GURU KASHI UNIVERSITY

M.Sc. Soil Science (SOIL)

Session: 2025-26

Department of Soil Science

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 ofnutrient 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>Supporting courses</td><td>06</td></tr>
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<tr><td>Seminar</td><td>01</td></tr>
<tr><td>(ii) Thesis Research</td><td>30</td></tr>
<tr><td>Total</td><td>70</td></tr>
</table>
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<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**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
SOIL501	Soil Fertility and Fertilizer Use	Major	2	0	0	2	30	70	100
BIO501	Plant Physiology	Minor	2	0	0	2	30	70	100
STAT501	Agricultural Statistics	Supporting	3	0	0	3	30	70	100
PGC501	Library and Information Services-Lab	Common	0	0	2	1	30	70	100
PGC502	Agricultural Research, Research Ethics and Rural Develop-mentProgra mmes	Common	1	0	0	1	30	70	100
SOIL502	Soil Fertility and Fertilizer Use – Lab	Major	0	0	2	1	30	70	100
BIO502	Plant Physiology-Lab	Minor	0	0	2	1	30	70	100
STAT502	Agricultural Statistics-Lab	Supporting	0	0	2	1	30	70	100
SOIL500	Masters Research	Research	-	-	-	5	S/US	S/US	S/US
Total						**17**	240	560	800

SEMESTER-II									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
SOIL551	Soil Chemistry	Major	2	0	0	2	30	70	100
SOIL553	Crop production in Problem Soils and Water	Major	2	0	0	2	30	70	100
AGRON553	Irrigation Water Management	Minor (CBCS) (Choose any one)	2	0	0	2	30	70	100
AGRON555	Weed Management								
CA551	Fundamentals of Computer Applications-Lab	Supporting		-	4	2	30	70	100
SOIL552	Soil Chemistry-Lab	Major	0	0	2	1	30	70	100
SOIL554	Crop production in Problem Soils and Water - Lab	Major	0	0	2	1	30	70	100
AGRON554	Irrigation Water Management-Lab	Minor (CBCS) (Choose any one)	0	0	2	1	30	70	100
AGRON556	Weed Management-Lab								
SOIL555	Seminar	Seminar	-	-	-	1	30	70	100
PGC551	Basic Concepts in Laboratory Techniques-Lab	Common	0	0	2	1	30	70	100
SOIL500	Masters Research	Research	-	-	-	5	S/US	S/US	S/US
Total						**18**	270	630	900

SEMESTER-III									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
SOIL601	Soil Mineralogy, Genesis and Classification	Major	2	0	0	2	30	70	100
SOIL603	Soil Physics	Major	2	0	0	2	30	70	100
PGC600	Technical Writing and Communication Skills-Lab	Common	0	0	2	1	30	70	100
SOIL602	Soil Mineralogy, Genesis and Classification – Lab	Major	0	0	2	1	30	70	100
SOIL604	Soil Physics Lab	Major	0	0	0	1	30	70	100
SOIL605	Analytical Technique and Instrumental Methods in Soil and Plant Analysis	Major	0	0	4	2	30	70	100
SOIL500	Masters Research	Research	-	-	-	10	S/US	S/US	S/US
Total						**19**	**180**	**420**	**600**

SEMESTER-IV									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
SOIL651	Soil Biology and Biochemistry	Major	2	0	0	2	30	70	100
AGRON651	Agronomy of Major Cereal and Pulse crops	Major	1	0	0	1	30	70	100
PGC651	Intellectual Property And its management in Agriculture	Common	1	0	0	1	30	70	100
SOIL652	Soil Biology and Biochemistry – Lab	Major	0	0	2	1	30	70	100
AGRON652	Agronomy of Major Cereal and Pulse crops – Lab	Major	0	0	2	1	30	70	100
SOIL500	Masters Research	Research	-	-	-	10	S/US	S/US	S/US
Total						**16**	150	350	500
Grand Total						**70**			

Semester I

Course Title: Soil Fertility and Fertilizer Use
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:
1. Acquire the knowledge regarding the concept of soil fertility and soil Productivity
2. Get the knowledge regarding the concept of nutrients sources
3. Attain knowledge regarding the concept of transformation of nutrients (NPK)
4. Learn about the concept of availability of micro nutrients and their transformation
5. Know the concept of site specific nutrient management concept of soil fertility evaluation and soil quality.

