Detailed Course Scheme

Master of Science in Agriculture

(Agronomy)

Semester- III

(2024- 26)

DOC202406150008

RNB GLOBAL UNIVERSITY
Educating stars for tomorrow

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 (July – December) 2025 along with examination pattern is as follows:

Course Scheme

Semester –III

S. No.	Course Code	Category	Course Name	L	T	P	Credits
1	MSAC52200	S	Experimental Designs	2	0	0	2
2	MSAC52201	S	Experimental Designs Lab	0	0	2	1
3	MSAC55200	C	Basic concepts in laboratory techniques Lab	0	0	2	1
4	MSAC55201	C	Agricultural research, research ethics and rural development programmes	1	0	0	1
5	DAPE99249		Thesis Research	10	0	0	10
6		E	Elective course (non-gradial)*				
			Total	**13**	**0**	**4**	**15**

S: Supporting course;

C: Common course;

E: Elective course

Elective course (non-gradial) *

S. No.	Category	Course code	Course Name	L	T	P	Credits
1	E	MSAE41200	Conservation Agriculture	1	0	0	1
2	E	MSAE41201	Conservation Agriculture Lab	0	0	1	1
3	E	MSAE41202	Agronomy of Fodder and Forage crops	2	0	0	2
4	E	MSAE41203	Agronomy of Fodder and Forage crops Lab	0	0	1	1
5	E	MSAE41204	Agronomy of oilseeds, fiber and sugarcane crops	2	0	0	2
6	E	MSAE41205	Agronomy of oilseeds, fiber and sugarcane crops Lab	0	0	1	1
7	E	MSAE41206	Agronomy of medicinal aromatic and underutilized crops	2	0	0	2
8	E	MSAE41207	Agronomy of medicinal aromatic and underutilized crops Lab	0	0	1	1
9	E	MSAE41208	Agrostology and Agro forestry	2	0	0	2
10	E	MSAE41209	Agrostology and Agro forestry Lab	0	0	1	1
11	E	MSAE41210	Cropping system and sustainable agriculture	2	0	0	2
Students can choose any two elective courses (one in third semester and one in fourth semester)							

M: Major course; Mi: Minor course; S: Supporting course; C: Common course; E: Elective course

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
Academic and course involvement		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
Academic and course involvement		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 graduates 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	Course outcomes: - After completion of these courses' students should be able to
MSAC52200 – Experimental Design	**CO1:** Identify and describe key statistical concepts and terminology relevant to experimental design, including randomization, replication, control, and bias. **CO2:** Explain the principles of various statistical experimental designs, including completely randomized designs, randomized block designs, factorial designs, and crossover designs, and their applications in research. **CO3:** Apply statistical principles to select appropriate experimental designs based on research objectives, hypotheses. **CO4:** Analyze experimental data using statistical software and techniques, interpreting results. **CO5:** Evaluate the validity and reliability of different experimental designs and statistical methods.
MSAC52201 - Experimental design Lab	**CO1:** Identify and describe key components of statistical experimental design and factors affecting experimental outcomes. **CO2:** Explain the significance of different statistical designs (e.g., completely randomized, randomized block, factorial designs) in the context of laboratory experiments. **CO3:** Apply statistical principles to design and conduct experiments, selecting appropriate designs based on objectives. **CO4:** Analyze experimental data using statistical software (e.g., R, SPSS, or SAS), **CO5:** Evaluate the results of experiments by interpreting statistical output, assessing the validity of findings, and discussing implications for research conclusions.

MSAC55200 – Basic concepts in laboratory techniques	**CO1:** Identify and describe fundamental laboratory techniques, equipment, and safety protocols used in scientific research and experiments. **CO2:** Explain the principles behind various laboratory techniques and their applications in scientific research. **CO3:** Apply proper laboratory techniques and procedures in conducting experiments and data collection. **CO4:** Analyze and interpret experimental data obtained from laboratory techniques, assessing the accuracy and reliability of results. **CO5:** Evaluate laboratory results and procedures to enhance experimental accuracy and safety.
MSAC55201 - Agricultural research, research ethics and rural development programme	**CO1:** Identify and describe key concepts, terminology and methodologies related to agricultural research, research ethics, and rural development. **CO2:** Explain the importance of ethical considerations in agricultural research and the impact of research on rural communities. **CO3:** Apply appropriate research methodologies to design and conduct agricultural research that addresses specific challenges faced by rural communities. **CO4:** Analyze the outcomes of agricultural research and rural development programmes in improving livelihoods and promoting sustainable practices. **CO5:** Evaluate the ethical implications of research practices and the impact of agricultural innovations on rural development.
DAPE99249- Thesis research	**CO1:** Identify and describe key components of agricultural research methodologies, including literature review, data collection techniques, and statistical analysis. **CO2:** Explain the significance of formulating a clear research hypothesis, as well as the ethical considerations in agricultural research. **CO3:** Apply appropriate research methodologies to design and implement a research project including experimental design and data collection. **CO4:** Analyze research data using statistical tools and techniques, interpreting results to draw valid conclusions. **CO5:** Evaluate the implications of research findings on agricultural practices, policy-making, and rural development.

MSAE41200 - Conservation Agriculture	**CO1:** Identify and describe key components of conservation agriculture, including conventional and conservation agriculture systems, sustainability concerns, and global and Indian perspectives. **CO2:** Explain the significance of different management strategies in conservation agriculture, such as nutrient management, water management, weed control, insect-pest and disease management, and their role in improving sustainability. **CO3:** Apply conservation agriculture principles to design and implement sustainable farming systems, considering factors like crop residue management, cover cropping, and farm machinery use. **CO4:** Analyze the impact of conservation agriculture on climate change mitigation, including carbon sequestration, soil health, and the role of soil microbes, using scientific methods and data analysis tools. **CO5:** Evaluate the economic feasibility and adoption constraints of conservation agriculture, assessing its long-term potential as the future of sustainable agriculture.
MSAE41201 - Conservation Agriculture Lab	**CO1:** Analyze data from long-term experiments on conservation agriculture (CA) to assess its impact on soil health, crop productivity, and sustainability. **CO2:** Evaluate key soil health parameters, including physical, chemical, and biological indicators, to determine the effects of conservation agriculture on soil quality and fertility. **CO3:** Estimate carbon sequestration potential under different CA practices and assess its role in climate change mitigation and sustainable farming systems. **CO4:** Perform machinery calibration for sowing different crops in CA systems and assess weed seedbank dynamics, energy requirements, and operational efficiency. **CO5:** Conduct an economic analysis of conservation agriculture by comparing input costs, energy use, and long-term profitability with conventional farming systems.

