Detailed Course Scheme

Master of Science in Agriculture

(Agronomy)

Semester- I

(2024- 26)

DOC202406150005

RNB GLOBAL UNIVERSITY

RNB Global City, Ganganagar Road,
Bikaner, Rajasthan 334601

OVERVIEW

RNB Global University follows Semester System along with Choice Based Credit System as per latest guidelines of University Grants Commission (UGC) and Indian Council of Agricultural Research (ICAR). Accordingly, each academic year is divided into two semesters, **Odd (July-December) and Even (January- June).** Also, the university follows a system of continuous evaluation along with regular updating in course curricula and teaching pedagogy.

The Curriculum for M. Sc Agriculture (Agronomy) program for 2024-2026 along with examination pattern is as follows:

Course Scheme

Semester –I

S. No.	Course Code	Course Name	L	T	P	Credits
1.	MSAC41100	Modern Concepts in Crop Production	3	0	0	3
2.	MSAC41101	Principles and Practices of Weed Management	2	0	0	2
3.	MSAC41102	Principles and Practices of Weed Management Lab	0	0	1	1
4.	MSAE41103	Principles and Practices of Organic Farming	2	0	0	2
5.	MSAE41104	Principles and Practices of Organic Farming Lab	0	0	1	1
6.	MSAE41105	Agronomy of major Cereals and Pulses	2	0	0	2
7.	MSAE41106	Agronomy of major Cereals and Pulses Lab	0	0	1	1
8.	MSAC51100	Physiological and molecular responses of plants to abiotic stresses	2	0	0	2
9.	MSAC51101	Physiological and molecular responses of plants to abiotic stresses Lab	0	0	1	1
10.	MSAC52100	Statistical methods for applied sciences	2	0	0	2
11.	MSAC52101	Statistical methods for applied sciences Lab	0	0	1	1
12.	MSAC55100	Library and information services	1	0	0	1
Total			**14**	**0**	**5**	**19**

EVALUATION SCHEME - THEORY

The evaluation of the theory paper of M. Sc. Ag. (Agronomy) program would be based on Internal and External Assessments. Internal Assessment would consist of 50% of the marks (50 marks) and external assessment (in form of End Term Exam) would consist of remaining 50% marks (50 marks). Detailed scheme of Internal and External Assessments as follows:

Internal Assessment

The distribution of Internal Assessment Marks is as follows:

Type	Details	Marks
Mid Term	One Mid-term Sessional	25
Marks obtained in various Tests, Assignments, Presentations, Quiz, Tutorials, etc.	Average of marks obtained	20
Attendance	75% + : 5 marks	5
TOTAL		**50**

External Assessment

Type	Marks
Theory	50

EVALUATION SCHEME - PRACTICAL

The evaluation of the practical paper of M. Sc. Ag (Agronomy) program would be based on Internal and External Assessments. Internal Assessment would consist of 50% of the marks (50 marks) and external assessment (in form of End Term Exam) would consist of remaining 50% marks (50 marks). Detailed scheme of Internal and External Assessment is as follows:

Internal Assessment

Type	Details	Marks
Marks obtained in various manuals, practical file, participation, any model prepared, output of practical	Average of marks obtained	45
Attendance	75%+: 5 marks	5
TOTAL		**50**

External Assessment

Type	Marks
Practical	50

1. Vision

Vision of School of Agriculture is to be established as advanced studies and research and skill-based centre for students and scholars.

2. Mission

Mission of School of Agriculture is to cultivate a scholarly mindset and analytical abilities in students, as well as train them in agricultural sphere, to reach the profession's daunting needs by providing dynamic knowledge in the field of agriculture.

3. Program Educational Objectives (PEOs)

After successful completion of the program, the postgraduates will be

AGPEO 1: Able to apply concepts of basic and applied sciences to Agriculture

AGPEO 2: Able to design and develop interdisciplinary and innovative systems.

AGPEO 3: Able to inculcate effective communication skills, team work, ethics, leadership in preparation for a successful career in agriculture and R&D organizations.

4. Program Outcomes (POs)

Students post graduating with the M.Sc. Agriculture (Agronomy) degree should be able to:

PO1. Agriculture knowledge: Apply the knowledge of basic and applied sciences to agriculture, agriculture fundamentals and agriculture specialization to the solution of complex agriculture problems. Apply the knowledge of regenerative agriculture with a conservation and rehabilitation approach to food and farming systems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex agriculture problems reaching substantiated conclusions using first principles of basic and applied sciences. Understand rapid appraisal of agricultural innovation systems, a diagnostic tool that can guide the analysis of complex agricultural problems and innovation capacity of the agricultural system towards futuristic agriculture.

PO3. Design/development of solutions: Design solutions for complex agriculture problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, social, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern agriculture and IT tools including prediction and modeling to complex agriculture activities with an understanding of the limitations. Learning use of GIS, IoT, Automation, and Intelligent Systems in Farming & Agriculture development & trading.

PO6. The agriculture postgraduate and society: Apply reasoning informed by the contextual knowledge to assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional agriculture practices. Recognize, analyze, and evaluate the critical human and social factors impacting agriculture. Understand the social dimensions of agriculture and its connections with food and environmental systems.

PO7. Environment and sustainability: Understand the impact of the professional agriculture solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the agriculture practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex agriculture activities with the agriculture community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the agriculture in general and crop husbandry as specific and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. Able to design, launch and run a new business, to create job and not to seek for job. Also capable with an effective mix of knowledge, skills, and personal attitudes to be employed initially and function successfully in the required roles.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Outcomes (PSOs)

At the end of the program, the student will be able to:

PSO 1. Clearly understand the concepts and applications in the field of agriculture in general and crop husbandry in specific. Apply the knowledge of crop cultivation, crop improvement, soil and crop management for sustainable organic agricultural production and development.

PSO 2. Associate the learning from the courses related to agriculture to arrive at solutions to real world problems. Analyze and identifying complex agricultural problems and formulating ethical solutions using the principles of agricultural science, and business.

PSO 3. Have the capability to comprehend the technological advancements in the usage of modern design tools to analyze and design subsystems/processes for a variety of applications. Develop innovative processes, products, and technologies to meet the challenges in agriculture and farming practices

PSO 4. Possess the skills to communicate in both oral and written forms, the work already done and the future plans with necessary road maps, demonstrating the practice of professional ethics and the concerns for social and environmental wellbeing.

6. Course Outcomes (COs)

Course Code & Course Name	After completion of these courses students should be able to
MSAC41100 Modern concepts in crop production	**CO1:** Recall key terminologies, principles, and techniques related to modern crop production methods, including precision farming, integrated pest management, and sustainable agriculture.. **CO2:** Explain the role of modern technologies (e.g., remote sensing, GIS, and drones) in enhancing crop productivity and monitoring plant health. **CO3:** Demonstrate the application of sustainable farming practices in crop production to improve yield while conserving resources. **CO4:** Analyze the impact of different environmental factors (soil, water, climate) and cropping systems on crop yield and resource efficiency. **CO5:** Critically assess modern crop production methods and strategies to recommend improvements for specific farming scenarios, considering economic and environmental sustainability.
MSAC41101 Principles and Practices of weed management	**CO1:** Identify and recall common weed species, their classification, and life cycles in various cropping systems. **CO2:** Explain the ecological and economic impacts of weeds on crop production and the environment. **CO3:** Implement integrated weed management strategies, including cultural, mechanical, chemical, and biological control methods in real-world scenarios. **CO4:** Analyze the effectiveness of different weed management practices under varying environmental and cropping conditions. **CO5:** Evaluate the long-term sustainability and environmental impacts of different weed management approaches and propose improvements.
MSAC41102 Principles and Practices of weed management Lab	**CO1:** Identify and recall common weed species by their morphological characteristics in field and laboratory settings. **CO2:** Explain the procedures for using different weed control tools and methods (mechanical, chemical, biological) in a lab or field setup. **CO3:** Apply integrated weed management practices in simulated or actual field conditions, including herbicide application and weed monitoring. **CO4:** Analyze the effectiveness of different weed control methods by measuring weed density, crop health, and yield in lab trials. **CO5:** Assess the environmental and safety aspects of herbicide usage and propose improvements to current weed management practices in a controlled lab environment.