Course Contents

UNIT-I
7hours
Soil fertility and soil productivity. Nutrient sources – fertilizers and manures. Soil N – sources and N transformations.

UNIT-II **8hours**
Biological nitrogen fixation. Nitrogenous fertilizers - their fate in soils and enhancing N use efficiency. Soil P - forms, reactions in soils and factors affecting availability. Management of P fertilizers. Potassium- forms, mechanism of fixation, Q/I relationships.

UNIT-III **7hours**
Management of K fertilizers. Sulphur, Ca and Mg – source, forms, fertilizers and their behavior in soils and management. Micronutrients- critical limits in soils and plants, factors affecting their availability, sources and management. Common soil test methods for fertilizer recommendations.

UNIT-IV **8hours**
Site-specific and plant need based nutrient management. Concept of balanced nutrition and integrated nutrient management. Blanket fertilizer recommendations- usefulness and limitations. Soil fertility evaluation. Soil quality in relation to sustainable agriculture.

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 Fertility and Fertilizer Use
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:

1. Have knowledge regarding the laboratory and green house experiment are evaluation of indices of nutrient availability
2. Acquire knowledge about calculation of critical values of nutrients in soil and Plants
3. Determine the total and available nutrients in soils
4. Know about the skill development regarding analysis of nutrients in plants
5. Know the concept of site specific nutrient management concept of soil fertility evaluation and soil quality

Course Contents

Laboratory and greenhouse experiments for evaluation of indices of nutrient availability and their critical values in soils and plants. Chemical analysis of soil for total and available nutrients. Analysis of plants for essential elements.

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.

Course Title: Plant Physiology
Course Code: BIO501

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. Get knowledge about the various plant water relations

2. Learn about the mineral nutrition in plants

3. Understand the mechanism of various metabolic processes in plants

4. Know the basic knowledge about growth and development in plants

5. Learn about skills and techniques related to plant physiology so that they can design their own experiments

Course Contents

UNIT-I **7hours**
Photosynthesis, pigments, CO_2 fixation and reduction. Carbohydrate synthesis in C_3,C_4 and CAM plants.

UNIT-II **8hours**
Translocation of metabolites. Photo respiration. Environmental and agricultural aspects of photosynthetic efficiency, source- sink relationship and productivity. Respiration. Concept of growth, differentiation and pattern formation. Factor affecting growth and general aspects of development.

UNIT-III **7hours**
Hormones and growth regulators -auxins, gibberellins, cytokinins, ethylene and ABA. Other inhibitors. Retardants. Polyamines. Alliphaticalcohols. Brassins. Hormonal regulation of growth & development. Photoperiodism. Flowering hormones, Vernalization. Abscission. Aging. Senescence.

UNIT-IV **8hours**
Physiology of seed and fruit development. Seed germination. Seed and bud dormancy. Plant water relationship. Osmotic potential, water potential. Pressure potential and their relationship. Plasmolysis. Imbibitions. Absorption and translocation of water. Stomata, stomata mechanism. Factor affecting water loss. Physiological role of nutrients.

Transaction Mode

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

Suggested Readings

Plant Physiology and Development by Eduardo Zeiger and Lincoln Taiz.2000.

Physicochemical and Environmental Plant Physiology by Park Nobel. 2002.

Fundamentals of Plant Physiology by V.K. Jain. 2000.

