GURU KASHI UNIVERSITY

M.Sc. Agronomy

Session : 2023-24

Department of Agronomy

Graduate Outcomes of the programme

Develop proficiency in different methods of different types of field crops cultivation and resource utilization problems. Inculcate rational thinking in the students by the introduction of the conditions of rationality in the areas of consumption, production and distribution. Understand firm and farm level decision rules for the efficient growing and handling of organic farming at field and standard for export of farm produce.

Program Learning Outcomes

After completing the programme, the learner will be able to:

1. Acquire knowledge about efficient production systems for major field crops, to enhance the quality & productivity of crop production, to introduce new technologies in crop production: fertigation & new varieties, to understand the morphology & physiology of crops.

2. Learn principles and techniques for agronomy of *rabi* oil seed, *kharif* oil seed, fibre crops, sugar crops, forage crops, medicinal and aromatic crops along with their estimation for quantitative and qualitative parameters for growth, yield and quality.

3. Explore production technology of *kharif* and *rabi* fodder crops, principles and methods of hay and silage making, value addition of quality fodder, seed production techniques of fodder crops.

4. Inculcate skills of cropping systems under different land use pattern, farming systems, allelopathic effects, selection of plants for dry land, forage crop production, different indices like LER, CEY etc

5. Establish different methods of irrigating different field crops and managing water as precious element of crop production and increasing water use efficiency. To develop the skill for measurement of soil moisture by different direct and indirect methods

6. Comprehend weed control by different methods in field crops, herbicide structure factors affecting herbicide selectivity in different situations, calculation of cost benefit ratio, weed control efficiency, Herbicide residue

7. Get familiar with the physical source, soil and water management in cropping system, concept of sustainability in cropping system, different types of cropping system, crop diversification for sustainable productivity, crop intensification, concept of organic farming, organic standards and classifications in relevant to India and global agriculture, organic manures and their applicability for sustainable agriculture

8. Diffrentiate about the crop growth analysis, quantitative agro-biological principles, crop yield equation, physiology of grain yield in cereals, concept of ideal plant type, yield and environmental stress, Climate change, weather forecasting and global warming, resources conservation technology and crop residue management-recycling and precision agriculture

9. Provide knowledge about the concepts of soil fertility and productivity, essential plant nutrients & their importance, transformation; it also imparts preparation and use of Farm Yard Manures, commercial manure and fertilizers, fertilizer mixtures, ways to increase fertilizer use efficiency.

10. Develop Statistical procedures apply in all the areas of experimental work and they have a very important role in agriculture, decision making, agriculture development and estimates agriculture and national income

Programme Structure

SEMESTER-1st						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**Credit**
MAR103	Agronomy of Oilseed, Fiber, Sugar and Important Medicinal and Aromatic Crops	Major	2	0	0	2
MAR107	Dry Land Farming and Water Shed Management	Major	3	0	0	3
MAR119	Plant Physiology	Minor (CBCS)	3	0	0	3
MAR132	Soil erosion and conservation					
MAR121	Agricultural Statistics	Supporting	3	0	0	3
MAR125	Lab -Library and Information Services	Common		-	4	2
MAR104	Lab: Agronomy of Oilseed, Fiber, Sugar and Important Medicinal and Aromatic Crops	Major	0	0	2	1
MAR108	Lab: Dry Land Farming and Water Shed Management	Major	0	0	2	1
MAR120	Lab: Plant Physiology	Minor	0	0	2	1
MAR133	Lab: Soil erosion and conservation	Minor				
MAR122	Lab: Agricultural Statistics	Supporting	0	0	2	1
MAR100	Masters Research	Thesis research	-		6	3(NC)
Total						**17+3NC**
SEMESTER-2nd						
MAR201	Agronomy of Fodder and Forage/ Pasture Crops	Major	2	0	0	2
MAR202	Irrigation Water Management	Major	3	0	0	3
MAR203	Weed Management	Major	3	0	0	3
MAR204	Crop production in Problem Soils and Water	Minor (CBCS)	2	0	0	2
MAR205	Soil, water and air pollution					
MAR206	Lab -Fundamentals of Computer Applications	Supporting		-	4	2
MAR207	Lab: Agronomy of Fodder and Forage/ Pasture Crops	Major	0	0	2	1