MSAE41202 - Agronomy of Fodder and Forage Crops	**CO1:** Identify and describe the adaptation, distribution, varietal improvement, agro-techniques, and quality aspects, including anti-quality factors, of important fodder crops such as sorghum, maize, bajra, guar, cowpea, oats, barley, berseem, senji, and lucerne. **CO2:** Analyze the adaptation, distribution, varietal improvement, agro-techniques, and quality aspects of important forage crops and grasses like Napier grass, Panicum, Lasiurus, and Cenchrus. **CO3:** Develop strategies for year-round fodder production and management, including preservation and utilization of forage and pasture crops for sustainable livestock feeding. **CO4:** Evaluate the principles and methods of hay and silage making, including chemical and biochemical changes, nutrient losses, and enrichment techniques, as well as innovative approaches like hydroponic fodder production and Azolla cultivation. **CO5:** Assess the economics of forage cultivation, seed production techniques, and the utilization of fodder crops to enhance productivity and profitability in livestock farming systems.
MSAE41203 - Agronomy of Fodder and Forage Crops Lab	**CO1:** Demonstrate practical skills in farm operations for raising fodder crops, including land preparation, sowing, nutrient management, and harvesting techniques. **CO2:** Measure and analyze canopy characteristics, yield parameters, and leaf-to-stem ratio in various fodder and forage crops to assess their productivity and quality. **CO3:** Evaluate the nutritional quality of fodder and forage crops by estimating crude protein, neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin, silica, cellulose, and in vitro dry matter digestibility (IVDMD). **CO4:** Identify and quantify anti-quality factors such as hydrocyanic acid (HCN) in sorghum and other toxic compounds in different fodder crops to ensure safe livestock feeding. **CO5:** Apply principles of hay and silage making, assess the economic feasibility of their preparation, and utilize various techniques to enhance the nutritive value of stored fodder.

MSAE41204 - Agronomy of Oilseed, Fiber and Sugar Crops	**CO1:** Explain the origin, history, area, and production trends of major Rabi and Kharif oilseeds, fiber crops, and sugar crops in India and globally. **CO2:** Classify and evaluate improved varieties of oilseeds (rapeseed, mustard, linseed, niger, groundnut, sesame, castor, sunflower, soybean, and safflower), fiber crops (cotton, jute, ramie, mesta), and sugar crops (sugarcane, sugar beet) based on adaptability and agronomic performance. **CO3:** Assess the climatic, soil, water, and cultural requirements of oilseeds, fiber, and sugar crops to optimize growth, yield, and sustainability. **CO4:** Analyze the nutritional and quality components of oilseeds, fiber, and sugar crops and their impact on processing, market value, and end-use applications. **CO5:** Apply handling, processing, and post-harvest management techniques to enhance productivity and maximize the economic returns of oilseed, fiber, and sugar crops.
MSAE41205 - Agronomy of Oilseed, Fiber and Sugar Crops Lab	**CO1:** Demonstrate skills in planning and layout of field experiments, including seed treatment, sowing methods, and intercultural operations for oilseeds, fiber, and sugar crops. **CO2:** Perform agronomic practices such as cutting, treating, and sowing sugarcane setts, tying and propping, and determining cane maturity through sucrose content, purity percentage, and recovery calculations. **CO3:** Evaluate crop growth and productivity using growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW) and assess land-use efficiency through cropping intensity, diversity index, crop equivalent yield, and competition analysis. **CO4:** Analyze physiological maturity, harvest index, oil content in oilseeds, fiber quality in fiber crops, and yield estimation techniques to determine economic viability and quality parameters. **CO5:** Develop and assess cropping schemes, cost of cultivation, and sustainable crop production strategies by conducting farm visits, studying field experiments on cultural, fertilizer, weed control, and water management aspects, and identifying constraints in crop production.

MSAE41206 - Agronomy of Medicinal, Aromatic and Underutilized Crops	**CO1:** Explain the significance of medicinal and aromatic plants in human health, national economy, and related industries, along with their classification, uses, and export potential. **CO2:** Assess the climate, soil requirements, cultural practices, yield potential, and key constituents of medicinal plants such as Mulhati, Isabgol, Rauwolfia, Poppy, Aloe vera, Satavar, Stevia, Safed Musli, Kalmegh, Asafoetida, Nux vomica, and Roselle. **CO3:** Evaluate the climate, soil conditions, agronomic practices, and essential oil yield of aromatic plants, including Citronella, Palmarosa, Mentha, Basil, Lemongrass, Rose, Patchouli, and Geranium. **CO4:** Analyze the growth requirements, agronomic practices, and yield potential of underutilized crops such as Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea, and Tobacco. **CO5:** Demonstrate knowledge of post-harvest handling, including drying, processing, grading, packaging, storage, value addition, and quality standards in herbal and aromatic products.
MSAE41207 - Agronomy of Medicinal, Aromatic and Underutilized Crops Lab	**CO1:** Identify medicinal, aromatic, and underutilized crops based on their morphological and seed characteristics. **CO2:** Develop a herbarium of medicinal, aromatic, and underutilized plants to document their botanical characteristics and uses. **CO3:** Evaluate the quality parameters of medicinal and aromatic plants by assessing key constituents influencing their therapeutic and commercial value. **CO4:** Demonstrate proficiency in methods of essential oil extraction and chemical analysis for determining active compounds in medicinal and aromatic plants. **CO5:** Apply scientific techniques for post-harvest handling, processing, and quality enhancement of medicinal and aromatic plants to meet industrial and export standards.