Web Sources

- https://www.sciencedirect.com/book/9780123741431/physicochemical-and-environmental-plant-physiology
- https://besjournals.onlinelibrary.wiley.com/doi/full/10.1046/j.1365-2664.1999.00459-5.x
- https://go.gale.com/ps/i.do?id=GALE%7CA63605079&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=0011183X&p=AONE&sw=w&userGroupName=anon%7E8b5a362f

Course Title: Lab - Plant Physiology
Course Code: BIO 502

L	T	P	Credits
2	0	0	2

30hours

Learning Outcomes:
After successful completion of this course, the students will be able to:
1. Understand the mechanism of various metabolic processes in plants
2. Acquire basic knowledge about growth and development in plants
3. Equip students with skills and techniques related to plant physiology so that they can design their own experiments
4. Know the basic knowledge about growth and development in plants
5. Equip students with skills and techniques related to plant physiology so that they can design their own experiments

Course Contents

Experiments related to photosynthesis. Chlorophyll and other pigment determination. Experiments related to respiration, Osmosis, 1mbitition, Plasmolysis. Measurements of μw and μs. Membrane permeability. Transpiration experiments. catalase, peroxidase and nitrate reductase activities as indicators of Nutrient status of crop. Experiment on growth measurements. Experiment on quality of light on seed germination. Breaking of dormancy. Experiment on photo-periodism. Experiment on hormonal regulation and development.

Suggested Readings

Plant Physiology and Development by Eduardo Zeiger and Lincoln Taiz.2000.

Physicochemical and Environmental Plant Physiology by Park Nobel. 2002.

Fundamentals of Plant Physiology by V.K. Jain. 2000.

Course Title: Lab - 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: STAT501

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: Lab - Library and Information Services
Course Code: PGC501

L	T	P	Credits
1	0	0	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: Lab - 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 Chemistry
Course Code: SOIL551

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 Soilcolloids andtheir concept.

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

4 Aabout 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**

on 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.Statisticalmechanics.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.Conceptofquantity/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: SOIL552

L	T	P	Credits
0	0	0	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 andtheir 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: Crop production in Problem Soils and Water
Course Code: SOIL553

L	T	P	Credits
2	0	0	2

Total hours - 30

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

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 Contents

UNIT-I **Hours-7**
Area, distribution, origin and basic concepts of problematic soils. Morphological features and characterization of salt-affected soils.

UNIT-II **Hours-8**
Management of salt- affected soils. Salt tolerance of crops - mechanism and ratings. Monitoring of soil salinity in the field. Management principles for sandy, clayey, red lateritic and dry land soils.

UNIT-III **Hours-8**
Acid soils – nature, sources and management. Effect on plant growth. Lime requirement of acid soils. Biological sickness of soils and its management. Quality of irrigation water, principles and management of brackish water.

UNIT-IV **Hours-7**
Salt balance under irrigation. Characterization of brackish waters, area and extent. Agronomic practices in relation to problematic soils. Cropping pattern for utilizing poor quality ground waters.

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

Suggested Readings

- *Introductory Soil Science by D.K. Das. 2021.*

- *Principles of Agronomy by S. R. Reddy. 2022.*
- *Principles Of Agronomy by Reddy & Reddy. 2020.*

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/wp-content/uploads/Introduction-to-Soil-Science.pdf

Course Title: Lab - Crop production in Problem Soils and Water
Course Code: SOIL554

L	T	P	Credits
0	0	2	1

30 hours

Course Outcomes:

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

1. Have knowledge regarding the characterization of acid, acid sulphate, salt -affected and calcereous soils.
2. Attain knowledge about the determination of cations (Na+, K+, Ca++ and Mg++) in ground water and soil samples,
3. Learn about the development regarding the determination of anions (CI, SO4-2 , Co3-2 and HCO3) in ground water and soil
4. Acquire the knowledge about the determination of lime and gypsum requirement of acid and sodic soil
5. Learn regarding the management of sandy, clayey, compact and waterlogged soils

