RAMA UNIVERSITY, UTTAR PRADESH, KANPUR

Faculty of Agricultural Sciences and Allied Industries

SYLLABUS & EVALUATION SCHEME

M.Sc. AGRONOMY

1st & 2nd Year

[Effective from the Session 2024-25]

M.Sc. (Ag.) Agronomy
Faculty of Agricultural Sciences and Allied Industries
RAMA UNIVERSITY UTTAR PRADESH, KANPUR

A meeting of the Board of Studies of the Faculty of Agriculture & Allied Sciences, Rama University Uttar Pradesh, Kanpur was held on 11th May 2024 at 11 AM. The following members were present:

1.	Dr. Aneeta Yadav	Convener
2.	Dr. Ravikesh Kumar Pal	Member
3.	Dr. Raghvendra Singh	Member
4.	Mr. Durgesh Kumar Maurya	Member
5.	Prof. (Dr.) D. D. Yadav	External Member

The quorum of the meeting was complete.

Agenda of the meeting:

1. Assessment Criteria
2. Question Paper Format
3. Syllabus

The meeting resolved unanimously that attached Assessment Criteria, Question Paper Format and Syllabus are justified and approved.

Convener
Signature: .....
Name : Dr. Aneeta Yadav
Date :

Internal Members

Signature:	1.....	2.....	2.....
Name:	Dr. Ravikesh Kumar Pal	Dr. Raghvendra Singh	Mr. Durgesh K. Mauraya
Date:			

External Members

Signature: 1.....
Name: Prof. (Dr.) D. D. Yadav
Date:

Faculty of Agricultural Sciences & Allied Industries

Rama University, Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc. Agronomy First Year (Semester-I)

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit Hours
			L	T	P	CE	MTE	ETE		
Theory subjects										
1.	MSA-101	Agronomy of Medicinal, Aromatic and Under-utilized Crops	2	0	0	20	20	60	100	2
2.	MSA-102	Principles and Practices of Water Management	2	0	0	20	20	60	100	2
3.	MSA-103	Principles & Practices of Organic Farming	2	0	0	20	20	60	100	2
4.	MSS-102	Soil Fertility And Fertilizer Use*	2	0	0	20	20	60	100	2
5.	MSS-204	Crop Physiology*	2	0	0	20	20	60	100	2
6.	MAS-104	Computer Application*	2	0	0	20	20	60	100	2
Practical's / Project										
7.	MSA-151	Agronomy of Medicinal, Aromatic and Under-utilized Crops	0	0	1	30	20	50	100	1
8.	MSA-153	Principles & Practices of Organic Farming	0	0	1	30	20	50	100	1
9.	MSS-152	Soil Fertility and Fertilizer Use	0	0	1	30	20	50	100	1
10.	MSS-254	Crop Physiology	0	0	1	30	20	50	100	1
11.	MAS-153	Computer Application	0	0	1	30	20	50	100	1
Total			**12**	**0**	**5**	**270**	**220**	**610**	**1100**	**17**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

***indicates interdisciplinary course.**

Faculty of Agricultural Sciences & Allied Industries
Rama University, Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc. Agronomy First Year (Semester-II)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	MSA-201	Agronomy of Major Cereals and Pulses	2	0	0	20	20	60	100	2
2	MSA-202	Dryland Farming & Watershed Management	2	0	0	20	20	60	100	2
3	MSA-203	Agronomy of Oilseed, Fibre and Sugar Crops	2	0	0	20	20	60	100	2
4	MSA-204	Agro meteorology & Crop Weather Forecasting	2	0	0	20	20	60	100	2
5	MAS-205	Basic of Experimental Design	2	0	0	20	20	60	100	2
Practical's										
6	MSA-251	Agronomy of Major Cereals and Pulses	0	0	1	30	20	50	100	1
7	MSA-252	Dryland Farming & Watershed Management	0	0	1	30	20	50	100	1
8	MSA-253	Agronomy of Oilseed, Fibre and Sugar Crops	0	0	1	30	20	50	100	1
9	MSA- 254	Agro meteorology & Crop Weather Forecasting	0	0	1	30	20	50	100	1
10	MAS-255	Basic of Experimental Design	0	0	1	30	20	50	100	1
11	MSA-280	Master Seminar	0	0	1	0	0	100	100	1
12	MSA-281	Master's Research (Synopsis)	0	0	5	Satisfactory /Unsatisfactory				5
Total			**10**	**0**	**11**	**250**	**200**	**650**	**1100**	**21**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