MAR208	Lab: Irrigation Water Management	Major	0	0	2	1
MAR209	Lab: Weed Management	Major	0	0	2	1
MAR210	Lab: Crop production in Problem Soils and Water	Minor (CBCS)	0	0	2	1
MAR211	Lab: Soil, water and air pollution					
MAR212	Seminar-I	Seminar	NA	NA	2	2
MAR100	Masters Research	Thesis research	-		4	2(NC)
Total						**18+2NC**
SEMESTER-3rd						
MAR301	Modern Concepts in Crop Productions	Major	3	0	0	3
MAR302	Soil Fertility and Fertilizer Use	Minor (CBCS)	3	0	0	3
MAR303	Soil microbiology					
MAR304	Lab-Technical Writing and Communication Skills	Common		-	4	2
MAR305	Lab: Soil Fertility and Fertilizer Use	Minor (CBCS)	0	0	2	1
MAR306	Lab: Soil microbiology					
MAR100	Masters Research	Thesis Research	-		26	11(NC)
Total						**9+11NC**
SEMESTER-4th						
MAR401	Agronomy of Major Cereal and Pulse crops	Major	3	0	0	3
MAR402	Intellectual Property And its management in Agriculture	Common	2	0	0	2
MAR403	Lab: Agronomy of Major Cereal and Pulse crops	Major	0	0	2	1
MAR100	Masters Research	Thesis Research	-		28	14(NC)
Total						**6+14NC**
Grand Total						**36+35=71**

CBCS- Choice based credit system.NC- Non credit

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks]

Continuous Assessment 1: [10 Marks]

Continuous Assessment 2: [10 Marks]

Continuous Assessment 3: [05 Marks]

B. Mid Semester Test: [30 Marks]

C. End-Term Exam: [40 Marks]

D. Attendance: [5 Marks]

For the CAs the teacher shall take surprised test/term, paper/quiz/assignments etc.

Evaluation Criteria for practical Courses

The syllabus of subject is divided into five experiments, each experiment contains 20 marks (10 lab performance, 5 viva, 5 lab record)- Total marks 100

Evaluation Criteria for Seminar

It is of total Marks-100

Collection of review of literature - 20marks

Data Analysis -20 marks

Power Point Presentation - 20 marks

Presentation skills - 20 marks

Viva voce - 20 marks

Evaluation Criteria for Master Research

The evaluation is Satisfactory or Unsatisfactory on the basis of the performance of thecandidate.

Course Title: Agronomy of Oilseed, Fiber, Sugar and Important Medicinal and Aromatic Crops

L	T	P	C
2	0	2	3

Course Code: MAR103

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able to:

1. Express introduction and evaluation of new improved lines of spice crops and medicinal crops.
2. Distinguish about the improved agronomic practice
3. Get Familiar about improved cultivars and productivity.
4. Attain knowledge about Management of pest and diseases.
5. Develop improved post-harvest techniques for major medicinal and aromatic crops.

Course content

UNIT-I **Hours-11**

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, castor, sunflower, soybean,), fiber crops (Cotton, jute, sunnhemp) and sugar crops (Sugar- beet and sugarcane).

UNIT-II **Hours-13**

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-12**

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

UNIT-IV **Hours- 9**

Description, distribution, climate, soil requirements, cultural practices, processing and important constituents/ quality of medicinal, aromatic,

plantation and under-utilized crops Clusterbean, French bean, Celery, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco Turmeric.

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.*
- *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*

Web Sources

- https://www.scientificpubonline.com/bookdetail/introduction-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: Lab- Agronomy of Oilseed, Fiber, Sugar and important Medicinal and Aromatic Crops

Course Contents

- Planning and layout of field experiments.
- Cultivation of sugarcane crop and estimation of its quality parameters. Intercultural operations in different crops;
- Cotton seed treatment;
- Working outgrowth indices of prominent intercropping systems;
- Judging of physiological maturity in different crops and working out harvest index;
- Working out cost of cultivation of different crops;
- Estimation of crop yield on the basis of yield attributes;
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities;

- Determination of oil content in oilseeds and computation of oil yield; Estimation of quality of fiber of different fiber crops; Study of seed production techniques in various crops;
- Visit of field experiments.
- Identification of crops based on morphological and seed characteristics; Raising of herbarium of medicinal, aromatic and under-utilized plants.