Course Contents

- Characterization of acid soils
- Characterization of acid sulfate soils
- Characterization of salt- affected soils
- Characterization of calcareous soils.
- Determination ofcations (Na+, K+, Ca+, and Mg++) in ground water
- Determination ofcations (Na+, K+, Ca+, and Mg++) in soil samples.
- Determination ofanions (CI-, SO4 2-, CO3 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

- *Introductory Soil Science by D.K. Das. 2021.*
- *Principles of Agronomy by S. R. Reddy. 2022.*
- *Principles Of Agronomy by Reddy & Reddy. 2020.*

Course Title: Irrigation Water Management
Course Code: AGRON553

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. 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.
5. Learn about Micro irrigation system and less water requiring crops

Course Contents

UNIT-I **2hours**
History of irrigation in India; Major irrigation projects in India; Water resources development.

UNIT-II **12hours**
Concepts of irrigation scheduling, Different approaches of irrigation scheduling; 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, transpiration, soil-water-plant relationships and water absorption by plants.

UNIT-III **8hours**
Plant response to water stress. Methods of irrigation viz. surface methods, overhead methods, drip irrigation and air conditioning 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 **8hours**
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; Drainage requirement of crops, methods of field drainage, their layout and spacing.

Transaction Mode

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

Suggested Reading

Paliwal, K.V. 2004. Irrigation with Saline Water. WTC, IARI, New Delhi.

Panda, S. C. 2003. Principles and Practices of Water Management. Agrobios.

Prihar, S. S. and Sandhu.B.S.2000. Irrigation of Field Crops - Principles and practices, ICAR, New Delhi.

Sankara Reddi, G.H. and Yellamanda Reddy, T. 2003 Efficient Use of Irrigation Water. Kalyani , Ludhiana.

Singh, P. and Maliwal, P. L. 2005. 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: Lab- Irrigation Water Management
Course Code: AGRON554

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. Learn about the development regarding Prevention of excess use of water
2. Have knowledge about the development regarding Prevention of soil erosion
3. Have knowledge to determinate of irrigation requirements.
4. Understand the Maintenance of quality of ground water and downstream surface Water
5. Attain the knowledge about development regarding the Increase in crop yield and maintenance of product quality

Course Contents

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

Suggested Readings

Paliwal, K.V. 2004. Irrigation with Saline Water. WTC, IARI, New Delhi.

Panda, S. C. 2003. Principles and Practices of Water Management. Agrobios.

Prihar, S. S. and Sandhu.B.S.2000. Irrigation of Field Crops - Principles and practices, ICAR, New Delhi.

Sankara Reddi, G.H. and Yellamanda Reddy, T. 2003 Efficient Use of Irrigation Water. Kalyani , Ludhiana.

Singh, P. and Maliwal, P. L. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ.

Course Title: Lab- Fundamental of Computer Application
Course Code: CA551

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: Seminar-I
Course Code: SOIL555

L	T	P	Credits
0	0	2	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 Mineralogy, Genesis and Classification
Course Code: SOIL601

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

Theory:
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.Identificationtechniques, 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.Soilprofile.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.Soilclassification.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.*
- *Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I. Concept and Interaction. Elsevier.*

Course Title: Lab-Soil Mineralogy, Genesis and Classification
Course Code: SOIL602

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.*
- *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.*
- *Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I. Concept and Interaction. Elsevier.*

Course Title: Soil Physics
Course Code: SOIL603

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 the concept of soil physics
2. Get the knowledge regarding physical properties of soil and impact on soil productivity.
3. Attain knowledge regarding the effect of properties on Soil structure - genesis, types, characterization and management soil structure
4. Learn about the concept of Soil water: content and potential. Soil water retention, soil-water constants and measurement.
5. Know the concept of Modes of energy transfer in soils;, soil temperature in relation to plant growth and temperature management

Theory

UNIT I **Hours- 8**

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 **Hours- 7**

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.

