restoration of degraded soil for optimization of crop yield.
- Aerial photo and satellite data interpretation for soil and land use
- Characterization of acid soils
- Characterization of acid sulfate soils
- Characterization of salt- affected soils
- Characterization of calcareous soils.
- Determination of cations (Na+, K+, Ca+, and Mg++) in ground water
- Determination of cations (Na+, K+, Ca+, and Mg++) in soil samples.
- Determination of anions (CI, SO_4^{2-} , CO 3 2- and HCO3 -) in ground waters and soil samples.
- Lime requirement of acid and sodic soil
- Gypsum requirement of acid and sodic soil.

Suggested Readings

- *Biswas TD and Narayanasamy G. (Eds.). 1996. Soil Management in Relation to Land Degradation and Environment. Bull. Indian Soc. Soil Sci. 17, New Delhi.*
- *Doran JW and Jones AJ. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Madison.*
- *Greenland DJ and Szabolcs I. 1994. Soil Resilience and Sustainable Land Use. CABI.*
- *Lal R, Blum WEH, Vailentine C and Stewart BA. 1997. Methods for Assessment of Soil Degradation. CRC Press.*

Sehgal J and Abrol IP. 1994. Soil Degradation in India - Status and Impact. Oxford & IBH.

Web Sources

- https://www.agriexam.com/introduction-to-soil-science-book-pdf
- https://cdnsciencepub.com/doi/10.1139/cjss-2018-0006
- https://www.agrimoon.com/wpcontent/uploads/Introduction-to-Soil-Science.pdf

Course Title: Intellectual Property and its Management in Agriculture
Course Code: PGC505

L	T	P	Credits
0	0	1	1

Course Outcomes

On successful completion of this course, the students will able to:
1. Equip students and stakeholders with
2. Know about Intellectual Property Rights (IPR) related protection systems
3. Make use of IPR as a tool for wealth and value creation in a knowledge-based economy.
4. International Treaty on Plant Genetic Resources for Food and Agriculture

Course Content

Unit-I **3 hours**

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs.

Unit-II **4 hours**

Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks.

Unit-III **4 hours**

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.

Unit-IV **4 hours**

National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

- Erbisch FH and Maredia K.1998. Intellectual Property Rights in AgriculturalBiotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing KnowledgeEconomy.McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC
- And Aesthetic Technologies

Course Title: Master's Research
Course Code: SOIL600

L	T	P	Credits
0	0	30	30

Learning Outcomes:

On successful completion of this course, the students willable to:

1. Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
2. Negotiate, plan, design and execute a research-based project,
3. Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
4. Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments
5. Familiarize with indexing databases, citation databases: web of science, scopus etc.