Suggested Readings

- *Das NR. 2020. Introduction to Crops of India. Scientific Publ.*
- *Das PC. 2019. Oilseed Crops of India. Kalyani.*
- *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*

Course Title: Dry Land Farming and Water Shed Management

L	T	P	C
2	0	2	3

Course Code: MAR107

Total Hours-60

Learning outcomes: After completion of this course, the learner 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. Acquaint with 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. Formulate the concept of watershed resource management, problems, approach, and components

Course Contents

UNIT-I

Hours-5

Definition, concept and characteristics of dry land farming. Dry land versus rainfed farming. Significance and dimensions of dry land farming in Indian agriculture.

UNIT-II **Hours-10**

Soil and climatic parameters with special emphasis on rainfall characteristics.

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.

UNIT-III **Hours-5**

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-10**

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). Anti-transpirants, soil and crop management techniques, seeding and efficient fertilizer use. Fertilizer placement top dressing foliage application.

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%20techniques%20include%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: Lab- Dry Land Farming and Water Shed Management

Course Contents

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents
- moisture stress effects 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,
- water use efficiency,
- preparation of crop plans for different drought conditions.
- Visit to dryland farming unit at farmer's field.

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.*

Course Title: Plant Physiology

L	T	P	C
2	0	2	3

Course Code: MAR119

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able to:

1. Explore about the various plant water relations.
2. Classify about the mineral nutrition in plants.
3. Comprehend the mechanism of various metabolic processes in plants
4. Distinguish the basic knowledge about growth and development in plants
5. Inculcate the skills and techniques related to plant physiology so that they can design their own experiments

Course Contents

UNIT-I

Hours-3

Photosynthesis, pigments, CO_2 fixation and reduction. Carbohydrate synthesis in C_3,C_4 and CAM plants.

UNIT-II **Hours-8**

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 **Hours-9**

Hormones and growth regulators -auxins, gibberellins, cytokinins, ethylene and ABA. Other inhibitors. Retardants. Polyamines. Alliphatic alcohols. Brassins. Hormonal regulation of growth & development. Photoperiodism. Flowering hormones, Vernalization. Abscission. Aging. Senescence.

UNIT-IV **Hours-10**

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

Suggested Readings

- *Plant Physiology and Development by Eduardo Zeiger and Lincoln Taiz.2021.*
- *Physicochemical and Environmental Plant Physiology by Park Nobel. 2022.*
- *Fundamentals of Plant Physiology by V.K. Jain. 2020.*

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

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.2021.
- Physicochemical and Environmental Plant Physiology by Park Nobel. 2022.
- Fundamentals of Plant Physiology by V.K. Jain. 2020.

Course Title: Soil erosion and conservation
Course Code: MAR132

L	T	P	C
2	0	2	3

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able to:

1. Understand various types of soil erosion.
2. Explain about the measures to be taken for controlling soil erosion to conserve soil and water.
3. Estimate the planning for soil conservation and protection of biodiversity.
4. Recommend about the watershed management in depth.
5. Formulate water harvesting and recycling projects.

Course Contents

UNIT-1 **7**

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;

UNIT-2 **8**

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. Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

UNIT-3 **7**

Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout. 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-VI **8**

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.

Practical

• 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
• Visits to a watersheds

Suggested Readings

- *Biswas TD & Narayanasamy G. (Eds.) 2020. Soil Management in Relation to Land Degradation and Environment. Bull. Indian Society of Soil Science No. 17.*

- *Doran JW & Jones AJ. 2021. Methods of Assessing Soil Quality. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.*
- *Gurmal Singh, Venkataramanan C, Sastry G & Joshi BP. 2021. Manual of Soil and Water Conservation Practices. Oxford & IBH.*

Course Title: Agricultural Statistics

L	T	P	C
3	0	2	4

Course Code: MAR121

Total Hours-60

Learning outcomes: After completion of this course, the learner 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.