MSAE41208 - Agrostology and Agro forestry	**CO1:** Explain the principles of agrostology, grassland ecology, and the ecological status of grasslands in India, including succession, dominant species, and management challenges. **CO2:** Classify and assess the importance, scope, status, and research needs of pastures, including natural and cultivated pastures, their improvement, renovation, and common pasture grasses. **CO3:** Describe the principles, importance, and types of agroforestry systems, including agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aquasilviculture, alley cropping, and energy plantations. **CO4:** Analyze crop production technologies in agroforestry and agrostology systems, with a focus on silvipastoral systems, species selection, seed germination issues, planting methods, irrigation, and nutrient management. **CO5:** Evaluate the ecological and economic viability of agroforestry, including associative influences, lopping, coppicing, nutritive value of trees, and their role in sustainable land use and wasteland development.
MSAE41209 - Agrostology and Agro forestry Lab	**CO1:** Develop charts and maps illustrating different types of pastures and agroforestry systems across India to understand their distribution and significance. **CO2:** Identify seeds and plants of common grasses, legumes, and trees of economic importance in agroforestry and pasture management. **CO3:** Demonstrate seed treatment techniques to enhance germination and improve vegetation establishment in agroforestry and pasture systems. **CO4:** Apply various propagation and planting methods for grasses and trees in silvipastoral systems, including fertilizer application and post-plantation care. **CO5:** Analyze the nutritional and economic aspects of agroforestry by estimating protein content in fodder trees, caloric value of fuelwood, total biomass, and economic feasibility.

MSAE41210 - Cropping system and sustainable agriculture	**CO1:** Explain the concept, indices, and significance of cropping systems, including soil and water management strategies and land use assessment for sustainable agriculture. **CO2:** Analyze the principles of sustainable cropping and farming systems, including monoculture, multiple cropping, alley cropping, sequential cropping, and intercropping, along with their yield advantages. **CO3:** Evaluate above- and below-ground interactions, allelopathic effects, competition relations, and the impact of non-monetary inputs and low-cost technologies on yield stability and sustainability. **CO4:** Assess crop diversification strategies, soil fertility maintenance through organic matter and crop residue management, fertilizer use efficiency, and the role of advanced nutritional tools in big data analysis for precision agriculture. **CO5:** Examine plant ideotypes for drylands, the role of plant growth regulators in sustainability, and the application of Artificial Intelligence in modern agriculture for enhanced decision-making and resource management.

7. CO PO Mapping

MSAC52200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	3	3	3	3	3	3	3
CO2	2	2	3	3	3	2	2	2	1	3	2	2
CO3	2	3	3	3	1	2	3	3	2	3	2	3
CO4	3	2	2	2	3	2	2	3	2	3	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3

MSAC52201	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	3	3	3	3	3	3	3
CO2	2	2	3	3	3	2	2	2	1	3	2	2
CO3	2	3	3	3	1	2	3	3	2	3	2	3
CO4	3	2	2	2	3	2	2	3	2	3	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3

MSAC55200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	3	3	3	3	3	3	3
CO2	2	2	3	3	3	2	2	2	1	3	2	2
CO3	2	3	3	3	1	2	3	3	2	3	2	3
CO4	3	2	2	2	3	2	2	3	2	3	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3

MSAC55201	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	2	3	3	3	3	3
CO2	2	2	3	3	3	2	3	2	3	3	2	3
CO3	2	3	2	1	1	2	2	3	2	3	3	3
CO4	3	3	2	2	3	2	3	3	2	3	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3

DAPE99249	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	2	3	3	3	3	3
CO2	2	2	3	3	3	2	3	2	3	3	2	3
CO3	2	3	2	1	1	2	2	3	2	3	3	3
CO4	3	3	2	2	3	2	3	3	2	3	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3

MSAE41200	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3		2	3	3	2		2	
CO2	2	3	3	2		2	2		3	3	3	3
CO3	3	2		2	3	2	3	2	2		2	3
CO4	3	3	2	2	2		2		3	2	3	2
CO5		3			3	2	3	3	3	2	3	2

MSAE41201	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		2	2			2	2	2	3
CO2	2		2		3	3	2		2	2	2	3
CO3	3	3	3	3	3		3	2	2	3	3	2
CO4	2	3	3	3		2	2	3	3	2		2
CO5	2	3	3	3	3	2	2	2	2	2	2	2

MSAE41202	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	2	3	3	2	2		3
CO2	3	3		2				2	2	2		2
CO3	3	3	2	2		2		2		2	2	
CO4	3	2			2		2	2			2	2
CO5	2	2	3	2	2	2	3	3	2	2		3

MSAE41203	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3		2		2	2	2	2	2
CO2	3	2	3	2	2			3	3		3	
CO3	2	3	2	3			2	3	3	2		2
CO4	3	2			3	2	3			2	2	3
CO5	2		3	3	3	2		3	3	2	3	3

MSAE41204	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3		2		3	2	3	2	2
CO2				2	2		3	3	3		3	
CO3	3	3	2		3		2	2	3	2		2
CO4	3	2	2	3		2			2	3	2	2
CO5	2		3	3	3	3		3	3	3	3	3

MSAE41205	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3		2	2	2		3	2
CO2		2		3	2	3	2	2	2	3	2	2
CO3	3	3	3		3	3	3		3	3	3	
CO4	3		2	2	2	3	3	2		3	3	2
CO5	3	3	3	3	3	3		2	3		3	

MSAE41206	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3		3	3		2	3	3	3
CO2	3		3		2	2	3	2	2	2	3	2
CO3		3	3	3		3	3	3		3	3	3
CO4	2	2	2	3	3	2	3		2			3
CO5	2	2		3	3	2	3		2		3	3

MSAE41207	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3			2	2		3	2
CO2			3		2	2	3	3		2	3	2
CO3	3	3	3	3		3	3	3		3	3	3
CO4	2	2		3	3	2	3		2		3	3
CO5	3	3		3		3	3		2	3		3

MSAE41208	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	3	2	3	2	3	3	2	2	2	3
CO2	3	3	2	3	3		3	2	3	2		3
CO3	3	3	2		3	2	3	3	3		2	3
CO4	2	2	2	3		3	2		3	2	2	3
CO5	3	2	3	3		3		2	2	3	3	2

MSAE41209	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		3	3	3	3	2	3	2	3	2
CO2	2	3	2	3	2		2	3	2	3		2
CO3	3	3	3		3	2	3	2		2	2	3
CO4	3	3	2	3	3	3	2	3	2	3		3
CO5	2		3	2	3		3	2	3	2	3	3

MSAE41210	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		2	2		2	2	3	3	
CO2	2	3	3	2		3	3		2	2	2	2
CO3	3	2		3	2	2	3		2		3	3
CO4	3	2	2	2	3		2	3	3	3	2	3
CO5	3	3	3	3		2	3	3	3	3		2

8. Curriculum

Course Name: Experimental Design
Course Code: MSAC52200

Course Outline

Theory

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

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

Unit III
Factorial experiments, (symmetrical as well as asymmetrical). Orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV
Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Response surfaces, Combined analysis.