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 III **Hours- 8**

Water flow in saturated and unsaturated soils. Poiseuille's law, Darcy's law, hydraulic conductivity, permeability and fluidity, hydraulic diffusivity, measurement of hydraulic conductivity in saturated and unsaturated soils.

Infiltration, internal drainage and redistribution, evaporation; hydrologic cycle, field water balance. Soil-plant- atmosphere continuum.

UNIT IV **7 Hours**

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.

Suggested Readings

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

Course Title: Lab- Soil Physics
Course Code: SOIL604

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. Acquire the knowledge regarding the concept of soil physics
2. Get the knowledge regarding physical properties of soil and impact on soil productivity.
3. Attain knowledge regarding the effect of properties on Soil structure - genesis, types, characterization and management soil structure
4. Learn about the concept of Soil water: content and potential. Soil water retention, soil-water constants and measurement.
5. Know the concept of Modes of energy transfer in soils;, soil temperature in relation to plant growth and temperature management

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.

Suggested Readings

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

- *Lal R & Shukla MK. 2004. Principles of Soil Physics. Marcel Dekker.*
- *Oswal MC. 1994. Soil Physics. Oxford & IBH. Saha AK. 2004. Text Book of Soil Physics. Kalyani.*

Course Title: Technical Writing and Communication Skills
Course Code: PGC600

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 et

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.

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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.

Course Title: Analytical Technique and Instrumental Methods in Soil and Plant Analysis
Course Code: SOIL605

L	T	P	Credits
0	0	4	2

Total hours - 60

After successful completion of this course, the students will be able to:
1. Acquire the knowledge on analytical techniques and instrumental methods used soilanalysis
2. Get the knowledge regarding knowledge on analytical techniques and instrumental methods used for irrigation water
3. Attain knowledge regarding knowledge on analytical techniques and instrumental methods used for fertilizer analysis the concept of transformation of nutrients (NPK)
4. Attain knowledge regarding knowledge on analytical techniques and instrumental methods used for plant analysis

Practical

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. 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, ultraviolet and infra-red 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. Electrochemical titration of clays. Estimation of exchangeable cations (Na, Ca, Mg, K). Estimation of root cation exchange capacity.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. Drawing normalized exchange isotherms.Measurement of redox potential

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 & Keeney DR. 1982. Methods of Soil Analysis. Part II. SSSA, Madison.*
- *Piper CE. Soil and Plant Analysis. Hans Publ. Singh D,*

- *Chhonkar PK & Pandey RN. 1999. Soil Plant Water Analysis – A Methods Manual. IARI, New Delhi.*
- *Tan KH. 2003. Soil Sampling, Preparation and Analysis. CRC Press.*
- *Taylor & Francis. Tandon HLS. 1993. Methods of Analysis of Soils, Fertilizers and Waters. FDCO, New Delhi.*
- *Vogel AL. 1979. A Textbook of Quantitative Inorganic Analysis. ELBS Longman.*

Semester 4th

Course Title: Soil Biology and Biochemistry
Course Code: SOIL651

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 Types of organisms in different soils..Soilmicrobial 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.andbiofertilizers.

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
andproteinaceousmaterials.Cycles of important organic nutrients. Organic wastes and their use for production of biogas and manures.Biotic factors in soil development.Microbial toxins in the soil.

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: SOIL652

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.Soilmicrobial 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.andbiofertilizers .