Transaction Mode

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

Suggested Readings

- *Panse, V.G. and Sukhatme, P.V.2021. Statistical methods for agricultural workers.*

- *Gupta, S.C. and Kapoor, V.K. 2022. Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.*
- *Snecdecor, G.W. and Cochran, W.G. 2021. Statistical Methods, 8th Edition. Wiley-Blackwell.*
- *Rangaswamy, R. 2019. Textbook of Agricultural Statistics.New Age International (P) Ltd. New Delhi.*

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

Learning outcomes:

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

2. Statistical principles apply in all the areas of experimental work and they have a very important role in agriculture.

3. It is required at the national level and farm level for agriculture policy making, decision making, agriculture development and estimates agriculture and national income.

4. 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.

5. It is helpful in land utilization and irrigation including the net area sown gross cultivated area, current follow, cultivable waste

6. Know how to analyze statistical data graphically using frequencydistributions 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
- 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. 2021. Statistical methods for agricultural workers.*
- *Gupta, S.C. and Kapoor, V.K. 2022. Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.*
- *Snecdecor, G.W. and Cochran, W.G. 2021. Statistical Methods, 8th Edition. Wiley-Blackwell.*
- *Rangaswamy, R. 2019. Textbook of Agricultural Statistics.New Age International (P) Ltd. New Delhi.*

Course Title: Lab - Library and Information Services
Course Code: MAR125

L	T	P	C
0	0	2	1

Total Hours-30
Learning outcomes: After completion of this course, the learner will be able to:

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. 2020. 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. 2020. Library and Information Science. Atlantic Publishers & Distributors. New Delhi. pp. 272.*

Semester-2

Course Title: Agronomy of Fodder and Forage/ Pasture Crops

Course Code: MAR201

L	T	P	C
1	0	2	2

Total Hours-45

Learning outcomes: After completion of this course, the learner will be able to:

1. Explore about the production technology of kharif fodder crops.
2. Acquaintance about the production technology of rabi fodder crops.
3. Attain knowledge about the principles and methods of hay and silage making.
4. Know about the value addition of quality fodder.
5. Compile about the seed production techniques of fodder crops.

Course Contents

UNIT-I **Hours-3**

Adaptation, distribution, varietal improvement, agro-techniques and quality

aspects including anti quality factors of important fodder crops like maize, bajra, guar, cowpea, oats, barley, berseem, senji, lucerne etc.

UNIT-II **Hours-4**

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops like, napier grass, panicum, lasiuras, cenchrus etc.

UNIT-III **Hours-4**

Year-round fodder production and management, preservation and utilization of forage and pasture crops. Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage

UNIT-IV **Hours-4**

Use of physical and chemical enrichments and biological methods for improving nutrition. Value addition ofquality fodder. Economics of forage cultivation uses and seed production techniques.

Transaction Mode

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

Suggested Readings

- *Chatterjee BN. 2022. Forage Crop Production - Principles and Practices. Oxford & IBH.*
- *Das NR. 2021. Introduction to Crops of India. Scientific Publ.*
- *Narayanan TR & Dabadghao PM. 2020. Forage Crops of India. ICAR.*
- *Singh P & Srivastava AK. 2021. Forage Production Technology. IGFRI, Jhansi.*
- *Singh C, Singh P & Singh R. 2019. Modern Techniques of Raising Field Crops. Oxford & IBH.*
- *Tejwani KG. 2018. Agroforestry in India. Oxford & IBH*

Course Title: Lab- Agronomy of Fodder and Forage/ Pasture Crops

Learning outcomes:

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

1. Understand about the phonological studies at different crop growth stages
2. Knowledge about the formulation of cropping scheme for various farm sizes

3. Learn about working of growth indices of prominent intercropping systems and seed production techniques of crops
4. Know the skill development regarding the planning and layout of the field experiments.
5. Get knowledge about development the termination of cost cultivation and working out harvest index of various crops

Course Contents

- Farm operations in raising fodder crops;
- Canopy measurement,
- Yield Estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops;
- Quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops;
- Anti-quality components like HCN in sorghum and such factors in other crops;
- Hay making and economics of their preparation
- Silage making and economics of their preparation.