MSAE41103 Principles and Practices of Organic farming	**CO1:** Recall the basic principles, standards, and terminologies of organic farming, including soil health management, crop rotation, and organic certification. **CO2:** Explain the ecological benefits of organic farming practices, including biodiversity enhancement, soil fertility, and water conservation. **CO3:** Implement organic farming practices such as composting, green manuring, and natural pest control in farm or garden settings. **CO4:** Analyze the differences between conventional and organic farming systems in terms of yield, sustainability, and resource efficiency. **CO5:** Evaluate the challenges and opportunities of transitioning from conventional to organic farming, considering economic, social, and environmental factors.
MSAE41104 Principles and Practices of Organic farming Lab	CO1: Identify and recall various organic inputs such as compost, biofertilizers, and organic pest control agents used in organic farming. CO2: Explain the processes involved in organic composting, vermiculture, and preparation of biofertilizers in a lab or farm setting. CO3: Demonstrate organic farming practices such as composting, crop rotation, and preparation of organic pest repellents in a practical setting. CO4: Analyze the quality and nutrient content of organic compost and biofertilizers produced in the lab, and compare them with conventional inputs. CO5: Evaluate the overall effectiveness and sustainability of organic farming practices applied in the lab or field, considering soil health, crop yield, and pest management.
MSAE41105 Agronomy of major cereals and pulses	**CO1:** Recall key agronomic practices for the production of major cereals (e.g., rice, wheat, maize) and pulses (e.g., chickpea, lentils). **CO2:** Explain the growth stages, environmental requirements, and physiology of major cereals and pulses. **CO3:** Apply principles of soil management, water use, and fertilizer application in the cultivation of cereals and pulses. **CO4:** Analyze the impact of crop rotation, pest management, and disease control on the yield and quality of cereals and pulses. **CO5:** Design a comprehensive agronomic plan for a selected cereal or pulse crop, incorporating advanced technologies and environmental considerations.
MSAE41106 Agronomy of major cereals and pulses Lab	**CO1:** Identify and label different cereal and pulse crops based on their morphological characteristics. **CO2:** Explain the importance of various agronomic inputs (such as seeds, fertilizers, and irrigation) in relation to the growth stages of cereals and pulses. **CO3:** Perform field operations like seedbed preparation, sowing, and irrigation scheduling for different cereals and pulses under laboratory conditions.

	CO4: Analyze soil samples and assess nutrient requirements for optimal growth of selected cereal and pulse crops. **CO5:** Evaluate different planting techniques and crop management practices in terms of their efficiency and effect on crop yield in an experimental setup.
MSAC51100 Physiological and molecular responses of plants to abiotic stresses	**CO1:** List various types of abiotic stresses (e.g., drought, salinity, heat, cold) and the physiological processes affected in plants. **CO2:** Explain the key physiological and molecular mechanisms plants use to cope with abiotic stresses, including osmotic adjustment, antioxidant defense, and stress signaling pathways. **CO3:** Apply physiological assays (e.g., measurement of chlorophyll content, electrolyte leakage) to assess plant responses to specific abiotic stress conditions in experimental settings. **CO4:** Analyze the impact of abiotic stresses on plant growth, metabolism, and yield by studying physiological indicators like water use efficiency, photosynthesis rates, and stress hormone levels. **CO5:** Design a research project that investigates molecular responses (e.g., gene regulation, protein expression) of plants under a specific abiotic stress and propose strategies to improve stress tolerance.
MSAC51101 Physiological and molecular responses of plants to abiotic stresses Lab	**CO1:** Identify key laboratory techniques used to assess physiological and molecular responses of plants to abiotic stresses (e.g., drought, salinity, heat). **CO2:** Describe the principles behind physiological assays (e.g., relative water content, electrolyte leakage) and molecular techniques (e.g., qPCR, Western blotting) used to study stress responses. **CO3:** Perform physiological measurements (e.g., photosynthesis rate, stomatal conductance) and molecular experiments (e.g., gene expression analysis) to assess the impact of abiotic stresses on plants. **CO4:** Analyze the physiological and molecular data collected during lab experiments to evaluate plant responses to specific abiotic stressors (e.g., changes in antioxidant enzyme activities or expression of stress-related genes). **CO5:** Evaluate the effectiveness of various molecular markers and physiological indicators in identifying stress-tolerant and stress-sensitive plant varieties.
MSAC52100 Statistical methods for applied sciences	**CO1:** Recall fundamental statistical concepts and terminologies, including types of data, probability distributions, and measures of central tendency and variability. **CO2:** Explain the importance and application of various statistical methods such as hypothesis testing, regression analysis, and analysis of variance (ANOVA) in solving real-world problems. **CO3:** Apply appropriate statistical techniques (e.g., t-tests, chi-square tests, correlation, and regression) to analyze datasets from applied science disciplines.

	CO4: Analyze datasets using statistical software (e.g., R, SPSS, SAS) to identify trends, relationships, and patterns in applied sciences research. **CO5:** Critically evaluate the results of statistical analyses, assessing the validity, reliability, and significance of the conclusions drawn from scientific experiments and studies.
MSAC52101 Statistical methods for applied sciences Lab	**CO1:** Identify different statistical software tools (e.g., R, SPSS, SAS, or Excel) and basic commands used for statistical analysis in applied sciences. **CO2:** Describe the steps for conducting basic statistical analyses, such as descriptive statistics, hypothesis testing, and correlation, using software. **CO3:** Use statistical software to perform specific statistical analyses, such as t-tests, chi-square tests, ANOVA, and regression, on real or simulated datasets from applied science fields. **CO4:** Analyze statistical outputs from software (e.g., significance levels, p-values, confidence intervals) and interpret the meaning of the results in relation to applied science research questions. **CO5:** Evaluate the appropriateness of statistical methods and the quality of the data analysis for different types of applied science experiments, considering assumptions, limitations, and errors.
MSAC55100 Library and information services	**CO1:** Identify different types of library resources (e.g., books, journals, databases, digital repositories) and information services provided by academic and research libraries. **CO2:** Explain the organization of information within a library, including cataloging, classification systems **CO3:** Demonstrate the ability to search for and retrieve relevant information using online library catalogs, databases, and other library information systems for academic and research purposes. **CO4:** Analyze the reliability, credibility, and relevance of different information sources **CO5:** Evaluate the effectiveness of different information retrieval strategies

7. CO POMapping

MSAC41100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	3	2	3	3	2	3	3	2
CO2	3	3	2	3	2	3	2	2	3	3	3	2
CO3	3	2	3	2	2	2	3	3	3	2	3	3
CO4	2	2	3	3	3	3	3	3	2	2	2	2
CO5	2	3	3	2	2	3	2	2	2	3	3	2

MSAC41101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	3	2	3	3	2	3
CO2	2	3	3	2	2	2	3	2	3	3	2	3
CO3	3	2	3	2	3	3	2	3	2	2	3	2
CO4	2	2	2	3	3	2	3	3	3	3	3	2
CO5	2	3	2	3	2	3	3	2	2	3	2	3

MSAC41102	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	2	2	2	2	3	2	2	3
CO2	3	1	3	3	2	2	3	2	3	3	2	3
CO3	2	3	2	2	3	2	2	1	2	3	3	2
CO4	3	3	2	3	3	2	2	3	3	2	2	3
CO5	3	2	3	2	2	3	3	2	2	2	2	2

MSAE41103	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	2	2	3	2	2	3
CO2	2	1	3	3	2	2	3	2	3	3	2	3
CO3	3	3	2	3	2	2	2	1	3	2	3	2
CO4	2	3	2	2	3	3	2	3	2	2	2	2
CO5	3	2	3	2	2	3	3	2	2	2	2	3

MSAE41104	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	2	2	3	2	2	3
CO2	2	1	3	3	2	2	3	2	3	3	2	3
CO3	3	3	2	3	2	2	2	1	3	2	3	2
CO4	1	3	2	2	3	3	2	3	2	2	2	2
CO5	3	2	3	2	2	3	3	2	2	2	2	3

MSAE41105	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	3	2	2	3	2	2	3
CO2	1	1	3	3	2	2	3	2	3	3	2	3
CO3	3	3	2	3	2	2	2	1	3	2	3	2
CO4	2	3	2	2	3	3	2	3	3	3	2	2
CO5	1	2	3	2	2	3	3	2	2	2	2	3

MSAE41106	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	3	2	3	2	2	3
CO2	2	1	3	3	2	2	3	2	3	3	2	3
CO3	3	3	2	3	2	2	2	3	3	2	3	2
CO4	1	3	2	2	3	3	2	3	2	2	2	2
CO5	3	2	3	2	2	3	3	2	2	2	2	3

MSAC51100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	3	2	2	3	2	2		2	2	2
CO2	2		2		2	2	3	2	2	1	3	2
CO3	2	2	2	2	3	1		2		3	2	
CO4	3	2	1	3		2	2	2	2	2		2
CO5	2	2	2	2	2		2		3		2	3

MSAC 51101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	3	2	3	3	2	2		1	2	2
CO2	3		2		2	2	2	2	2	2	3	2
CO3	2	2	1	1	3	1		2		3	2	
CO4	3	2	2	3		2	2	2	2	2		2
CO5	2	2	2	2	2		2		3		2	3

MSAC 52100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1				1	3	3	3	2	1	1
CO2	2		1		3	3	1		2	2	2	3
CO3	3	3	3	3	3	2	3	2	2	3	3	2
CO4	2	3	3	3	3	2	2	3	1	2	2	2
CO5	1	3	3	3	1	2	1	2	2	1	2	2

MSAC 52101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		2	3	2	2	2	2	1	3
CO2	3	3		2			1	2	1	2		3
CO3	3	2		3	3	2	2	3	3	3	3	
CO4	2	2	2	3	2	2	2	2	2	2		2
CO5	2	1	2		3	2	2	2	2	1	2	

MSAC55100	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2		2				2	2	2
CO2	2	3	2	3	2			2				2
CO3	3	2	3	3	2	2	2				2	
CO4	2	2	2					2				1
CO5	2	2	2	3	3	3	2	2		3		3

8. Curriculum

Course Name: Modern Concepts in Crop Production

Course Code: MSAC41100

Course Outline

Theory

Unit I

Crop growth analysis in relation to environment; geo-ecological zones of India.