**** indicates basic supporting course.**

Faculty of Agricultural Sciences & Allied Industries
Rama University, Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc. Agronomy SECOND YEAR (SEMESTER-III)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory Subjects										
1	MSA-301	Principles & Practices of Weed Management	2	0	0	20	20	60	100	2
2	MSA-302	Agronomy of Fodder & Forage Crops	2	0	0	20	20	60	100	2
3	MSA-303	Cropping Systems & Sustainable Agriculture	2	0	0	20	20	60	100	2
4	MSA-304	Modern Concepts in Crop Production	2	0	0	20	20	60	100	2
5	MSA-305	Agrostology and Agroforestry	2	0	0	20	20	60	100	2
Practical's										
6	MSA-351	Principles & Practices of Weed Management	0	0	1	30	20	50	100	1
7	MSA-352	Agronomy of Fodder & Forage Crops	0	0	1	30	20	50	100	1
8	MSA-353	Agrostology and Agroforestry	0	0	1	30	20	50	100	1
9	MSA-381	Master's Research	0	0	6	Satisfactory /Unsatisfactory				5
Total			**10**	**0**	**9**	**250**	**160**	**450**	**800**	**18**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

Note: For MSA-381: Master's Research (Research Work & Thesis) student will not be assigned any marks. Their performance will be evaluated as satisfactory (S) and unsatisfactory (US). In case of US student has to repeat the unsatisfactory research credits.

Faculty of Agricultural Sciences & Allied Industries
Rama University, Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc. Agronomy Second Year (Semester-IV)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Practical/Project										
2	MSA- 401	Master's Research (Research Work & Thesis)	0	0	10	Satisfactory /Unsatisfactory				10
Total			0	0	10					10

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

3. Attendance: 5 Marks
4. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

Note: For MSA-401: Master's Research (Research Work & Thesis) student will not be assigned any marks. Their performance will be evaluated as satisfactory (S) and unsatisfactory (US). In case of US student has to repeat the unsatisfactory research credits.

MSA-101: AGRONOMY OF MEDICINAL, AROMATIC AND UNDER-UTILIZED CROPS 3 (2+1)

Course objective: - To acquaint students about different medicinal, aromatic and underutilized field crops, their package of practices and processing.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

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 uses,

UNIT II

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

UNIT IV

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

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 and aromatic plants

Course Learning Outcomes (CLO):-

CO1-Medicinal and aromatic plants fit very well in the current scheme of crop diversification in different agro-climatic regions of India.

CO2-While considering lateral crop diversification, vertical diversification in processing and value addition vastly improves the crop economics.

CO3-Agronomists are posed with challenge of scientifically fitting most suitable medicinal and aromatic plants (MAPs) in different agro-climatic regions.

CO4-This paper deals with different areas viz. nutrients, water and their management, cropping systems, utilization of waste/marginal lands, organic farming, quality of end products in relation to agronomic interventions etc.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	3	1	2	-	2	-	1	-	3	2	3
CO_2	2	2	1	1	-	-	2	-	1	1	-
CO_3	1	1	-	2	1	1	1	-	1	-	1
CO_4	1	1	2	1	3	1	2	-	2	-	2
Average	1.75	1.25	1.25	1	1.5	0.5	1.5		1.75	0.75	1.5

Text books:-

1. N. Kumar (2000) Cultivation Of Spices, Plantation & Medicinal Aromatic Plants Oxford Publication New Delhi
2. Chadha KL & Gupta R. 1995. Advances in Horticulture. Vol. II. Medicinal and Aromatic Plants. Malhotra Publ.
3. Das NR. 2007. Introduction to Crops of India. Scientific Publ.
4. Handa SS. 1984. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu.
5. ICAR 2006. Hand Book of Agriculture. ICAR, New Delhi.
6. Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford & IBH.