Suggested Readings

- Cochran WGand Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.
- Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
- Pearce S C. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. www.drs.icar.gov.in.

Course Name: Experimental Design Lab
Course Code: MSAC52201

Practical
Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments, Analysis with missing data, Split plot and strip plot designs.

Course Name: Basic Concepts in Laboratory Techniques Lab

Course Code: MSAC55200

Course Outline

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micro-pipettes and vaccupets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical used in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, and oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

- Furr A K. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
- Gabb M H and Latchem W E. 1968. A Handbook of Laboratory Solutions. Chemical Publ.Co.

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

Course Code: MSAC55201

Course Outline

Theory
Research ethics
UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the

environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural R esearch (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

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

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla G S and Singh G. 2001. Indian Agriculture- Four Decades of Development. Sage Publ.
- Punia M S. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
- Rao B S V. 2007. Rural Development Strategies and Role of Institutions Issues, Innovations and Initiatives.
- Mittal Publ. Singh K. 1998. Rural Development-Principles, Policies and Management. Sage Publ.
- Pearce S C. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. www.drs.icar.gov.in.

Course Name: Conservation Agriculture

Course Code: MSAE41200

Course Outline

Theory

Unit I

Conventional and conservation agriculture systems, sustainability concerns, conservation agriculture: Historical background and present concept, global experiences, present status in India.

Unit II

Nutrient management in CA, water management, weed management, energy use, insect-pest and disease management, farm machinery, crop residue management, cover crop management.

Unit III

Climate change mitigation and CA, C-sequestration, soil health management, soil microbes and CA.

Unit IV

CA in agroforestry systems, rainfed / dryland regions

Unit V

Economic considerations in CA, adoption and constraints, CA: The future of agriculture

Suggested Reading

- Arakeri HR and Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford & IBH.
- Bisht JK, Meena VS, Mishra PK and Pattanayak A. 2016. Conservation Agriculture- An approach to combat climate change in Indian Himalaya. Publisher: Springer Nature. Doi: 10/1007/978-981-10-2558-7.
- Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
- FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas*. *Soils Bull.,* Paper 57.
- Gracia-Torres L, Benites J, Martinez-Vilela A and Holgado-Cabera A. 2003. Conservation Agriculture- Environment Farmers experiences, innovations Socio-economic policy.
- Muhammad F and Kamdambot HMS. 2014. Conservation Agriculture. Publisher: SpringerCham Heidelberg, New Yaork Dordrecht London. Doi: 10.1007/978-3-319-11620-4.
- Yellamanda Reddy T and Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani.

Course Name: Conservation Agriculture Lab

Course Code: MSAE41201

Course Outline

Practicals

- Study of long-term experiments on CA,
- Evaluation of soil health parameters,
- Estimation of C-sequestration,
- Machinery calibration for sowing different crops, weed seedbank estimation under CA, energy requirements, economic analysis of CA.

Course Name: Agronomy of Fodder and Forage Crops

Course Code: MSAE41202

Course Outline

Theory

Unit I

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like sorghum, maize, *bajra*, *guar*, cowpea, oats, barley, berseem, *senji*, lucerne, etc.

Unit II

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasseslime, Napier grass, *Panicum, Lasiuras, Cenchrus,* etc.

Unit III

Year-round fodder production and management, preservation and utilization of forage and pasture crops.

Unit IV

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poorquality fodder. Fodder production through hydroponics. Azolla cultivation.

Unit V

Economics of forage cultivation uses and seed production techniques of important fodder crops.

Suggested Reading

- Chatterjee BN. 1989. *Forage Crop Production - Principles and Practices*. Oxford & IBH.
- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Narayanan TR and Dabadghao PM. 1972. *Forage Crops of India*. ICAR.
- Singh P and Srivastava AK. 1990. *Forage Production Technology*. IGFRI, Jhansi.
- Singh C, Singh P and Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
- Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.

Course Name: Agronomy of Fodder and Forage Crops Lab

Course Code: MSAE41203

Course Outline

Practical

- Practical training of farm operations in raising fodder crops;
- Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose and IVDMD, etc. of various fodder and

forage crops
- Anti-quality components like HCN in sorghum and such factors in other crops
- Hay and silage making and economics of their preparation.

Course Name: Agronomy of Oilseed, Fiber and Sugar Crops

Course Code: MSAE41204

Course Outline

Theory

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

Unit I

Rabi oilseeds – Rapeseed and mustard, Linseed and Niger

Unit II

Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower

Unit III

Fiber crops - Cotton, Jute, Ramie and Mesta.

Unit IV

Sugar crops – Sugar-beet and Sugarcane.

Suggested Reading

- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Das PC. 1997. *Oilseed Crops of India*. Kalyani.
- Lakshmikantam N. 1983. *Technology in Sugarcane Growing*. 2nd Ed. Oxford & IBH.
- Prasad Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
- Singh SS. 1998. *Crop Management*. Kalyani.

Course Name: Agronomy of Oilseed, Fiber and Sugar Crops Lab

Course Code: MSAE41205

Course Outline

Practical

- Planning and layout of field experiments
- Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop

- Intercultural operations in different crops
- Cotton seed treatment
- Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- 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 fibre of different fibre crops
- Study of seed production techniques in various 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

Course Name: Agronomy of Medicinal, Aromatic and Underutilized Crops

Course Code: MSAE41206

Course Outline

Theory

Unit I

Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and their uses, export potential and indigenous technical knowledge.

Unit II

Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Mulhati, Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, *Stevia*, Safed Musli, Kalmegh, Asaphoetida, *Nuxvomica*, Rosadle, etc).

Unit III

Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium).

Unit IV

Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco).

Unit V

Post harvest handling –drawing, processing, grading, packing and storage, value addition and quality standards in herbal products.