Suggested Readings

- *Chatterjee BN. 2022. Forage Crop Production - Principles and Practices. Oxford & IBH.*
- *Das NR. 2021. Introduction to Crops of India. Scientific Publ.*
- *Narayanan TR & Dabadghao PM. 2020. Forage Crops of India. ICAR.*
- *Singh P & Srivastava AK. 2021. Forage Production Technology. IGFRI, Jhansi.*
- *Singh C, Singh P & Singh R. 2019. Modern Techniques of Raising Field Crops. Oxford & IBH.*
- *Tejwani KG. 2018. Agroforestry in India. Oxford & IBH*

Course Title: Irrigation Water Management

Course Code: MAR202

L	T	P	C
2	0	2	3

Total Hours-60

Learning outcomes: After completion of this course, the learner 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. Establish Micro irrigation system and less water requiring crops

Course Contents

UNIT-I **Hours-2**

History of irrigation in India; Major irrigation projects in India; Water resources development.

UNIT-II **Hours-12**

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, 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-8**

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, 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 Tile: Lab- Irrigation Water Management

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, 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.

Suggested Readings

- *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.*

Course Title: Weed Management

L	T	P	C
2	0	2	3

Course Code: MAR203

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able to:

1. Get familiar about weed and its four stages of development
2. Comprehend the difference between annual, biennial and perennial weeds
3. Take knowledge about cultural weed controls
4. Identify the advantages and disadvantages of the various method of herbicides applications
5. Estimate herbicide carryover and how to prevent it

Course Contents

UNIT-I **Hours-6**

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-7**

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-9**

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.

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 - Weed Management

Learning outcomes:

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

1. Get knowledge about different weeds.
2. Identify different Herbicides and their mode of action
3. Known about the method of weed control
4. Learn how to preserve weed plants in lab and herbarium
5. Know the advantages and disadvantages of the various method of herbicides applications

Course Contents

- Identification of important crop weeds.
- Preparation of a weed herbarium.
- Weed survey in crops and cropping systems.
- Crop-weed competition studies.
- Weed indices.

- Preparation of spray solutions of herbicides for high and low-volume sprayers. Use of various types of spray pumps and nozzles and calculation of swath width.
- Economics of weed control.
- Herbicide residue analysis in plant and soil.
- Bioassay of herbicide residue.
- Calculation of herbicidal requirement.

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.*

Course Title: Crop production in Problem Soils and Water

L	T	P	C
2	0	2	3

Course Code: MAR204

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able to:

1. Earn knowledge regarding basic concept of problematic soils
2. Acquire knowledge regarding the diagnosis and reclamation of saline - alkaline soils
3. Attain the knowledge regarding the diagnosis and reclamation of acidic soils
4. Comprehend regarding the management of sandy, clayey, compact and waterlogged soils
5. Construct 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 productions in Problem Soils and Water

Learning 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 of cations (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: Soil, water and air pollution
Course Code: MAR205

L	T	P	C
2	0	2	3

Total Hours-60
Learning outcomes: After completion of this course, the learner will be able to:

1. Make the students aware of the problems of soil, water and air pollution associated with use of soils for crop production
2. Identify the Sewage and industrial effluents – their composition and effect on soil health and plant growth and human beings
3. Attain the knowledge regarding the Pollution of water resources due to leaching of nutrients and pesticides from soil
4. Pick up regarding the management of soil and water pollution.
5. Integrate about remediation/amelioration of contaminated soil and water.

Course Contents

UNIT-I **7**

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 **8**

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

UNIT-III **7**

Toxic elements – their sources, behavior 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.

UNIT-IV **8**

Remediation/amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution. Emission of greenhouse gases – carbon dioxide, methane and nitrous oxide.