Reference books:-

1. Hussain A. 1984. Essential Oil Plants and their Cultivation. CIMAP, Lucknow.
2. Hussain A. 1993. Medicinal Plants and their Cultivation. CIMAP, Lucknow.
3. Prajapati ND, Purohit SS, Sharma AK & Kumar T. 2003. A Hand Book of Medicinal Plants: A Complete Source Book. Agrobios.
4. Sharma R. 2004. Agro-Techniques of Medicinal Plants. Daya Publ. House.

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MSA-102: Principles and Practices of Water Management **2 (2+0)**

Course objective:- To teach the principles of water management and practices to enhance the water productivity and utility.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

Unit-I

Water, its properties and role in plants; Water resources of India, Major irrigation projects and extent of area and crops irrigated in India and different states, Watershed and its management.

Unit-II

Water potential – concept, components and relationship between different components; Water movement in plant and soils; Absorption and transpiration of water in plants; Scheduling and methods of irrigation including micro irrigation system; Fertigation.

Unit-III

Water use efficiency: Water management of crops and cropping systems; Soil, plant and meteorological factors determining water needs of crops; Water deficit stress in plants and its effect on growth.

Unit-IV

Quality of irrigation water – effect of saline water and soil salinity on plants and its management, Excess soil water and plant growth.

Unit-V

Water management in problem soils; Drainage requirement of crops and methods of drainage, their layout and spacing.

Practical:

Determination of soluble salts, Ca + Mg, CO = and HCO - and Na in irrigation water; Determination of FC and PWP; Soil moisture measurement by tensiometer and pressure plate apparatus; Water flow measurement using different devices. Determining soil profile moisture deficit and irrigation requirement. Calculations on irrigation efficiencies; Computation of water requirement of crops using modified Penman formula. Determination of infiltration rates and hydraulic conductivity.

Course Learning Outcomes (CLO):-

CO1-To impart knowledge on principles and practices of irrigation water management, soil moisture constant.

CO2-Soil water plant atmospheric relationship, quality of irrigation water etc.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	3	1	2	3	-	1	1	-	2	-	2
CO_2	2	2	-	1	1	-	2	-	1	1	-
Average	2.5	1.5	2	2	0.5	0.5	1.5	-	1.5	0.5	1

Text books:-

1. S.C.Panda 2003. Principles and practices of water management. Agrobios, Jodhpur
2. S.R. Reddy 2000. Principles of Crop Production, Kalyani Publication, New Delhi.
3. A.M. Michael, 1987. Irrigation – Theory and Practice, Vikas Publishing House Pvt. Ltd., New Delhi
4. S.S. Parihar and B.S. Sandhu, 1978. Irrigation of field crops – Principles and Practices, ICAR, New Delhi
5. R.D. Mishra and M. Ahmed. 1987. Manual on Irrigation Agronomy, Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi
6. Lenka D. 1999. Irrigation and Drainage. Kalyani

Reference books:-

1. Singh Pratap & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ.
2. G.H. Sankara Reddy and T. Yellamanda Reddy. 1995. Efficient use of irrigation water. Kalyani Publishers, New Delhi

Signature:-

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MSA-103: PRINCIPLES AND PRACTICES OF ORGANIC FARMING

3 (2+1)

Course objective:- To study the principles and practices of organic farming for sustainable crop production.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

UNIT I

Organic farming – concept, principle, definition & its importance in agriculture, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT II

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

UNIT III

Farming systems, crop rotations, multiple and relay cropping systems, inter cropping in relation to maintenance of soil productivity.

UNIT IV

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

UNIT V

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

Practical

- Aerobic and anaerobic methods of making compost
- Making of vermicompost
- Identification and nursery raising of important agro-forestry tress and tress for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures infield
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditationprocedures for farm produce from organic farms

Course Learning Outcomes (CLO):-

CO1-Students understand will importance of cereals, vegetables & spices in human nutrition improved and national economy.