Suggested Reading

- Chadha KL and Gupta R. 1995. *Advances in Horticulture*. Vol. II. *Medicinal and Aromatic Plants*. Malhotra Publ.
- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Handa SS. 1984. *Cultivation and Utilization of Medicinal Plants*. RRL, CSIR, Jammu.
- Hussain A. 1984. *Essential Oil Plants and their Cultivation*. CIMAP, Lucknow.
- Hussain A. 1993. *Medicinal Plants and their Cultivation.* CIMAP, Lucknow.
- ICAR 2006. *Hand Book of Agriculture.* ICAR, New Delhi.
- Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants.* Oxford & IBH.
- Prajapati ND, Purohit SS, Sharma AK and Kumar T. 2003. *A Hand Book of Medicinal Plants: A Complete Source Book*. Agrobios.
- Sharma R. 2004. *Agro-Techniques of Medicinal Plants*. Daya Publ. House.

Course Name: Agronomy of Medicinal, Aromatic and Underutilized Crops Lab

Course Code: MSAE41207

Course Outline

Practical
- Identification of crops based on morphological and seed characteristics
- Raising of herbarium of medicinal, aromatic and under-utilized plants
- Quality characters in medicinal and aromatic plants
- Methods of analysis of essential oil and other chemicals of importance in medicinal

Course Name: Agrostology and Agro forestry

Course Code: MSAE41208

Course Outline

Theory

Unit I

Agrostology: definition and importance; principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological status of grasslands in India, grass cover of India; problems and management of grasslands.

Unit II

Importance, classification (various criteria), scope, status and research needs of

pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.

Unit III

Agroforestry: definition and importance; agroforestory systems, agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aquasilviculture, alley cropping and energy plantation.

Unit IV

Crop production technology in agro-forestory and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relation to above ground and underground interferences; lopping and coppicing in agro- forestry systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics.

Suggested Reading

- Chatterjee BN and Das PK. 1989. *Forage Crop Production. Principles and Practices.* Oxford & IBH.
- Dabadghao PM and Shankaranarayan KA. 1973. *The Grass Cover in India*. ICAR.
- Dwivedi AP. 1992. *Agroforestry- Principles and Practices.* Oxford & IBH.
- Indian Society of Agronomy. 1989*. Agroforestry System in India. Research and Development,*

New Delhi.

- Narayan TR and Dabadghao PM. 1972. *Forage Crop of India*. ICAR, New Delhi.

Course Name: Agrostology and Agro forestry Lab

Course Code: MSAE41209

Course Outline

Practical

- Preparation of charts and maps of India showing different types of pastures and agro-forestry systems
- Identification of seeds and plants of common grasses, legumes and trees of economic importance with reference to agro-forestry
- Seed treatment for better germination of farm vegetation
- Methods of propagation/ planting of grasses and trees in silvipastoral system
- Fertilizer application in strip and silvipastroal systems
- After-care of plantation
- Estimation of protein content in loppings of important fodder trees
- Estimation of calorie value of wood of important fuel trees
- Estimation of total biomass and fuel wood
- Economics of agro-forestry
- Visit to important agro-forestry research stations

Course Name: Cropping system and sustainable agriculture

Course Code: MSAE41210

Course Outline

Theory

Unit I

Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

Unit II

Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

Unit III

Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

Unit IV

Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system. Advanced nutritional tools for big data analysis and interpretation.

Unit V

Plant ideotypes for drylands; plant growth regulators and their role in sustainability.

Unit VI

Artificial Intelligence- Concept and application.

Suggested Reading

- Panda SC. 2017. *Cropping Systems and Sustainable Agriculture*. Agrobios (India)
- Panda SC. 2018. *Cropping and Farming Systems*. Agrobios.
- Palaniappan SP and Sivaraman K. 1996. *Cropping Systems in the Tropics; Principles and Management.* New Age.
- Panda SC. 2003. *Cropping and Farming Systems*. Agrobios.
- Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
- Sankaran S and Mudaliar TVS. 1997. *Principles of Agronomy.* The Bangalore Printing & Publ. Co.
- Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.
- Tisdale SL, Nelson WL, Beaton JD and Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice Hall.

9. Lesson Plan:

MSAC52200-Experimental Design

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Need for designing of experiments,	C-1	Lecture
Unit-I	characteristics of a good design.	C-2	Lecture
Unit-I	Quiz	C-3	Quiz
Unit-I	characteristics of a good design.	C-4	Lecture
Unit-I	Basic principles of designs- randomization, replication and local control.	C-5	Lecture
Unit-I	Basic principles of designs- randomization, replication and local control.	C-6	Lecture
Unit-I	Clarification class	C-7	Clarification class
Unit-II	Uniformity trials, size and shape of plots and blocks,	C-8	Lecture
Unit-II	Analysis of variance,	C-9	Lecture
Unit-II	Completely randomized design,	C-10	Lecture
Unit-II	randomized block design and Latin square design.	C-11	Lecture
Unit-II	Classroom Assignment	C-12	Classroom Assignment
Unit-III	Factorial experiments- symmetrical and asymmetrical	C-13	Lecture
Unit-III	Factorial experiments- symmetrical and asymmetrical	C-14	Lecture
Unit-III	Orthogonality and partitioning of degrees of freedom.	C-15	Lecture
	Presentation	C-16	Presentation
Unit-III	Concept of confounding.	C-17	Lecture
Unit-IV	Split plot design	C-18	Lecture
Unit-IV	Split plot design	C-19	Lecture
	Home Assignment		Home Assignment
Unit-IV	Strip plot design	C-20	Lecture
Unit-IV	Quiz	C-21	Quiz
Unit-IV	Analysis of covariance and missing plot techniques (in RBD and LSD)	C-22	Lecture
Unit-IV	Transformations	C-23	Lecture
	Home Assignment	C-24	Home Assignment
Unit-IV	Balanced Incomplete Block Design	C-25	Lecture
Unit-IV	Resolvable designs and their applications	C-26	Lecture
Unit-IV	Clarification class	C-27	Clarification class
Unit-IV	Response surfaces	C-28	Lecture
Unit-IV	Combined analysis	C-29	Lecture
Unit-IV	Classroom Assignment	C-30	Classroom Assignment