Unit II

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.

Unit III

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

Unit IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress, use of growth hormones and regulators for better adaptation in stressed condition.

Unit V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture. Modern crop production concepts: soil less cultivation, Aeroponic, Hydroponic, Robotic and terrace farming. use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.

Lecture Schedule – Theory

S. No.	Topic	No. of lectures
1.	Crop growth analysis in relation to environment: LAI, CGR, RGR, NAR, LAD	2
2.	Geo-ecological and agroclimatic zones of India and Rajasthan	2
3.	Quantitative agro-biological principles and inverse yield nitrogen law	2
4.	Mitscherlich yield equation, its interpretation and applicability	2
5.	Baule unit	2
6.	Effect of lodging in cereals	1
7.	Physiology of grain yield in cereals	2
8.	Optimization of plant population and planting geometry in relation to different resources	2
9.	Concept of ideal plant type and crop modeling for desired crop yield, characteristics of an ideotype plant for dryland agriculture	3
10.	Scientific principles of crop production	2
11.	Crop response production functions	2

12.	Concept of soil plant relations	2
13.	Abiotic and biotic stresses; yield and environmental stress, seed priming,use of growth hormones and regulators for better adaptation in stressed condition	3
14.	Integrated farming systems	2
15.	Organic farming – definition, differences between conventional and organic farming and principles and components of organic farming	2
16.	Resource conservation technology including modern concept of tillage - zero tillage, minimum tillage, furrow irrigated raised bed system, conservation tillage -its advantages, disadvantages andtypes	2
17.	Dry farming	1
18.	Determining the nutrient needs for yield potentiality of crop plants	2
19.	Concept of balance nutrition and integrated nutrient management	1
20.	Precision agriculture-definition, basic concept, scope and approach	2
21.	Modern crop production concepts	2
22.	Soil less cultivation	1
23.	Aeroponic, Hydroponic, Robotic and terrace farming	3
24.	Use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture	3
	Total	48

Suggested Reading

1. Balasubramaniyan P and Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.
2. Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
3. Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. *Soil Fertility and Fertilizers.* 7th
4. Ed. Prentice Hall.
5. Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.
6. Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.
7. Sankaran S and Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.
8. Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.
9. Alvin PT and kozlowski TT (ed.). 1976. *Ecophysiology of Tropical Crops*. Academia Pul., New York.
10. Gardner PP, Pearce GR and Mitchell RL. 1985. *Physiology of Crop Plants*. Scientific Pub. Jodhpur.
11. Lal R. 1989. *Conservation tillage for sustainable agriculture: Tropics versus Temperate Environments. Advances in Agronomy* 42: 85-197.
12. Wilsie CP. 1961. *Crop Adaptation and Distribution*. Euresia Pub., New Delhi.

Course Name: Principles and Practices of Weed Management

Course Code: MSAC41101

Course Outline

Theory

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Lecture Schedule – Theory

S. No.	Topic	No. of lectures
1.	Weed biology, ecology and classification, crop-weed competition including allelopathy	2
2.	Principles and methods of weed control and classification management	2
3.	Weed indices, weed shift in different eco-systems	1
4.	Herbicides- introduction and history of their development	1
5.	Classification based on chemical, physiological application and selectivity	1
6.	Properties, mode and mechanism of action of herbicides	2
7.	Herbicide structure - activity relationship	2
8.	Factors affecting the efficiency of herbicides	1
9.	Herbicide formulations, herbicide mixtures, adjuvants and safeners, sequential application of herbicides, rotation	2
10.	Weed control through use of nano-herbicides and bio-herbicides, myco-herbicides, bio-agents and allelochemicals	1
11.	Movement of herbicides in soil and plant	2
12.	Degradation of herbicides in soil and plants	1
13.	Herbicide resistance, residue, persistence and management	1
14.	Development of herbicide resistance in weeds and crops and their management	1
15.	Herbicide combination and rotation	1
16.	Weed management in major crops and cropping systems a) Grain crops , b)Oilseeds and pulses, c)Sugar and fibre crops b) Tuber and forage crops c) Weed control under intercropping system, drylands and non-cropped area	4
17.	Noxious, alien, invasive and parasitic weeds and their management	2
18.	Weed shifts in cropping systems	1
19.	Aquatic and perennial weeds and their control	1
20.	Integrated weed management	1
21.	Recent development in weed management- robotics, use of drones and aeroplanes, organic etc.	1
22.	Cost: benefit analysis of weed management	1
	Total	32

Suggested Reading

- Böger, Peter, Wakabayashi, Ko, Hirai, Kenji (Eds.). 2002. *Herbicide Classes in Development*. *Mode of Action*, *Targets*, *Genetic Engineering*, *Chemistry*. Springer.
- Chauhan B and Mahajan G. 2014. *Recent Advances in Weed Management*. Springer.
- Das TK. 2008. *Weed Science: Basics and Applications*, Jain Brothers (New Delhi).
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- Walia US. 2006. *Weed Management*, Kalyani.
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Course Name: Principles and Practices of Weed Management Lab

Course Code: MSAC41102

Practical

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

Lecture schedule-Practical

S. No.	Topic	No. of lectures
1.	Identification of important *Kharif* and *Rabi* weeds	1
2.	Identification of perennial weeds of crop fields, road sides, wastelands and irrigation channels	1
3.	Preparation of a weed herbarium	1
4.	Weed survey in crops and cropping systems	1
5.	Crop-weed competition studies	1
6.	Weed indices calculation and interpretation with data	1
7.	Familiarization with trade names, common names, uses, cost and sources of availability of herbicides	1
8.	Preparation of spray solutions of herbicides for high and low-volume sprayers	1
9.	Use of various types of spray pumps and nozzles and calculation of swath width	1
10.	Economics of weed control	1
11.	Herbicide resistance analysis in plant and soil	2
12.	Bioassay of herbicide resistance residues	2
13.	Calculation of herbicidal requirement	2
	Total	16

Course Name: Principles and Practices of Organic Farming

Course Code: MSAE41103

Course Outline

Theory

Unit I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organics and farming standards; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.

Unit II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures, bio-fertilizers and biogas technology.

Unit III

Farming systems, selection of crops andcrop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

Unit V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Lecture schedule – Theory

S. No.	Topic	No. of lectures
1.	Organic farming - concept and definition, its relevance to India and global agriculture and future prospects	1
2.	Principles of organic agriculture, organics and farming standards	1
3.	Organic farming and sustainable agriculture	1
4.	Selection and conversion of land, soil and water management - land use, conservation tillage,shelter zones, hedges, pasture management, agro-forestry	2
5.	Organic farming and water use efficiency	1
6.	Soil fertility, nutrient recycling, organic residues, organic manures, composting, green manures, soil biota and decomposition of organic residues,	1
7.	Earthworms and vermicompost	1
8.	Bio-fertilizers and biogas technology	1
9.	Farming systems, selection of crops andcrop rotations,	1
10.	Multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity	1
11.	Weed management,diseases and insect pest management	1
12.	Biological agents, pheromones and bio-pesticides	1
13.	Socio-economic impacts, marketing and export potentialof organic farming	1
14.	Inspection, certification, labeling and accreditation procedures	1
15.	Organic farming and national economy	1
16.	Total	16

Suggested Reading

- Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
- Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.
- Joshi M. 2016. *New Vistas of Organic Farming*. Scientific Publishers
- Lampin N. 1990. *Organic Farming*. Press Books, lpswitch, UK.
- Palaniappan SP and Anandurai K. 1999. *Organic Farming – Theory and Practice.* Scientific Publ.
- Rao BV Venkata. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*: Publ.3, ParisaraprajnaParishtana, Bangalore.
- Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
- Sharma A. 2002. *Hand Book of Organic Farming*. Agrobios.
- Singh SP. (Ed.). 1994. *Technology for Production of Natural Enemies.* PDBC, Bangalore.
- Subba Rao NS. 2002. *Soil Microbiology*. Oxford & IBH.
- Trivedi RN. 1993. *A Text Book of Environmental Sciences*, Anmol Publ.
- Veeresh GK, Shivashankar K and Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture.* Association for Promotion of Organic Farming, Bangalore.

- WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO.
- Woolmer PL and Swift MJ. 1994. *The Biological Management of Tropical Soil Fertility*. TSBF & Wiley.

Course Name: Principles and Practices of Organic Farming Lab

Course Code: MSAE41104

Practical

- Method of making compost by aerobic method
- Method of making compost by anaerobic method
- Method of making vermicompost
- Identification and nursery raising of important agro-forestry tress and tress for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field • Visit to a biogas plant
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

Lecture schedule-Practical

S. No.	Topic	No. of lectures
1.	Method of making compost by aerobic method	2
2.	Method of making compost by anaerobic method	2
3.	Method of making vermicompost	2
4.	Identification and nursery raising of important agro-forestry tress and tress for shelter belts	2
5.	Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field	2
6.	Visit to a biogas plant	1
7.	Visit to an organic farm	2
8.	Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms	3
	Total	16

Course Name: Agronomy of Major Cereals and Pulses

Course Code: MSAE41105

Course Outline

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of:

Unit I: *Rabi* cereals.

Unit II: *Kharif* cereals.

Unit III: *Rabi* pulses.

Unit IV: *Kharif* pulses.

Lecture Schedule – Theory

S. No.	Topic	No. of lectures
1.	**Rice** Origin and history, importance, production, distribution, adaptability and classification, cropping systems Climate, soil and cultural requirements and improved varieties Nutrient, water and weed management Crop protection, handling and processing of produce, quality components and industrial uses of main and by products	4
2.	**Maize** Origin and history, importance, production, distribution and classification Climate, soil and cultural requirements and improved varieties Nutrient, water, weed management and quality components Crop protection, handling and processing of produce, prospects of *rabi* maize cultivation in India	4
3.	**Sorghum :** Origin and history, importance, production and distribution Climate, improved varieties, soil and cultural requirements Nutrient, water and weed management Crop protection, handling and processing of produce and quality components	4
4.	**Pearl millet :** Origin and history, importance, production, distribution and cropping systems Climate, improved varieties, soil and cultural requirements for maximization of production Nutrient, weed and water management	3

	Plant protection, quality components and industrial uses of the main and by products.	
5.	**Wheat** Origin and history, importance, production, distribution, adaptability and classification Cropping systems, adaptability, climate and improved varieties, soil and cultural requirements Nutrient, water and weed management in relation to latest research Crop protection, handling and processing of produce	4
6.	**Barley** Origin and history, importance, production, distribution, classification Climate, improved varieties, soil and cultural requirements Nutrient, water and weed management Crop protection, handling and processing of produce, quality components and industrial uses of the main and by products.	3
7.	Acquaintance about important minor millets	2
8.	**Pigeon pea :**Origin and history, importance, protection and distribution, classification, morphology and phenology, cropping systems, Adaptability, climate, soil and improved varieties, Nutrient, water and weed management, crop protection, handling and processing of produce.	3
9.	**Chickpea** : Origin and history, importance, production and distribution, classification, morphology and phenology, cropping systems, adaptability, Climate, soil and cultural requirement for maximization of production and improved varieties Nutrient, water and weed management, crop protection, handling and processing of produce	3
10.	Package of practices of common pulses; greengram, blackgram, cowpea, mothbean, lentil	2
	Total	32

Suggested Reading

- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Hunsigi G and Krishna KR. 1998*. Science of Field Crop Production*. Oxford & IBH.
- Jeswani LM and Baldev B. 1997. *Advances in Pulse Production Technology*.ICAR.
- Khare D and Bhale MS. 2000. *Seed Technology*. Scientific Publ.
- Kumar Ranjeet and Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
- Pal M, Deka J and Rai RK. 1996. *Fundamentals of Cereal Crop Production*.Tata McGraw Hill.
- Prasad Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
- Singh C, Singh P and Singh R. 2003. *Modern Techniques of Raising FieldCrops*. Oxford & IBH.
- Singh SS. 1998. *Crop Management*. Kalyani.
- Yadav DS. 1992. *Pulse Crops*. Kalyani.Prentice Hall

Course Name: Agronomy of Major Cereals and Pulses Lab

Course Code: MSAE41106

Practical

- 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 and calculation of croppingand rotational intensities
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW, etc)
- Assessment of land use and yield advantage (Rotational intensity, Croppingintensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- Estimation of protein content in pulses
- Planning and layout of field experiments
- Judging of physiological maturity in different crops
- 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 selected crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

Lecture schedule-Practical

S . No.	Topic	No. of lectures
1.	Phenological studies at different growth stages of crop	1
2.	Estimation of crop yield on the basis of yield attributes	1
3.	Formulation of cropping schemes for various farm sizes and calculation of croppingand rotational intensities	1
4.	Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLWetc.)	2
5.	Assessment of land use and yield advantage (Rotational intensity, Croppingintensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)	2
6.	Estimation of protein content in pulses	1
7.	Planning and layout of field experiments	1
8.	Judging of physiological maturity in different crops	1
9.	Intercultural operations in different crops	1
10.	Determination of cost of cultivation of different crops	1
11.	Working out harvest index of various crops	1
12.	Study of seed production techniques in selected crops	1
13.	Visit of field experiments on cultural, fertilizer, weed control and watermanagement aspects	1
14.	Visit to nearby villages for identification of constraints in crop production	1
	Total	16

Course Name: Physiological and Molecular Responses of Plants to Abiotic Stresses
Course Code: MSAC51100

Course Outline

Theory

BLOCK 1: ABIOTIC STRESSES

Unit 1

Introduction to Abiotic Stresses: Abiotic stresses major constraints to realize potential yields of crop plants, yield losses, Drought prone areas in India- Frequency of occurrence of drought, Rainfed Kharif, Rabi, areas affected by salinity, heavy metals, water logging, high temperature scenario due to global warming.

BLOCK 2: DROUGHT STRESS

Unit 1

Moisture Stress Responses in Plants

Drought-characteristic features; water potential in the soil-plant-air continuum, Physiological and biochemical processes affected by drought. Oxidative stress-generation of ROS and other cytotoxic compounds, their effect on cellular process.

Effect on total carbon gain- decrease in photosynthetic area and function, protein turn over and lipid characters, phenology reproductive aspects, critical stages.

Unit 2

Stress Perception and Molecular Responses of Plants to Drought Stress

Stress perception and signal transduction leading to expression of regulatory genes, stress specific kinases, stress specific transcription factors, functional genes associated with adaptive mechanisms.

Unit3

Plant Adaptive Mechanisms to Drought

Escape and desiccation avoidance mechanism

Concept of stress escapes exploiting genetic variability in phenology. Drought avoidance mechanisms, Maintenance of cell turgor, water mining by root characters, Regulation of transpiration Moisture conservation traits reducing heat load, Stomatal factors guard cell metabolism, moisture conservation by waxes, Water use efficiency(WUE) and concept of water productivity-regulation of transpiration efficiency stomatal conductance, mesophyll efficiency, relevance of WUE and Passioura's model.

Desiccation tolerance-Concept of acquired tolerance

Decreased turgor mediated upregulation of cellular tolerance mechanisms, Osmolytes, managing cyto toxic compounds, ROS, RCC, scavenging-enzymatic and non enzymatic, protein turnover, stability, chaperones, membrane stability, photo protection of chlorophylls.

Unit4

Approaches to Improve Drought Tolerance

Developmentofgeneticresources-donorgenotypesforspecifictraits,Genomicresources-QTL'sregulating adaptive mechanisms, Conventional, transgenic and breeding approaches to improve relevant adaptive traits, concept of trait introgression genes, molecular

BLOCK3: SALT, Heavy Metal, Waterlogging, Temperature and Lightst Stress

Unit1

Salt Stress

Soil salinity-Effect of salt stress, ionic and osmotic effects; species variation in salt tolerance; glycophytes and halophytes, Salt tolerance mechanisms exclusion, extrusion and compartmentalization, Signaling during salt stress SOS pathway. Approaches to improve salt tolerance.