CO2-They will knowledge about quality requirement, production techniques *and* managing skill for solving field problems etc.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	2	3	1	2	1	-	1	-	3	2	1
CO_2	1	1	-	1	-	1	1	-	2	1	-

Average	1.5	2	0.5	1.5	0.5	0.5	1		2.5	1.5	0.5

Text books:-

1. Lampin N. 1990. Organic Farming. Press Books, Ipswitch, UK.
2. Palaniappan SP & Anandurai K. 1999. Organic Farming – Theory and Practice. Scientific Publ. Rao BV
3. Anmol Publ. Veeresh GK, Shivashankar K & Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture.
4. Association for Promotion of Organic Farming, Bangalore. WHO. 1990. Public Health Impact of Pesticides Used in Agriculture.
5. Woolmer PL & Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF & Wiley

Reference books:-

1. Stanbury, P.F & Whittacker, *Principles of Fermentation technology* , Pergamon. Press Oxford
2. Parisaraprajna Parishtana, Bangalore. Reddy MV. (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. Oxford & IBH.
3. Sharma A. 2002. Hand Book of Organic Farming. Agrobios. Singh SP. (Ed.) 1994. Technology for Production of Natural Enemies. PDBC, Bangalore. Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
4. Michael L Shuler & Fikret Kargi , *Bioprocess Engg.: Basic concepts* , Prentice Hall, New Delhi.
5. M.Yoong (Ed-in-Chief) , *Comprehensive Biotechnology Vol 3* , Pergamon, Oxford
6. B.D.Singh , *Biotechnology- Expanding Horizons* , Kalyani Publishers ,NewDelhi.
7. H.K.Das , *Text book of Biotechnology* , Wiley Publications , New Delhi.

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MSS- 102: SOIL FERTILITY AND FERTILIZER USE **3 (2+1)**

Course objective:- To inform students about soil fertility, and to recognize the role of fertilizers and manures in supplying plants with nutrients so that high fertilizer use efficiency is achieved.

Detail Contents

Unit 1:	**10%**
Unit 2:	**20%**
Unit 3:	**15%**
Unit 4:	**20%**
Unit 5:	**10%**
Unit 6:	**25%**

Theory

Unit-I: Historical view and future of soil fertility, Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms.

Unit-II: Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation - types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

Unit-III: Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions. Mechanism of phosphorus solubilization and mobilization by microorganisms.

Unit-IV: Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions. Sulphur - source, forms, fertilizers and their behavior in soils; Sulphur transformations in soil; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers. Mechanism of potassium solubilization and mobilization by microorganisms.

Unit-V: Micronutrients – critical limits in soils and plants; transformations of micronutrient in soils, factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

Unit-VI: Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions. Fertilizer use efficiency; nutrient requirements of crops and cropping systems in sustainable agriculture and quality of the produce, foliar nutrition of crop plants; blanket fertilizer recommendations – usefulness and limitations; site-specific nutrient management; Fertilizer x water interactions, crop production under fertilizer / water constraints; long-term fertilizer experiments; organic farming: principles, practices and its impact on soil processes; precision farming: concept and practices; plant need based nutrient management; integrated nutrient management. Soil fertility evaluation - biological methods, soil, plant and tissue tests; critical nutrient concentration - concept and determination (graphical and statistical procedures); critical nutrient range; diagnosis recommendation and integrated system (DRIS); STCR approach; soil quality and soil health: definitions and affecting factors in relation to sustainable agriculture.

Practical

- Principles of colorimetry
- Flame-photometry and atomic absorption spectroscopy
- Chemical analysis of soil for total and available nutrients
- Analysis of plants for essential elements

Course Learning Outcomes (CLO)

Through this course students should successfully:

- Discuss soil fertility
- Analyze the role of manures and fertilizers as source of nutrients to plants
- Review nutrients' recycling in agro ecosystem
- Illustrate the critical concentration and forms of soil nutrients
- Explain the methods of soil fertility evaluation and fertilizer recommendation

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	2	-	1	3	3	2	-	3
CLO_2	3	2	-	1	3	3	2	-	3
CLO_3	3	2	-	1	3	3	2	-	3
CLO_4	3	2	-	1	3	3	2	-	3
CLO_5	3	2	-	1	3	3	2	-	3
Average	3	2	-	1	3	3	2	-	3

Text books:-

Tisdale SL, Nelson SL, Beaton JD &Havlin JL. 1999. Soil Fertility and Fertilizers. 5th Ed. Prentice Hall of India.
Stevenson F J & Cole M A. 1999. Cycles of Soil: Carbon, Nitrogen,Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.