Practical

• Sampling of sewage waters, sewage sludge, solid/liquid industrial wastes, polluted soils and plants
• Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), nitrate and ammoniacal nitrogen and phosphorus, heavy metal content in effluents
• Heavy metals in contaminated soils and plants
• Management of contaminants in soil and plants to safeguard food safety
• Air sampling and determination of particulate matter and oxides of sulphur
• Visit to various industrial sites to study the impact of pollutants on soil and Plants

Suggested Readings

- *Lal R, Kimble J, Levine E & Stewart BA. 2020. Soil Management and Greenhouse Effect. CRC Press.*
- *Middlebrooks EJ. 2021. Industrial Pollution Control. Vol. I. Agro-Industries. John Wiley Interscience. Ross SM. Toxic Metals in Soil Plant Systems.*
- *John Wiley & Sons. Vesilund PA & Pierce 2022. Environmental Pollution and Control. Ann Arbor Science Publ.*

Course Title: Fundamental of Computer Application Lab
Course Code: MAR206

L	T	P	C
0	0	4	2

Total Hours-60
Learning outcomes: After completion of this course, the learner will be able to:

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. 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. 2020. Computer Fundamentals.Daryaganj, New Delhi. pp. 486.*
- *Manish, S. and Bhatt, A. 2021. Computers in Agriculture: Fundamentals and Applications. New India Publishing Agency.New Delhi. pp. 190.*
- *Manjunath, B.E. 2022.Computer Basics.Vasan Publications, Bengaluru, Karnataka. pp. 356.*

Course Title: Seminar-I
Course Code: MAR207

L	T	P	C
-	-	-	1

Learning outcomes: After completion of this course, the learner will be able 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. Ask appropriate questions, use evidence to support claims, respond to a range of questions

Course Content

Seminar topic will be suggested by faculty

Semester-3

Course Title: Modern Concepts in Crop Productions

L	T	P	C
2	0	0	2

Course Code: MAR301

Total Hours-30

Learning outcomes: After completion of this course, the learner will be able to:

1. Acquire the knowledge about crop growth analysis
2. Attain the knowledge about quantitative agro-biological principles
3. Get knowledge about crop yield equation and physiology of grain yield in cereals
4. Acquire knowledge about the concept of ideal plant type and environmental stress
5. Learn about the resource conservation technologies, residue management-recycling and precision agriculture

Course Contents

UNIT-I **Hours-7**

Crop growth analysis in relation to environment. Agro-ecological zones of India. Quantitative agro-biological principles and inverse yield nitrogen law.

UNIT-II **Hours-8**

Mitscherlich yield equation, its interpretation and applicability, Baule unit. Effect of lodging in cereals. Physiology of grain yield in cereals. Optimization of plant population and planting geometry in relation to different resources

UNIT-III **Hours-8**

Concept of ideal plant type and crop modeling for desired crop yield. Scientific principles of crop production and crop response production functions. Concept of soil plant relations. Yield and environmental stress. Integrated farming systems.

UNIT-IV **Hours-7**

Resource conservation technology including modern concept of tillage, dry farming. Determining the nutrient needs for yield potentiality of crop plants. Crop residue management-recycling and its effective utilization. Remote sensing for yield forecasting. Precision agriculture.

Transaction Mode

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

Suggested Readings

- *Balasubramaniyan P & Palaniappan SP. 2021. Principles and Practices of Agronomy. Agrobios.*
- *Fageria NK. 2020. Maximizing Crop Yields. Marcel Dekker.*
- *Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.*
- *Paroda R.S. 2021. Sustaining our Food Security. Konark Publ.*
- *Reddy SR. 2020. Principles of Crop Production. Kalyani Publ.*
- *Sankaran S & Mudaliar TVS. 2019. Principles of Agronomy. The Bangalore Printing & Publ.*
- *Singh SS. 2020. Principles and Practices of Agronomy. Kalyani.*

Course Title: Soil Fertility and Fertilizer Use

L	T	P	C
2	0	2	3

Course Code: MAR302

Total Hours-60

Learning outcomes: After completion of this course, the learner 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. Establish concept of site specific nutrient management concept of soil fertility evaluation and soil quality

Course Contents

UNIT-I **Hours-7**

Soil fertility and soil productivity. Nutrient sources – fertilizers and manures. Soil N – sources and N transformations.