MSAC52201-Experimental Design Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Formation of plots and blocks and Fairfield Smith law	P-1	Practical
Unit-I	Uniformity trial data analysis	P-2	Practical
Unit-I	Formation of plots and blocks and Fairfield Smith law	P-3	Practical
Unit-I	Analysis of CRD	P-4	Practical
Unit-I	Analysis of RBD	P-5	Practical
Unit-I	Analysis of LSD	P-6	Practical
Unit-I	Analysis of factorial experiment	P-7	Practical
Unit-I	Analysis of asymmetric factorial experiments	P-8	Practical
Unit-I	Analysis of confounded factorial experiments	P-9	Practical
Unit-I	Analysis with missing data in RBD	P-10	Practical
Unit-I	Analysis with missing data in LSD	P-11	Practical
Unit-I	Transformation of data	P-12	Practical
Unit-I	Analysis of SPD	P-13	Practical
Unit-I	Analysis of strip plot design	P-14	Practical
Unit-I	Analysis of resolvable designs	P-15	Practical

MSAC55200-Basic Concepts in Laboratory Techniques Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Safety measures while in Lab;	P-1	Practical
Unit-I	Handling of chemical substances;	P-2	Practical
Unit-I	Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micro-pipettes and vaccupets;	P-3	Practical
Unit-I	Washing, drying and sterilization of glassware;	P-4	Practical
Unit-I	Drying of solvents/chemicals;	P-5	Practical
Unit-I	Weighing and preparation of solutions of different strengths and their dilution;	P-6	Practical
Unit-I	Handling techniques of solutions;	P-7	Practical
Unit-I	Preparation of different agro-chemical used in field and pot applications;	P-8	Practical
Unit-I	Preparation of solutions of acids;	P-9	Practical
Unit-I	Neutralisation of acid and bases;	P-10	Practical
Unit-I	Preparation of buffers of different strengths and pH values;	P-11	Practical
Unit-I	Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, and oilbath;	P-12	Practical
Unit-I	Electric wiring and earthing;	P-13	Practical
Unit-I	Preparation of media and methods of sterilization;	P-14	Practical
Unit-I	Seed viability testing, testing of pollen viability;	P-15	Practical

MSAC55201-Agricultural Research, Research Ethics and Rural Development Programmes

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment;	C-1	Lecture
Unit-I	National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions	C-2	Lecture
Unit-I	Consultative Group on International Agricultural Research (CGIAR)	C-3	Lecture
Unit-I	International Agricultural Research Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system,	C-4	Lecture
Unit-I	Clarification class	C-5	Clarification Class
Unit-I	Strengthening capacities at national and regional levels; International fellowships for scientific	C-6	Lecture
Unit-II	Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.	C-7	Lecture
Unit-II	Quiz	C-8	Quiz
Unit-III	Concept and connotations of rural development, rural development policies and strategies	C-9	Lecture
Unit-III	Rural development programmes: Community Development Programme	C-10	Lecture
Unit-III	Presentation	C-11	Presentation
Unit-III	Intensive Agricultural District Programme, Special group Area Specific Programme, Integrated Rural Development Programme (IRDP)	C-12	Lecture
Unit-III	Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organizations.	C-13	Lecture
Unit-III	Quiz	C-14	Quiz
Unit-III	Class room assignment	C-15	Classroom Assignment

MSAE41200-Conservation Agriculture

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Conventional and conservation agriculture systems,	C-1	Lecture
Unit-I	sustainability concerns, conservation agriculture:	C-2	Lecture
Unit-I	Historical background and present concept,	C-3	Lecture
Unit-I	Classroom assignment	C-4	Classroom assignment
Unit-I	global experiences, present status in India.	C-5	Lecture
Unit-II	Nutrient management in CA, water management,	C-6	Lecture
Unit-II	weed management, energy use,	C-7	Lecture
Unit-II	Quiz	C-8	Quiz
Unit-II	insect-pest and disease management, farm machinery,	C-9	Lecture
Unit-II	crop residue management, cover crop management.	C-10	Lecture
Unit-II	Home Assignment		Home Assignment
Unit-III	Climate change mitigation and CA, C-sequestration,	C-11	Lecture
Unit-III	soil health management, soil microbes and CA.	C-12	Lecture
Unit-IV	CA in agroforestry systems, rainfed / dryland regions	C-13	Lecture
Unit-V	Economic considerations in CA, adoption and constraints, CA: The future of agriculture	C-14	Lecture
Unit-V	Clarification class	C-15	Clarification class

MSAE41201- Conservation Agriculture Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Study of long-term experiments on CA,	P-1,3	Practical
Unit-I	Evaluation of soil health parameters,	P-4,6	Practical
Unit-I	Estimation of C-sequestration,	P-7,11	Practical
Unit-I	Machinery calibration for sowing different crops, weed seedbank estimation under CA, energy requirements, economic analysis of CA.	P-12,15	Practical

MSAE41202- Agronomy of Fodder and Forage Crops

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like sorghum, maize, bajra	C-1	Lecture
Unit-I	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like guar, cowpea, oats	C-2	Lecture
Unit-I	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like, berseem, senji, lucerne, etc.	C-3	Lecture
Unit-I	Quiz	C-4	Quiz
Unit-II	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasseslime, Napier grass	C-5	Lecture
Unit-II	Home Assignment		Home Assignment
Unit-II	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops Panicum	C-6	Lecture
Unit-II	Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops Lasiuras, Cenchrus, etc.	C-7	Lecture
Unit-III	Year-round fodder production and management, preservation and utilization of forage and pasture crops.	C-8	Lecture
Unit-III	Classroom assignment	C-9	Classroom assignment
Unit-III	Year-round fodder production and management, preservation and utilization of forage and pasture crops.	C-10	Lecture
Unit-III	Year-round fodder production and management, preservation and utilization of forage and pasture crops.	C-11	Lecture
Unit-III	Year-round fodder production and management, preservation and utilization of forage and pasture crops.	C-12	Lecture
Unit-III	Clarification class	C-13	Clarification class
Unit-IV	Principles and methods of hay and silage making;	C-14	Lecture