Unit2

Heavy Metal Stress and Water Logging

Heavy metal toxicity in plants (eg., Al, Cd), tolerance mechanisms and approaches to improve, Plant response logging, tolerance and approaches to improve.

Unit3

Temperature and Light Stress

High and low temperatures; effect on plants; adaptive mechanisms, evaporation cooling, concept of cellular tolerance, protein stability, chaperones, HSPs, HSFs, membranes. High light and high ionizing radiation- photo oxidation and photo-inhibition; mechanisms of tolerance, plant adaptation to low light, concept of shade avoidance response (SAR)

Lecture Schedule –Theory

S. No.	Topics	No. of lectures
1	Abiotic stresses, major constraints to realize potential yields of crop plants, yield losses.	1
2	Drought prone areas in India-Frequency of occurrence of drought, Rainfed- kharif, Rabi, Areas affected by salinity, heavy metals, water logging, high temperature scenario due to global warming.	2
3	Drought-characteristic features; water potential in the soil-plant air continuum.	2
4	Physiological and biochemical processes affected by drought. Oxidative stress-generation of ROS and other cytotoxic compounds, their effect on cellular process.	2
5	Effect on total carbon gain-decrease in photosynthetic area and function, protein turn over and lipid characters, phenology- reproductive aspects, critical stages.	1
6	Stress perception and signal transduction leading to expression of regulatory genes, stress specific kinases, stress, specific transcription factors, functional genes associated with adaptive mechanisms	2
7	Concept of stress escape-exploiting genetic variability in phenology, Drought avoidance mechanisms- Maintenance of cell turgor, water mining by root characters.	2
8	Moisture conservation-Regulation of transpiration-traits reducing heat load, Stomatalfactors guard cell metabolism, moisture conservation by waxes	2
9	Water use efficiency (WUE) and concept of water productivity-regulation of transpiration efficiency-stomatal conductance, mesophyll efficiency, relevance of WUE and Passioura's model.	2
10	Decreased turgor mediated upregulation of cellular tolerance mechanisms, Osmolytes, managing cytotoxic compounds, ROS, RCC, scavenging-enzymatic and non-enzymatic, protein turnover, stability, chaperones,membrane stability, photo-protection of chlorophylls.	2
11	Development of genetic resources-donor genotypes for specific traits, Genomic resources-genes, QTL's regulating adaptive mechanisms, Conventional, transgenic and molecular breeding approaches to improve relevant adaptive traits, concept of trait introgression	2
12	Soil salinity-Effect of salt stress, ionic and osmotic effects; species variation in salt tolerance; glycophytes and halophytes, Salttolerance mechanisms-exclusion, extrusion and compartmentalization, Signaling during salt stress–SOS pathway, Approaches to improve salt tolerance	4
13	Heavy metal toxicity in plants (eg., Al, Cd), tolerance 2 305 mechanisms and approaches to improvement	2
14	Plant response to water logging, role of hormones-ethylene, mechanism of tolerance and approaches to improvement.	2

15	High and low temperatures; effect on plants; adaptive mechanisms, evaporation cooling, concept of cellular tolerance, protein stability, chaperones, HSPs, HSFs, membranes.	2
16	High light and high ionizing radiation-photo oxidation and photo inhibition; mechanisms of tolerance, plant adaptation to low light, concept of shade avoidance response (SAR)	2
	Total	32

Suggested Readings

1. Plant physiology Book by Frank B. Salisbury, Cleon W. Ross.
2. Plant Physiology Book by Eduardo Zeiger and Lincoln Taiz.
3. Sergey Shabala, 2012. Plant Stress Physiology.

Course Name: Physiological and Molecular Responses of Plants to Abiotic Stresses Lab

Course Code: MSAC51101

Lecture Schedule –Practical

S. No.	Topics	No. of lectures
1	Soil and plant water status	1
2	Drought stress imposition and measurement of physiological and biochemical changes in plants under stress–gas exchange and fluorescence measurements.	1
3	Determination of water use efficiency as a drought resistant trait.	1
4	Drought Susceptibility Index (DSI) -precise field technique to identify productive genotypes under stress.	1
5	Approaches to quantify root characters	1
6	Determination of stomatal parameters and canopy temperature as a reflection of transpiration and root activity	1
7	Determination of Salinity Tolerance Index.	1
8	Studying acclimation response - Temperature induction response	1
9	Heat tolerance and membrane integrity- Sullivans heat tolerance test.	1
10	Quantification of osmolytes – proline under stress.	1
11	Oxidative stress imposition- Quantification of oxidative stress	1
12	Quantification of ROS under stress.	1
13	Estimation of ABA content in leaf and root tissues under stress.	1
14	Determination of Sodium and Potassium in plant tissue grown under salt stress.	1
15	Estimation of antioxidant enzymes.	2
	Total	16

Course Name: Statistical Methods for Applied Sciences
Course Code: MSAC52100

Course Outline

Theory

Unit I

Descriptive statistics, Exploratory data analysis, Theoryof probability, Random variable and mathematical expectation.

Unit II

Discrete and continuous probability distributions, Binomial, Poisson, Normal Distribution and their applications. Concept of sampling distribution: chi-square, t andF distributions. Tests of significance based on Normal, chi-square, tand F distributions.

Unit III

Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rankcorrelation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination.

Unit IV

Non-parametric tests - Sign, Run test for the randomness of a sequence, Median test.

Unit V

Introduction to ANOVA: One way and Two way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

Lecture Schedule-Theory

S. No.	Topics	No. of lectures
1	Descriptive Statistics& Exploratory data analysis	2
2	Theory of probability	2
3	Random variable and mathematical expectation	2
4	Discrete and continuous probability distribution	1
5	Binomial, applications Poisson, Normal distribution and their	3
6	Concept of sampling distribution:chi-square, t and F distributions	3
7	Tests of significance for Normal, chi-square, t and F distributions	2
8	Introduction to theory of estimation and confidence intervals	1
9	Simple and multiple correlation coefficient, partial correlation	2
10	Rank correlation	1
11	Simple and multiple linear regression model	1
12	Test of significance of correlation coefficient and regression coefficients, Coefficient of determination	1
13	Non-parametric tests-Concept and definition	1
14	Sign, Run test for the randomness of a sequence, Median test	2
15	Introduction to ANOVA: One way and Two Way	3
16	Introduction to Sampling Techniques	2
17	Introduction to Multivariate Analysis	2
18	Transformation of Data	1
	Total	32

Suggested Readings

- Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
- Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. TheWorld Press.
- Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
- Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
- Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
- Siegel S, Johan N &Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. JohnWiley.
- Anderson W. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed. John Wiley

Course Name: Statistical Methods for Applied Sciences Lab
Course Code: MSAC52101

Practical

- Exploratory data analysis, fitting of distributions: Binomial, Poisson, Normal
- Large sample tests, testing square, tand F. of hypothesis based onexact sampling distributions, chi
- Confidence interval estimation and Correlationand regression analysis, fitting of Linear model.
- Non-parametric tests, ANOVA: One way, Two Way, SRS.

Lecture Schedule-Practical

S. No.	Practical	No. of Lectures
1	Exploratory data analysis	1
2	Fitting of Binomial distribution	1
3	Fitting of Poisson distribution	1
4	Fitting of Normal distribution	1
5	Large Sample tests	1
6	Chi Square test	1
7	One sample, two sample and paired t test	1
8	F- test	1
9	Confidence interval estimation and Computation of Simple correlation & regression	1
10	Computation of partial and multiple correlation	1
11	Sign test	1
12	Run test	1
13	Median test	1
14	One Way ANOVA	1
15	Two Way ANOVA	1
16	Simple Random Sampling	1
	Total	16

Course Name: Library and Information Services

Course Code: MSAC55100

Course Outline

Theory

To equip the library users with skills to trace information from libraries efficiently,to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.