Reference books:-

Kabata-Pendias A &Pendias H. 1992.Trace Elements in Soils and Plants.CRCPress.Kannaiyan S, Kumar K & Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.
Leigh JG. 2002. Nitrogen Fixation at the Millennium. Elsevier.Mengel K &Kirkby EA. 1982.Principles of Plant Nutrition. International Potash Institute, Switzerland.
Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.
Pierzinsky GM, Sims TJ & Vance JF. 2002. Soils and Environmental Quality. 2nd Ed. CRC Press.

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MSS-204: Crop Physiology **3 (2+1)**

Course objective:-
To impart knowledge about crop growth, development and interaction with environment with respect to physiological processes.

Detail Contents

Unit 1:	**10%**
Unit 2:	**15%**
Unit 3:	**15%**
Unit 4:	**15%**
Unit 5:	**15%**
Unit 6:	**15%**
Unit 7:	**15%**

Theory

Unit I Cell organelles and their physiological functions, structure and physiological functions of cell wall, cell inclusions; cell membrane structure and functions.

Unit II Soil and plant water relations, water and its role in plants, properties and functions of water in the cell water relations-cell water terminology, water potential of plant cells. Mechanism of water uptake by roots-transport in roots, aquaporins, movement of water in plants – Mycorrhizal association on water uptake. Water loss from plants-Energy balance-Solar energy input-energy dissipation at crop canopy level- evapotranspiration, transpiration –Driving force for transpiration, plant factors influencing transpiration rate.

Unit III Stomata structure and function – mechanism of stomatal movement, antitranspirants. Physiology of water stress in plants: Influence of water stress at cell, organ, plant and canopy levels. Indices for assessment of drought resistance. The role of mineral nutrients in plant metabolism: Essential elements, classification based on function of elements in plants.

Unit IV Uptake of mineral elements in plants –Mechanisms of uptake-translocation of minerals in plants.Physiological and metabolic functions of mineral elements, critical levels, deficiency symptoms, nutrient deficiency and toxicity.Foliar nutrition.

Unit V Photosynthesis and its importance in bio productivity.Photochemical process, photochemical reactions, CO_2 reduction in Calvin cycle, supplementary pathway of C fixation in C4 and CAM plants and its significance.Photorespiration and its relevance.Photosynthesis as a diffusive process, effect of environmental factors on photosynthetic rates.Synthesis of sucrose, starch, oligo and polysaccharides (composition of cell wall). Translocation of photosynthates and its importance in sink growth. Mitochondrial respiration, growth and maintenance respiration, cyanide resistant respiration and its significance.

Unit VI Nitrogen metabolism: Inorganic nitrogen species (N_2 , NO_3 and NH_3) and their reduction to amino acids, protein synthesis and nucleic acids. Lipid metabolism- Storage, protective and structural lipids.Biosynthesis of fatty acids, diacyl and triacyl glycerol, fatty acids of storage lipids. Secondary metabolites and their significance in plant defense mechanism. Growth and differentiation.

Unit VII Hormonal regulation of growth and differentiation, plant growth hormones and their physiological role, synthetic growth regulators, growth retardants, apical dominance, senescence, fruit growth, abscission. Photomorphogenesis: Photoreceptors, phytochrome, cryptochrome. Physiology of flowering: Photoperiodism and vernalization.

Practicals

- Estimation of plant water status: Relative water content,water potential estimation by pressure chamber/ psychrometer
- Growth parameters: Growth parameters measurement

- Photosynthesis and related parameters:Estimation of chlorophyll/ carotenoid content, separation of photosynthetic pigment using paper chromatography, photosynthesis measurements by IRGA, respiration rate measurement.
- Amino Acid and proteins: Estimation of total free amino acids, estimation of proteins by Lowry/ Bradford method.
- Nitrogen metabolism: *In vivo* nitrate reductase activity assay, nitrogenase activity assay by gas chromatography.

