Detailed Course Scheme

Master of Science in Agriculture

(Agronomy)

Semester- IV

(2024- 26)

DOC202406150009

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 (January – June) 2026 along with examination pattern is as follows:

Course Scheme

Semester –IV

S. No.	Course Code	Category	Course Name	L	T	P	Credits
1	DAPE99299		Thesis Research	20	0	0	20
2	WHNN99000		Seminar	1	0	0	1
3			Comprehensive Examination				Non credit
4		E	Elective course (non-gradial)*				
			Total	**21**	**0**	**0**	**21**

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)							

E: Elective course

EVALUATION SCHEME –THESIS RESEARCH AND SEMINAR

The evaluation of the Thesis Research of M. Sc. Ag. (Agronomy) program would be based on External Assessments. Detailed scheme of External Assessments as follows:

Assessment

The distribution of Assessment Marks is as follows:

Type	Details	Marks
Marks obtained Final thesis viva-voce	Average of marks obtained	1000
Research Seminar	Average of marks obtained	50
TOTAL	**1050**	

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
DAPE99299-Thesis Research	**CO1:** Identify and describe the key components of research methodology and statistical experimental design, including factors influencing experimental outcomes. **CO2:** Formulate and construct well-defined research objectives and hypotheses for agronomic studies, integrating advanced statistical tools and techniques. **CO3:** Analyze and evaluate experimental data using appropriate statistical software and techniques to interpret results accurately and draw meaningful conclusions. **CO4:** Develop and synthesize a comprehensive research thesis by effectively reviewing scientific literature, compiling data, and addressing research gaps in agronomy. **CO5:** Communicate and defend research findings through written thesis preparation and oral presentations, demonstrating scientific rigor and clarity.
WHNN99000-Seminar	**CO1:** Identify and explain the fundamental concepts of agronomic research methodologies, including experimental design and factors influencing research outcomes. **CO2:** Analyze and interpret scientific literature in agronomy, synthesizing key findings to address current challenges in agricultural research. **CO3:** Formulate and propose research hypotheses and objectives based on critical evaluation of agricultural problems and emerging trends in agronomy. **CO4:** Develop and deliver structured, evidence-based presentations on agronomic topics, effectively communicating ideas to both scientific and non-scientific audiences. **CO5:** Critically evaluate peer presentations, providing constructive feedback and engaging in discussions to enhance understanding of advanced agronomic concepts.

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

DAPE99299	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	2	3	3	3	3	3
CO2	2	2	3	3	3	2		2		3	2	2
CO3	2	3	2	2		2	3	3	2	3	2	3
CO4	3	2	3	3	2	2	2	3		3	2	
CO5	2	3	2	2	2	2	3	3	2	3	2	3

WHNN99000	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	1	3	1	3	3	3	3	3
CO2	2	2	3	3	3	2	1	2		3	2	
CO3	2	3	3	3	1	2	2	3	2	3	2	3
CO4	2	2	2	3	2	3	2	3	3	3	2	
CO5	2	3	2	2	2	2	3	3		2	2	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: Thesis Research

Course Code: DAPE99299

Course Outline

Thesis Research

The student of the M.Sc. Ag. (Agronomy) will initiate the thesis research work by reviewing and compilation of the research work in which he is interested to do the thesis research work. In consultation with the designated (allotted) guide, the brief of work with hypothesis, methodology, expected outcome with references will be prepared and submitted to the Dean Research. The Dean Research will put up the agenda in Board of Research meeting for consideration and approval. After approval by the concerned authority of the university, student will initiate their field/laboratory experiment with adherence to their approved work. After completion of the research work and compilation of findings in the form of thesis in the prescribed format of the university and submitted to the university. The university will evaluate the thesis by the external examiner. After receipt of the report, the university may arrange the viva voce examination. On successful completion of the viva-voce examination, final marks will be given by the examiner. The thesis work is the partial fulfillment of the degree programme

Course Name: Seminar

Course Code: WHNN99000

Course Outline

Seminar (Subjective)

The student will prepare the presentation on the topic assigned by guide and present before the committee of the department. The committee will evaluate the presentation and give the marks.

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

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

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

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