UNIT-II **Hours-8**

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 **Hours-7**

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 **Hours-8**

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

Suggested Readings

- *Brady NC & Weil R.R 2021. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Fageria NK, Baligar VC & Jones CA. 2022. Growth and Mineral Nutrition of Field Crops. Marcel Dekker.*
- *Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2022. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.*
- *Prasad R & Power JF. 2020. Soil Fertility Management for Sustainable Agriculture. CRC Press.*
- *Yawalkar KS, Agrawal JP & Bokde S. 2021. 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

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

Suggested Readings

- *Brady NC & Weil R.R 2021. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Fageria NK, Baligar VC & Jones CA. 2022. Growth and Mineral Nutrition of Field Crops. Marcel Dekker.*
- *Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2022. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.*
- *Prasad R & Power JF. 2020. Soil Fertility Management for Sustainable Agriculture. CRC Press.*
- *Yawalkar KS, Agrawal JP & Bokde S. 2021. Manures and Fertilizers. Agri-Horti Publ.*

Course Title: Soil Microbiology
Course Code: MAR303

L	T	P	C
2	0	2	3

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able to:

1. Acquire the knowledge regarding the basics of microbiology related to soil including biogeochemical cycles
2. Get the knowledge regarding the plant growth promoting rhizobacteria.
3. Attain knowledge regarding the microbial interactions in soil and other soil activities
4. Learn about the Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures.

5. Develop processes about Organic wastes and their use for production of biogas and manures.

Course Contents

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

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

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

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

Practical

- Determination of soil microbial population; Soil microbial biomass; Decomposition studies 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 micro-nutrients;
- Study of rhizosphere effect.

Suggested Readings

- *Martin Alexander 2021. Soil Microbiology. John Wiley.*
- *Paul EA. 2020. Soil Microbiology, Ecology and Biochemistry. 3rd ed. Academic Press.*

Course Title: Lab - Technical Writing and Communication Skills

Course Code: MAR304

L	T	P	C
0	0	4	2

Total Hours-60

Learning outcomes: After completion of this course, the learner 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.

.

Transaction Mode

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

Suggested Readings

- *Day, R.A. and Gastel, B. 2021. How to Write and Publish a Scientific Paper, 7th Edition. Greenwood Press, United States.*
- *Laplante, P.A. 2022. Technical Writing: A Practical Guide for Engineers and Scientists. CRC Press, London.*
- *Greenlaw, R. 2022. Technical Writing, Presentational Skills and Online Communication: Professional Tools and Insights. Idea Group, U.S.*

Semester-4

Course Title: Agronomy of Major Cereal and Pulse crops

Course Code: MAR401

L	T	P	C
3	0	2	4

Total Hours-60

Learning outcomes: After completion of this course, the learner will be able 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. Design about cropping and farming systems

Course Contents

UNIT-I **Hours-13**

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 **Hours-12**

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 **Hours-9**

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 **Hours-11**

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

Learning Outcomes:
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: Intellectual Property and its Management

in Agriculture

Course Code: MAR402

L	T	P	C
2	0	0	2

Total Hours-30

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

1. Equip students and stakeholders Interaction strategies.

2. Learn about Intellectual Property Rights (IPR) related protection systems.

3. Identify significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

4. Develop channels among National Biodiversity protection initiatives

5. Organize Plant Genetic Resources for Food and Agriculture meets.

Course Content

Unit-I **8 hours**

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

Unit-II **8 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 **5 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 **7 hours**

National Biodiversity protection initiatives; Convention on Biological Diversity;International Treaty on Plant Genetic Resources for Food and

Agriculture; Licensingof technologies, Material transfer agreements, Research collaborationAgreement,License Agreement.

Suggested readings:

1. *Erbisch FH and Maredia K.1998. Intellectual Property Rights in AgriculturalBiotechnology. CABI.*

2. Ganguli P. 2001. Intellectual Property Rights: Unleashing KnowledgeEconomy.McGraw-Hill.

3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC andAesthetic Technologies

Course Title: Master's Research
Course Code: MAR127

L	T	P	C
0	0	0	30

Learning outcomes: After completion of this course, the learner will be able 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. Analyze 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.