Unit-IV	Principles and methods of hay and silage making;	C-15	Lecture
Unit-IV	Principles and methods of hay and silage making;	C-16	Lecture
Unit-IV	Classroom assignment	C-17	Classroom assignment
Unit-IV	chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage;	C-18	Lecture
Unit-IV	chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage;	C-19	Lecture
Unit-IV	use of physical and chemical enrichments and biological methods for improving nutrition;	C-20	Lecture
Unit-IV	Clarification class	C-21	Clarification class
Unit-IV	value addition of poorquality fodder.	C-22	Lecture
Unit-IV	value addition of poorquality fodder.	C-23	Lecture
Unit-IV	Home Assignment		Home Assignment
Unit-IV	Fodder production through hydroponics.	C-24	Lecture
Unit-IV	Presentation	C-25	Presentation
Unit-IV	Azolla cultivation.	C-26	Lecture
Unit-IV	Azolla cultivation.	C-27	Lecture
Unit-V	Economics of forage cultivation uses and seed production techniques of important fodder crops.	C-28	Lecture
Unit-V	Economics of forage cultivation uses and seed production techniques of important fodder crops.	C-29	Lecture
Unit-V	Clarification class	C-30	Clarification class

MSAE41203- Agronomy of Fodder and Forage Crops Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Practical training of farm operations in raising fodder crops;	P-1,3	Practical
Unit-I	Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose and IVDMD, etc. of various fodder and forage crops	P-4,6	Practical
Unit-I	Anti-quality components like HCN in sorghum and such factors in other crops	P-7,11	Practical
Unit-I	Hay and silage making and economics of their preparation.	P-12,15	Practical

MSAE41204 - Agronomy of Oilseed, Fiber and Sugar Crops

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Rabi oilseeds – Rapeseed and mustard, Linseed and Niger	C-1,3	Lecture
Unit-I	Quiz	C-4	Quiz
Unit-I	Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Rabi oilseeds – Rapeseed and mustard, Linseed and Niger	C-5,8	Lecture
Unit-I	Home Assignment		Home Assignment
Unit-I	Classroom assignment	C-9	Classroom assignment
Unit-II	Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower	C-10,12	Lecture
Unit-II	Clarification class	C-13	Clarification class
Unit-II	Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower	C-14,16	Lecture
Unit-II	Classroom assignment	C-17	Classroom assignment
Unit-II	Origin and history, area and production, classification, improved varieties,	C-18,20	Lecture

	adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower		
Unit-II	Clarification class	C-21	Clarification class
Unit-II	Home Assignment		Home Assignment
Unit-III	Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Fiber crops - Cotton, Jute, Ramie and Mesta.	C-22,24	Lecture
Unit-III	Presentation	C-25	Presentation
Unit-IV	Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality component, handling and processing of the produce for maximum production of: Sugar crops – Sugar-beet and Sugarcane.	C-26,29	Lecture
Unit-IV	Clarification class	C-30	Clarification class

MSAE41205 - Agronomy of Oilseed, Fiber and Sugar Crops Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Planning and layout of field experiments, Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane	P-1	Practical
Unit-I	Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop	P-2	Practical
Unit-I	Intercultural operations in different crops	P-3	Practical
Unit-I	Cotton seed treatment	P-4	Practical
Unit-I	Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)	P-5	Practical
Unit-I	Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)	P-6	Practical
Unit-I	Judging of physiological maturity in different crops and working out harvest index	P-7	Practical
Unit-I	Working out cost of cultivation of different crops	P-8	Practical
Unit-I	Estimation of crop yield on the basis of yield attributes	P-9	Practical
Unit-I	Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities	P-10	Practical
Unit-I	Determination of oil content in oilseeds and computation of oil yield	P-11	Practical
Unit-I	Estimation of quality of fibre of different fibre crops	P-12	Practical
Unit-I	Study of seed production techniques in various crops	P-13	Practical
Unit-I	Visit of field experiments on cultural, fertilizer, weed control and water management aspects	P-14	Practical
Unit-I	Visit to nearby villages for identification of constraints in crop production	P-15	Practical

MSAE41206 - Agronomy of Medicinal, Aromatic and Underutilized Crops

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Importance of medicinal and aromatic plants in human health,	C-1	Lecture
Unit-I	national economy and related industries,	C-2	Lecture
Unit-I	classification of medicinal and aromatic plants according to botanical characteristics and their uses,	C-3	Lecture
Unit-I	Quiz	C-4	Quiz
Unit-I	export potential and indigenous technical knowledge.	C-5	Lecture
Unit-I	Home Assignment		Home Assignment
Unit-II	Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Mulhati, Isabgol, Rauwolfia).	C-6,7	Lecture
Unit-II	Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Poppy, Aloe vera, Satavar,).	C-8,9	Lecture
Unit-II	Classroom assignment	C-10	Classroom assignment
Unit-II	Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Safed Musli, Kalmegh, Asaphoetida).	C-11,12	Lecture
Unit-II	Clarification class	C-13	Clarification class
Unit-II	Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Nuxvomica, Rosadle, etc).	C-14,16	Lecture
Unit-II	Classroom assignment	C-17	Classroom assignment
Unit-III	Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha).	C-18,20	Lecture
Unit-III	Clarification class	C-21	Clarification class
Unit-III	Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Basil, Lemon grass, Rose).	C-22,23	Lecture
Unit-III	Home Assignment		Home Assignment
Unit-III	Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Patchouli, Geranium).	C-24	Lecture
Unit-III	Presentation	C-25	Presentation
Unit-IV	Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania).	C-26	Lecture

Unit-IV	Climate and soil requirements; cultural practices; yield of under-utilized crops (Clusterbean, French bean, Fenugreek).	C-27	Lecture
Unit-IV	Climate and soil requirements; cultural practices; yield of under-utilized crops (Grain Amaranth, Coffee, Tea and Tobacco).	C-28	Lecture
Unit-V	Post harvest handling –drawing, processing, grading, packing and storage, value addition and quality standards in herbal products.	C-29	Lecture
Unit-V	Clarification class	C-30	Clarification class

MSAE41207 - Agronomy of Medicinal, Aromatic and Underutilized Crops Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Identification of crops based on morphological and seed characteristics	P-1,3	Practical
Unit-I	Raising of herbarium of medicinal, aromatic and under-utilized plants	P-4,6	Practical
Unit-I	Quality characters in medicinal and aromatic plants	P-7,11	Practical
Unit-I	Methods of analysis of essential oil and other chemicals of importance in medicinal	P-12,15	Practical