9. Lesson Plans

MSAC41100 Modern Concepts in Crop Production

Unit	Particulars	Class No.	Pedagogy of Class
Unit 1	Crop growth analysis in relation to environment: LAI, CGR,	C1	Lecture
Unit 1	Crop growth analysis in relation to environment:, RGR, NAR, LAD	C2	Lecture
Unit 1	Geo-ecological and agroclimatic zones of India and Rajasthan	C3	Lecture
Unit 1	Geo-ecological and agroclimatic zones of India and Rajasthan	C4	Lecture
Unit 1	Quantitative agro-biological principles and inverse yield nitrogen law	C5	Lecture
Unit 1	Quantitative agro-biological principles and inverse yield nitrogen law	C6	Lecture
Unit 1	Mitscherlich yield equation, its interpretation and applicability	C7	Lecture
Unit 1	Mitscherlich yield equation, its interpretation and applicability	C8	Lecture
Unit 1	Baule unit	C9	Lecture
Unit 1	Effect of lodging in cereals	C10	Lecture
Unit 1	Physiology of grain yield in cereals	C11	Lecture
Unit 1	Clarification class	C12	Clarification class
Unit 1	Optimization of plant population and planting geometry in relation to different resources	C13	Lecture
Unit 1	Optimization of plant population and planting geometry in relation to different resources	C14	Lecture
Unit-1	Concept of ideal plant type and crop modeling for desired crop yield, characteristics of an ideotype plant for dryland agriculture	C15	Lecture
Unit-1	Concept of ideal plant type and crop modeling for desired crop yield, characteristics of an ideotype plant for dryland agriculture	C16	Lecture
Unit-1	Scientific principles of crop production	C17	Lecture
Unit-1	Crop response production functions	C18	Lecture

Unit-1	Concept of soil plant relations	C19	Lecture
Unit-1	Abiotic and biotic stresses; yield and environmental stress, seed priming,use of growth hormones and regulators for better adaptation in stressed condition	C20	Lecture
Unit-1	Abiotic and biotic stresses; yield and environmental stress, seed priming,use of growth hormones and regulators for better adaptation in stressed condition	C21	Lecture
Unit-1	Abiotic and biotic stresses; yield and environmental stress, seed priming,use of growth hormones and regulators for better adaptation in stressed condition	C22	Lecture
Unit-1	Clarification class	C23	Clarification class
Unit-2	Integrated farming systems	C24	Lecture
Unit-2	Integrated farming systems	C25	Lecture
Unit-2	Organic farming – definition, differences between conventional and organic farming and principles and components of organic farming	C26	Lecture
Unit-2	Organic farming – definition, differences between conventional and organic farming and principles and components of organic farming	C27	Lecture
Unit-2	Resource conservation technology including modern concept of tillage - zero tillage, minimum tillage, furrow irrigated raised bed system, conservation tillage -its advantages, disadvantages andtypes	C28	Lecture
Unit-2	Resource conservation technology including modern concept of tillage - zero tillage, minimum tillage, furrow irrigated raised bed system, conservation tillage -its advantages, disadvantages andtypes	C29	Lecture
Unit-2	Dry farming	C30	Lecture
Unit-2	Determining the nutrient needs for yield potentiality of crop plants the nutrient needs for yield potentiality of crop plants	C31	Lecture
Unit2	Determining the nutrient needs for yield potentiality of crop pl Determining the nutrient needs for yield potentiality of crop plants	32	Lecture
Unit2	Classroom assignment	C33	Classroom assignment

Unit3	Concept of balance nutrition and integrated nutrient management	C34	Lecture
Unit3	Concept of balance nutrition and integrated nutrient management	C35	Lecture
Unit3	Precision agriculture-definition, basic concept, scope and approach	C36	Lecture
Unit3	Precision agriculture-definition, basic concept, scope and approach	C37	Lecture
Unit3	Concept of balance nutrition and integrated nutrient management	C38	Lecture
Unit3	Modern crop production concepts	C39	Lecture
Unit3	Modern crop production concepts	C40	Lecture
Unit3	Soil less cultivation	C41	Lecture
Unit3	Aeroponic, Hydroponic, Robotic and terrace farming	C42	Lecture
Unit3	Aeroponic, Hydroponic, Robotic and terrace farming	C43	Lecture
Unit3	Aeroponic, Hydroponic, Robotic and terrace farming	C44	Lecture
Unit3	Clarification class	C45	Clarification class
Unit3	Use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture	C46	Lecture
Unit3	Use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture	C47	Lecture
Unit3	Use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture	C48	Lecture

MSAC41101 Principles and Practices of Weed Management

Unit	Particulars	Class No.	Pedagogy of Class
Unit 1	Weed biology, ecology and classification, crop-weed competition including allelopathy	C1	Lecture
Unit 1	Weed biology, ecology and classification, crop-weed competition including allelopathy	C2	Lecture
Unit 1	Principles and methods of weed control and classification management	C3	Lecture
Unit 1	Principles and methods of weed control and classification management	C4	Lecture
Unit 1	Weed indices, weed shift in different eco-systems	C5	Lecture
Unit 1	Herbicides- introduction and history of their development	C6	Lecture
Unit 1	Classification based on chemical, physiological application and selectivity	C7	Lecture
Unit 1	Properties, mode and mechanism of action of herbicides	C8	Lecture
Unit 1	Properties, mode and mechanism of action of herbicides	C9	Lecture
Unit 1	Herbicide structure - activity relationship	C10	Lecture
Unit 1	Herbicide structure - activity relationship	C11	Lecture
Unit 1	Clarification class	C12	Clarification class
Unit 2	Factors affecting the efficiency of herbicides	C13	Lecture
Unit 2	Herbicide formulations, herbicide mixtures, adjuvants and safeners, sequential application of herbicides, rotation	C14	Lecture
Unit-2	Herbicide formulations, herbicide mixtures, adjuvants and safeners, sequential application of herbicides, rotation	C15	Lecture
Unit-2	Weed control through use of nano-herbicides and bio-herbicides, myco-herbicides, bio-agents and allelochemicals	C16	Lecture
Unit-2	Movement of herbicides in soil and plant	C17	Lecture

Unit-3	Degradation of herbicides in soil and plants	C18	Lecture
Unit-3	Herbicide resistance, residue, persistence and management	C19	Lecture
Unit-3	Development of herbicide resistance in weeds and crops and their management	C20	Lecture
Unit-3	Class room assignment	C21	Assignment
Unit-3	Herbicide combination and rotation	C22	Lecture
Unit-3	Weed management in major crops and cropping systems a) Grain crops , b)Oilseeds and pulses, c)Sugar and fibre crops	C23	Lecture
Unit 3	Weed management in major crops and cropping systems a) Grain crops , b)Oilseeds and pulses, c)Sugar and fibre crops	C24	Lecture
Unit-3	Weed management in major crops and cropping systems a) Tuber and forage crops	C25	Lecture
Unit-3	Weed management in major crops and cropping systems (i) Weed control under intercropping system, drylands and non-cropped area	C26	Lecture
Unit-3	Clarification class	C27	Clarification class
Unit-4	Noxious, alien, invasive and parasitic weeds and their management	C28	Lecture
Unit-4	Weed shifts in cropping systems	C29	Lecture
Unit-4	Aquatic and perennial weeds and their control and Integrated weed management	C30	Lecture
Unit-4	Recent development in weed management-robotics, use of drones and aeroplanes, organic etc.	C31	Lecture
Unit4	Cost: benefit analysis of weed management potentiality of crop plants	32	Lecture

MSAC41102 Principles and Practices of Weed Management Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Identification of important *Kharif* and *Rabi* weeds	P1	Practical
2	Identification of perennial weeds of crop fields, road sides, wastelands and irrigation channels	P2	Practical
3	Preparation of a weed herbarium	P3	Practical
4	Weed survey in crops and cropping systems	P4	Practical
5	Crop-weed competition studies	P5	Practical
6	Weed indices calculation and interpretation with data	P6	Practical
7	Familiarization with trade names, common names, uses, cost and sources of availability of herbicides	P7	Practical
8	Preparation of spray solutions of herbicides for high and low-volume sprayers	P8	Practical
9	Use of various types of spray pumps and nozzles and calculation of swath width	P9	Practical
10	Economics of weed control	P10	Practical
11	Herbicide resistance analysis in plant and soil	P11	Practical
12	Bioassay of herbicide resistance residues	P12	Practical
13	Calculation of herbicidal requirement	P13	Practical
14	Identification of important *Kharif* and *Rabi* weeds	P14	Practical
15	Identification of perennial weeds of crop fields, road sides, wastelands and irrigation channels	P15	Practical