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,Soxidation,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.*
- *Wild A. 1993. Soil and the Environment - An Introduction. Cambridge Univ. Press.*

Course Title: Agronomy of Major Cereal and Pulse crops
Course Code: SOIL651

L	T	P	Credits
1	0	0	1

Total hours - 15

Course Outcomes:

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

1. Learn about efficient production systems for major field crops: wheat, gram, rapeseed & mustard, oat, barley.
2. Fulfill the demands of commercial firms, farmers, industrials and consumers
3. Attain knowledge about enhance the quality & productivity of crop production
4. New technologies in crop production: fertigation & new varieties.
5. Get knowledge of cropping and farming systems

Course Contents

UNIT-I **4hours**

Origin, modern history, area, production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of kharif cereals - rice, maize, sorghum, millets

UNIT-II **4hours**

Origin, modern history, area, production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Rabi cereals - wheat, barley

UNIT-III **3hours**

Origin, modern history, area, production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of *Kharif* pulse crops- *Pigeonpea*, *mungbean, urdbean*

UNIT-IV **4hours**

Origin, modern history, area, production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components,handling and processing of the produce for maximum production of *Rabi* pulses- *chickpea*, *Field*

*pea*and*lentil*

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

Suggested Readings

- *Das NR. 2019. Introduction to Crops of India. Scientific Publ.*
- *Hunsigi G & Krishna KR. 2022. Science of Field Crop Production. Oxford & IBH.*
- *Jeswani LM & Baldev B. 2020. Advances in Pulse Production Technology. ICAR.*
- *Khare D &Bhale MS. 2021. Seed Technology. Scientific Publ.*
- *Kumar Ranjeet & Singh NP. 2022. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.*
- *Pal M, Deka J & Rai RK. 2019. Fundamentals of Cereal Crop Production. Tata McGraw Hill.*
- *Prasad, Rajendra. 2022. Text Book of Field Crop Production. ICAR.*
- *Singh C, Singh P & Singh R. 2020. Modern Techniques of Raising Field Crops. Oxford & IBH.*

Web Sources

- https://www.perennia.ca/wp-content/uploads/2018/03/Cereal-Crops-Production-Guide-web.pdf
- https://www.britannica.com/topic/cereal-farming
- https://saiplatform.org/wp-content/uploads/2006/06/sai_platform_principles_practices_cereals.pdf

Course Title: Lab- Agronomy of Major Cereal and Pulse crops
Course Code: AGRON652

L	T	P	Credits
0	0	2	1

30 hours

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

1. Know about the phonological studies at different crop growth stages
2. Acquire knowledge about formulation of cropping scheme for various farm sizes
3. Know about working of growth indices of prominent intercropping systems
4. Attain knowledge about skill development regarding : planning and layout of the field experiments
5. Get knowledge about skill development regarding the termination of cost cultivation and working out harvest index of various crops
6. Understand about various seed production techniques of crops

Course Content

- Phenological studies at different growth stages of crop.
- Estimation of crop yield on the basis of yield attributes.
- Formulation of cropping schemes for various farm sizes.
- Calculation of cropping and rotational intensities.
- Working out growth indices of prominent intercropping systems of different crops.
- Estimation of protein content in pulses.
- Planning and layout of field experiments.
- Intercultural operations in different crops.
- Determination of cost of cultivation of different crops.
- Working out harvest index of various crops.
- Study of seed production techniques in various crops.
- Visit of field experiments.

Suggested Readings

- *Das NR. 2019. Introduction to Crops of India. Scientific Publ.*
- *Hunsigi G & Krishna KR. 2022. Science of Field Crop Production. Oxford & IBH.*
- *Jeswani LM & Baldev B. 2020. Advances in Pulse Production Technology. ICAR.*

- *Khare D &Bhale MS. 2021. Seed Technology. Scientific Publ.*
- *Kumar Ranjeet & Singh NP. 2022. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.*
- *Pal M, Deka J & Rai RK. 2019. Fundamentals of Cereal Crop Production. Tata McGraw Hill.*
- *Prasad, Rajendra. 2022. Text Book of Field Crop Production. ICAR.*
- *Singh C, Singh P & Singh R. 2020. Modern Techniques of Raising Field Crops. Oxford & IBH.*

Course Title: Master's Research
Course Code: SOIL500

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.