MSAE41208 - Agrostology and Agro forestry

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Agrostology: definition and importance;	C-1	Lecture
Unit-I	principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological status of grasslands in India,	C-2	Lecture
Unit-I	principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological status of grasslands in India,	C-3	Lecture
Unit-I	Quiz	C-4	Quiz
Unit-I	principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological status of grasslands in India,	C-5	Lecture
Unit-I	Home Assignment		Home Assignment
Unit-I	grass cover of India;	C-6	Lecture
Unit-I	problems and management of grasslands.	C-7	Lecture
Unit-II	Importance, classification (various criteria), scope, status and research needs of pastures;	C-8	Lecture
Unit-II	Classroom assignment	C-9	Classroom assignment
Unit-II	pasture establishment, their improvement and renovation-natural pastures,	C-10	Lecture
Unit-II	cultivated pastures;	C-11	Lecture
Unit-II	common pasture grasses.	C-12	Lecture
Unit-II	Clarification class	C-13	Clarification class
Unit-III	Agroforestry: definition and importance;	C-14	Lecture
Unit-III	agroforestory systems, agrisilviculture, silvipasture, agrisilvipasture,	C-15	Lecture
Unit-III	agrihorticulture, aquasilviculture,	C-16	Lecture
Unit-III	Classroom assignment	C-17	Classroom assignment
Unit-III	alley cropping and energy plantation.	C-18	Lecture
Unit-IV	Crop production technology in agro-forestory and agrostology system;	C-19	Lecture
Unit-IV	silvipastoral system: meaning and importance for wasteland development;	C-20	Lecture
Unit-IV	Clarification class	C-21	Clarification class
Unit-IV	selection of species, planting methods and problems of seed germination in agro-forestry systems;	C-22	Lecture
Unit-IV	irrigation and manuring in agro-forestry systems,	C-23	Lecture
Unit-IV	Home Assignment		Home Assignment
Unit-IV	associative influence in relation to above ground and underground interferences;	C-24	Lecture

Unit-IV	Presentation	C-25	Presentation
Unit-IV	lopping and coppicing in agro- forestry systems;	C-26	Lecture
Unit-IV	social acceptability and economic viability, nutritive value of trees;	C-27	Lecture
Unit-IV	social acceptability and economic viability, nutritive value of trees;	C-28	Lecture
Unit-IV	tender operation; desirable	C-29	Lecture
Unit-IV	Clarification class	C-30	Clarification class

MSAE41209 - Agrostology and Agro forestry Lab

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Preparation of charts and maps of India showing different types of pastures and agro-forestry systems	P-1	Practical
Unit-I	Identification of seeds and plants of common grasses, legumes and trees of economic importance with reference to agro-forestry	P-2	Practical
Unit-I	Seed treatment for better germination of farm vegetation	P-3	Practical
Unit-I	Seed treatment for better germination of farm vegetation	P-4	Practical
Unit-I	Methods of propagation/ planting of grasses and trees in silvipastoral system	P-5	Practical
Unit-I	Fertilizer application in strip and silvipastroal systems	P-6	Practical
Unit-I	After-care of plantation	P-7	Practical
Unit-I	Estimation of protein content in loppings of important fodder trees	P-8	Practical
Unit-I	Estimation of protein content in loppings of important fodder trees	P-9	Practical
Unit-I	Estimation of protein content in loppings of important fodder trees	P-10	Practical
Unit-I	Estimation of calorie value of wood of important fuel trees	P-11	Practical
Unit-I	Estimation of total biomass and fuel wood	P-12	Practical
Unit-I	Economics of agro-forestry	P-13	Practical
Unit-I	Visit to important agro-forestry research stations	P-14	Practical
Unit-I	Visit to important agro-forestry research stations	P-15	Practical

MSAE41210 - Cropping system and sustainable agriculture

Unit	Particulars	Class No.	Pedagogy of Class
Unit-I	Cropping systems: definition, indices and its importance;	C-1	Lecture
Unit-I	physical resources,	C-2	Lecture
Unit-I	soil and water management in cropping systems;	C-3	Lecture
Unit-I	Quiz	C-4	Quiz
Unit-I	assessment of land use.	C-5	Lecture
Unit-I	Home Assignment		Home Assignment
Unit-I	Concept of sustainability in cropping systems and farming systems,	C-6	Lecture
Unit-I	scope and objectives; production potential under monoculture cropping,	C-7	Lecture
Unit-I	multiple cropping, alley cropping, sequential cropping	C-8	Lecture
Unit-I	Classroom assignment	C-9	Classroom assignment
Unit-I	multiple cropping, alley cropping, sequential cropping	C-10	Lecture
Unit-II	intercropping,	C-11	Lecture
Unit-II	mechanism of yield advantage in intercropping systems.	C-12	Lecture
Unit-II	Clarification class	C-13	Clarification class
Unit-II	Above and below ground interactions and allelopathic effects;	C-14	Lecture
Unit-II	competition relations;	C-15	Lecture
Unit-II	multi-storied cropping and yield stability in intercropping,	C-16	Lecture
Unit-II	Classroom assignment	C-17	Classroom assignment
Unit-II	role of non-monetary inputs and low cost technologies;	C-18	Lecture
Unit-II	research need on sustainable agriculture.	C-19	Lecture
Unit-II	Crop diversification for sustainability;	C-20	Lecture
Unit-II	Clarification class	C-21	Clarification class
Unit-II	role of organic matter in maintenance of soil fertility;	C-22	Lecture
Unit-II	crop residue management;	C-23	Lecture
Unit-II	Home Assignment		Home Assignment
Unit-II	fertilizer use efficiency and concept of fertilizer use in intensive cropping system. Advanced nutritional tools for big data analysis and interpretation.	C-24	Lecture
Unit-II	Presentation	C-25	Presentation
Unit-II	fertilizer use efficiency and concept of fertilizer use	C-26	Lecture

	in intensive cropping system. Advanced nutritional tools for big data analysis and interpretation.		
Unit-II	Plant ideotypes for drylands;	C-27	Lecture
Unit-II	plant growth regulators and their role in sustainability.	C-28	Lecture
Unit-II	Artificial Intelligence- Concept and application.	C-29	Lecture
Unit-II	Clarification class	C-30	Clarification class

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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