MSAE41103 Principles and Practices of Organic Farming

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	Organic farming - concept and definition, its relevance to India and global agriculture and future prospects	C-1	Lecture
Unit-I	Principles of organic agriculture, organics and farming standards	C-2	Lecture
Unit-I	Organic farming and sustainable agriculture	C-3	Lecture
Unit-I	Organic farming and water use efficiency	C-4	Lecture
Unit-I	Soil fertility, nutrient recycling, organic residues, organic manures, composting, green manures, soil biota and decomposition of organic residues,	C-5	Lecture
Unit-I	Soil fertility, nutrient recycling, organic residues, organic manures, composting, green manures, soil biota and decomposition of organic residues,	C-6	Lecture
	Clarification class	C-7	Clarification Class
Unit-II	Bio-fertilizers and biogas technology	C-8	Lecture
Unit-II	Farming systems, selection of crops and crop rotations,	C-9	Lecture
Unit-II	Weed management,diseases and insect pest management	C-10	Lecture
Unit-II	Biological agents, pheromones and bio-pesticides	C-11	Lecture
Unit-II	Socio-economic impacts, marketing and export potentialof organic farming	C-12	Lecture
Unit-II	Inspection, certification, labeling and accreditation procedures	C-13	Lecture
Unit-II	Organic farming and national economy	C-14	Lecture
Unit-II	Organic farming - concept and definition, its relevance to India and global agriculture and future prospects	C-15	Lecture
Unit-II	Principles of organic agriculture, organics and farming standards	C-16	Lecture
Unit-II	Principles of organic agriculture, organics and farming standards	C-17	Lecture
Unit-II	Principles of organic agriculture, organics and farming standards	C-18	Lecture
	Clarification class	C-19	Clarification class
Unit-III	Organic farming - concept and definition, its relevance to India and global agriculture and future prospects influence on soil properties	C-20	Lecture

Unit-III	Organic farming - concept and definition, its relevance to India and global agriculture and future prospects	C-21	Lecture
	Quiz	C-22	Quiz
Unit-III	Assignment	C-23	Classroom assignment

MSAE41104 Principles and Practices of Organic Farming Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Method of making compost by aerobic method	P1	Practical
2	Method of making compost by anaerobic method	P2	Practical
3	Method of making vermicompost	P3	Practical
4	Identification and nursery raising of important agro-forestry tress and tress for shelter belts	P4	Practical
5	Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field	P5	Practical
6	Visit to a biogas plant	P6	Practical
7	Visit to an organic farm	P7	Practical
8	Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms	P8	Practical
9	Method of making compost by aerobic method	P9	Practical
10	Method of making compost by anaerobic method	P10	Practical
11	Method of making vermicompost	P11	Practical
12	Identification and nursery raising of important agro-forestry tress and tress for shelter belts	P12	Practical
13	Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field	P13	Practical
14	Visit to a biogas plant	P14	Practical
15	Visit to an organic farm	P15	Practical

MSAE41105 Agronomy of Major Cereals and Pulses

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	Rice-1 Origin and history, importance, production, distribution, adaptability and classification, cropping systems	C-1	Lecture
Unit-I	Rice-2 Climate, soil and cultural requirements and improved varieties	C-2	Lecture
Unit-I	Rice-3 Nutrient, water and weed management	C-3	Lecture
Unit-I	Rice-4 Crop protection, handling and processing of produce, quality components and industrial uses of main and by products	C-4	Lecture
Unit-I	Maize-1 Origin and history, importance, production, distribution and classification	C-5	Lecture
Unit I	Maize-2 Climate, soil and cultural requirements and improved varieties	C-6	Lecture
Unit-I	Maize-3 Nutrient, water, weed management and quality components	C-7	Lecture
Unit-I	Maize-4 Crop protection, handling and processing of produce, prospects of *rabi* maize cultivation in India	C-8	Lecture
	Clarification Class	C-9	Clarification Class
Unit-II	Sorghum -1 Origin and history, importance, production and distribution	C-10	Lecture
Unit-II	Sorghum -2 Climate, improved varieties, soil and cultural requirements	C-11	Lecture
Unit-II	Sorghum -3 Nutrient, water and weed management	C-12	Lecture
Unit-II	Sorghum -4 Crop protection, handling and processing of produce and quality components	C-13	Lecture
Unit-II	Classroom assignment	C-14	Class Assignment

Unit-II	Pearl millet 1 Origin and history, importance, production, distribution and cropping systems	C-15	Lecture
Unit-II	Pearl millet 2 Climate, improved varieties, soil and cultural requirements for maximization of production	C-16	Lecture
Unit-II	Pearl millet 3 Nutrient, weed and water management	C-17	Lecture
Unit-II	Pearl millet 4 Plant protection, quality components and industrial uses of the main and by products.	C-18	Lecture
Unit-II	Wheat 1 Nutrient, water and weed management in relation to latest research Crop protection, handling and processing of produce	C-19	Lecture
Unit-II	Wheat 2 Origin and history, importance, production, distribution, adaptability and classification	C-20	Lecture
Unit-II	Wheat 3 Cropping systems, adaptability, climate and improved varieties, soil and cultural requirements	C-21	Lecture
Unit-II	Wheat 4 Crop protection, handling and processing of produce	C-22	Lecture
Unit-III	**Barley1** Origin and history, importance, production, distribution, classification Climate, improved varieties, soil and cultural requirements	C23	Lecture
Unit-III	**Barley 2** Nutrient, water and weed management Crop protection, handling and processing of produce, quality components and industrial uses of the main and by products.	C24	Lecture
Unit-III	Clarification class	C25	Clarification class
Unit-III	Acquaintance about important minor millets	C26	Lecture
Unit-III	**Pigeon pea :**Origin and history, importance, protection and distribution, classification, morphology and phenology, cropping systems,	C27	Lecture

	Adaptability, climate, soil and improved varieties, Nutrient, water and weed management, crop protection, handling and processing of produce.		
Unit-III	**Chickpea** : Origin and history, importance, production and distribution, classification, morphology and phenology, cropping systems, adaptability, Climate, soil and cultural requirement for maximization of production and improved varieties Nutrient, water and weed management, crop protection, handling and processing of produce	C28	Lecture
Unit-III	Package of practices of common pulses; greengram, blackgram, cowpea, mothbean, lentil	C29	Lecture
Unit-III	Clarification class	C30	Clarification clas
Unit-III	Quiz	C31	Quiz
Unit-III	Package of practices of common pulses; greengram, blackgram, cowpea, mothbean, lentil	C32	Lecture

MSAE41106 Agronomy of Major Cereals and Pulses Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Phenological studies at different growth stages of crop	P1	Practical
2	Estimation of crop yield on the basis of yield attributes	P2	Practical
3	Formulation of cropping schemes for various farm sizes and calculation of croppingand rotational intensities	P3	Practical
4	Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLWetc.)	P4	Practical
5	Assessment of land use and yield advantage (Rotational intensity, Croppingintensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)	P5	Practical
6	Estimation of protein content in pulses	P6	Practical
7	Planning and layout of field experiments	P7	Practical
8	Judging of physiological maturity in different crops	P8	Practical
9	Intercultural operations in different crops	P9	Practical
10	Determination of cost of cultivation of different crops	P10	Practical
11	Working out harvest index of various crops	P11	Practical
12	Study of seed production techniques in selected crops	P12	Practical
13	Visit of field experiments on cultural, fertilizer, weed control and watermanagement aspects	P13	Practical
14	Visit to nearby villages for identification of constraints in crop production	P14	Practical
15	Phenological studies at different growth stages of crop	P15	Practical

MSAC51100 Physiological and Molecular Responses of Plants to Abiotic Stresses

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	Abiotic stresses, major constraints to realize potential yields of crop plants, yield losses.	C-1	Lecture
Unit-I	Drought prone areas in India-Frequency of occurrence of drought, Rainfed- kharif, Rabi, Areas affected by salinity, heavy metals, water logging, high temperature scenario due to global warming.	C-2	Lecture
Unit-I	Drought-characteristic features; water potential in the soil-plant air continuum.	C-3	Lecture
Unit-I	Drought-characteristic features; water potential in the soil-plant air continuum.	C-4	Lecture
Unit-I	Physiological and biochemical processes affected by drought. Oxidative stress-generation of ROS and other cytotoxic compounds, their effect on cellular process.	C-5	Lecture
Unit-I	Physiological and biochemical processes affected by drought. Oxidative stress-generation of ROS and other cytotoxic compounds, their effect on cellular process.	C-6	Lecture
Unit-I	Effect on total carbon gain-decrease in photosynthetic area and function, protein turn over and lipid characters, phenology-reproductive aspects, critical stages.	C-7	Lecture
Unit-I	Effect on total carbon gain-decrease in photosynthetic area and function, protein turn over and lipid characters, phenology-reproductive aspects, critical stages.	C-8	Lecture
Unit-I	Clarification class	C-9	Clarification class
Unit-I	Stress perception and signal transduction leading to expression of regulatory genes, stress specific kinases, stress, specific transcription factors, functional genes associated with adaptive mechanisms	C-10	Lecture

Unit-I	Stress perception and signal transduction leading to expression of regulatory genes, stress specific kinases, stress, specific transcription factors, functional genes associated with adaptive mechanisms	C-11	Lecture
Unit-I	Concept of stress escape-exploiting genetic variability in phenology, Drought avoidance mechanisms- Maintenance of cell turgor, water mining by root characters.	C-12	Lecture
Unit II	Moisture conservation-Regulation of transpiration-traits reducing heat load, Stomatal factors guard cell metabolism, moisture conservation by waxes	C-13	Lecture
Unit II	Water use efficiency (WUE) and concept of water productivity- regulation of transpiration efficiency-stomatal conductance, mesophyll efficiency, relevance of WUE and Passioura's model.	C-14	Lecture
Unit II	Water use efficiency (WUE) and concept of water productivity- regulation of transpiration efficiency-stomatal conductance, mesophyll efficiency, relevance of WUE and Passioura's model.	C-15	Lecture
Unit II	Decreased turgor mediated upregulation of cellular tolerance mechanisms, Osmolytes, managing cytotoxic compounds, ROS, RCC, scavenging-enzymatic and non-enzymatic, protein turnover, stability, chaperones, membrane stability, photo-protection of chlorophylls.	C-16	Lecture
Unit II	Development of genetic resources-donor genotypes for specific traits, Genomic resources-genes, QTL's regulating adaptive mechanisms, Conventional, transgenic and molecular breeding approaches to improve relevant adaptive traits, concept of trait introgression	C-17	Lecture
Unit II	Soil salinity-Effect of salt stress, ionic and osmotic effects; species variation in salt	C-18	Lecture

	tolerance; glycophytes and halophytes, Salttolerance mechanisms-exclusion, extrusion and compartmentalization, Signaling during salt stress–SOS pathway, Approaches to improve salt tolerance		
Unit II	Soil salinity-Effect of salt stress, ionic and osmotic effects; species variation in salt tolerance; glycophytes and halophytes, Salttolerance mechanisms-exclusion, extrusion and compartmentalization, Signaling during salt stress–SOS pathway, Approaches to improve salt tolerance	C-19	Lecture
	Class room assignment	C-20	Class Assignment
Unit III	Heavy metal toxicity in plants (eg., Al, Cd), tolerance 2 305 mechanisms and approaches to improvement	C-21	Lecture
Unit III	Heavy metal toxicity in plants (eg., Al, Cd), tolerance 2 305 mechanisms and approaches to improvement	C-22	Lecture
Unit III	Plant response to water logging, role of hormones-ethylene, mechanism of tolerance and approaches to improvement.	C-23	Lecture
Unit III	Plant response to water logging, role of hormones-ethylene, mechanism of tolerance and approaches to improvement.	C-24	Lecture
Unit III	Plant response to water logging, role of hormones-ethylene, mechanism of tolerance and approaches to improvement.	C-25	Lecture
	Class assignment	C-26	Class Assignment
Unit IV	High and low temperatures; effect on plants; adaptive mechanisms, evaporation cooling, concept of cellular tolerance, protein stability, chaperones, HSPs, HSFs, membranes	C-28	Lecture
	Clarification class	C-29	Clarification Class
Unit IV	High and low temperatures; effect on plants; adaptive mechanisms, evaporation cooling,	C-30	Lecture

	concept of cellular tolerance, protein stability, chaperones, HSPs, HSFs, membranes		
Unit IV	High light and high ionizing radiation-photo oxidation and photo inhibition; mechanisms of tolerance, plant adaptation to low light, concept of shade avoidance response (SAR)	C-31	Lecture
Unit IV	High light and high ionizing radiation-photo oxidation and photo inhibition; mechanisms of tolerance, plant adaptation to low light, concept of shade avoidance response (SAR)	C-32	Lecture

MSAC51101 Physiological and Molecular Responses of Plants to Abiotic Stresses Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Soil and plant water status	P1	Practical
2	Drought stress imposition and measurement of physiological and biochemical changes in plants under stress–gas exchange and fluorescence measurements.	P2	Practical
3	Determination of water use efficiency as a drought resistant trait.	P3	Practical
4	Drought Susceptibility Index (DSI) -precise field technique to identify productive genotypes under stress.	P4	Practical
5	Approaches to quantify root characters	P5	Practical
6	Determination of stomatal parameters and canopy temperature as a reflection of transpiration and root activity	P6	Practical
7	Determination of Salinity Tolerance Index.	P7	Practical
8	Studying acclimation response - Temperature induction response	P8	Practical
9	Heat tolerance and membrane integrity- Sullivans heat tolerance test.	P9	Practical
10	Quantification of osmolytes – proline under stress.	P10	Practical
11	Oxidative stress imposition- Quantification of oxidative stress	P11	Practical
12	Quantification of ROS under stress.	P12	Practical
13	Estimation of ABA content in leaf and root tissues under stress.	P13	Practical
14	Determination of Sodium and Potassium in plant tissue grown under salt stress.	P14	Practical
15	Estimation of antioxidant enzymes.	P15	Practical

MSAC52100 Statistical Methods for Applied Sciences

Unit	Particulars	Class No.	Pedagogy of Class
UNIT-I	Descriptive Statistics& Exploratory data analysis	C-1	Lecture
Unit-I	Descriptive Statistics& Exploratory data analysis	C-2	Lecture
Unit-I	Theory of probability	C-3	Lecture
Unit-I	Theory of probability	C-4	Lecture
Unit-I	Random variable and mathematical expectation	C-5	Lecture
Unit-I	Random variable and mathematical expectation	C-6	Lecture
	Clarification class	C-7	Clarification Class
Unit-II	Tests of significance for Normal, chi-square, t and F distributions	C-8	Lecture
Unit-II	Introduction to theory of estimation and confidence intervals	C-9	Lecture
	Class Assignment	C-10	Class assignment
Unit-II	Simple and multiple correlation coefficient, partial correlation	C-11	Lecture
Unit-II	Simple and multiple correlation coefficient, partial correlation	C-12	Lecture
Unit-II	Rank correlation	C-13	Lecture
Unit-II	Simple and multiple linear regression model	C-14	Lecture
Unit-III	Test of significance of correlation coefficient and regression coefficients, Coefficient of determination	C-15	Lecture
Unit-III	Test of significance of correlation coefficient and regression coefficients, Coefficient of determination	C-16	Lecture

Unit-III	Test of significance of correlation coefficient and regression coefficients, Coefficient of determination	C-17	Lecture
Unit-III	Non-parametric tests-Concept and definition	C-18	Lecture
Unit-III	Non-parametric tests-Concept and definition	C-19	Lecture
Unit-III	Sign, Run test for the randomness of a sequence, Median test	C-20	Lecture
Unit-IV	Sign, Run test for the randomness of a sequence, Median test	C-21	Lecture
Unit-IV	Sign, Run test for the randomness of a sequence, Median test	C-22	Lecture
	Quiz	C-23	Quiz
Unit-IV	Introduction to ANOVA: One way and Two Way	C-24	Lecture
Unit-IV	Introduction to Sampling Techniques	C-25	Lecture
Unit-IV	Introduction to Multivariate Analysis	C-26	Lecture
	Clarification class	C-27	Clarification Class
	Quiz	C-28	Quiz
	Class room assignment-II	C-29	Class Assignment
Unit-IV	Transformation of Data	C-30	Lecture

MSAC52101 Statistical Methods for Applied Sciences Lab

S. No.	Particulars	Class No.	Pedagogy of Class
1	Exploratory data analysis	P1	Practical
2	Fitting of Binomial distribution	P2	Practical
3	Fitting of Poisson distribution	P3	Practical
4	Fitting of Normal distribution	P4	Practical
5	Large Sample tests	P5	Practical
6	Chi Square test	P6	Practical
7	One sample, two sample and paired t test	P7	Practical
8	F- test	P8	Practical
9	Confidence interval estimation and Computation of Simple correlation & regression	P9	Practical
10	Computation of partial and multiple correlation	P10	Practical
11	Sign test	P11	Practical
12	Run test	P12	Practical
13	Median test	P13	Practical
14	One Way ANOVA	P14	Practical
15	Two Way ANOVA	P15	Practical

MSAC55100 Library and Information Services

S. No.	Particulars	Class No.	Pedagogy of Class
1.	To equip the library users with skills to trace information from libraries	L1-L2	Lecture
2.	Apprise them of information and knowledge resources	L3-L4	Lecture
3.	Classification systems and organization of library	P5-P6	Practical
4.	Sources of information- Primary Sources, Secondary Sources and Tertiary Sources	P7-P8	Practical
5.	Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.)	P9-P10	Practical
6.	Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.)	P11-P12	Practical
7.	Tracing information from reference sources	P13	Practical
8.	Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases,	P14	Practical
9.	Use of Internet including search engines and its resources; e- resources access methods.	P15	Practical

This is tentative lesson plan. The same may be changed from faculty as per the teaching pedagogy adapted by the faculty.

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