Course Learning Outcomes (CLO)

Through this course students should successfully:

- distinguish physiological processes involved in the formation of seedlings
- review the factors regulating growth and developmental processes of crop plants
- evaluate strategies used by plants with repect to nutrient uptake and utilization
- Illustrate the significance of assimilate translocation and partitioning.
- Associate crop-environment interaction and crop growth, yield

Mapping of course learning outcomes (CLO) with programme outcomes (PO) and programme specific outcomes (PSO)

PO & PSO / CLO	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4
CLO_1	3	-	-	3	3	3	-	3	2
CLO_2	3	-	-	3	3	3	-	3	2
CLO_3	3	-	-	3	3	3	-	3	2
CLO_4	3	-	-	3	3	3	-	3	2
CLO_5	3	-	-	3	3	3	-	3	2
Average	3	-	-	3	3	3	-	3	2

Text books:-

- Salisbury, F.B. and Ross, C.W. 1986. Plant Physiology, CBS Publishers & Distributors, New Delhi.
- Taize, L. and Zeiger, E. 2006. Plant Physiology. Sinauer Associates, Inc, Publishers, Sunderland, Massachusetts, USA.

Reference books:-

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MSA -201: AGRONOMY OF MAJOR CEREALS AND PULSES **3 (2+1)**

Course objective:- To teach the crop husbandry of cereals and pulse crops. Origin and history, area and production, classification, , improved varieties, , adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production.

Theory

Detail Contents

UNIT I **30%**
UNIT II **20%**
UNIT III **20%**
UNIT IV **30%**

Syllabus:-

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

UNIT I

***Rabi* cereals** (Wheat, Barley, Oat.)

UNIT II

***Kharif* cereals** (Rice, Maize, Sorghum)

.UNIT III

***Rabi* pulses** (Chickpea, Lentil, Peas.)

UNIT IV

***Kharif* pulses** (Pigeon Pea, Mungbean, Urdbean)

.Practical

- Phenological studies at different growth stages of crop
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Working out growth indices (CER, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops.
- Estimation of protein content in pulses
- Planning and layout of field experiments
- Judging of physiological maturity in different crops
- Intercultural operations in different crops
- Determination of cost of cultivation of different crops
- Working out harvest index of various crops
- Study of seed production techniques in 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 Learning Outcomes (CLO):-

CO1-Imparting detailed knowledge of agriculture and its allied branches facilitating detailed study of various agriculture forestry, Livestock and other allied branches required to raise the income of farmers providing detailed knowledge of agriculture in India.

CO2-Indian farmer's income generating enterprises knowledge dissemination regarding various technique of farming and farming system.

CO3-India Study of market and marketing of agricultural produce.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	1	2	1	1	1	2	1	2	2	1	1
CO_2	2	2	2	1	1	1	2	2	2	3	2

CO_3	1	1	1	1	2	2	2	1	2	3	1
Average	1.33	1.66	1.33	1	1.33	1.66	1.66	1.66	2	2.33	1.33

Text books:-

1. Das NR. 2007. Introduction to Crops of India. Scientific Publ.
2. C. Singh, P. Singh and R. Singh (2009) Modern techniques of raising field crops, Oxford & IBH Publishing Company New Delhi.
3. P. Rajendra (2006) Textbook of Field Crops Production, Volume I & II Published by ICAR.
4. Hunsigi G & Krishna KR. 1998. Science of Field Crop Production. Oxford & IBH.
5. Kumar Ranjeet & Singh NP. 2003. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.
6. Pal M, Deka J & Rai RK. 1996. Fundamentals of Cereal Crop Production. Tata McGraw Hill.

Reference books:-

1. Singh, SS. 1998. Crop Management. Kalyani.
2. Yadav DS. 1992. Pulse Crops. Kalyani.
3. Jeswani LM & Baldev B. 1997. Advances in Pulse Production Technology. ICAR.
4. Khare D & Bhale MS. 2000. Seed Technology. Scientific Publ.

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MSA-202: DRYLAND FARMING AND WATERSHED MANAGEMENT 3 (2+1)

Course objective:- To teach the basics concepts and practices of dry land farming and soil moisture conservation.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

UNIT I

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

UNIT II

Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.

UNIT III

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT IV

Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation, use of mulches, kinds, effectiveness and economics); anti-transpirants; soil and crop management techniques, seeding and efficient fertilizer use.

UNIT V

Concept of watershed resource management, problems, approach and components.

Practical

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents
- Moisture stress effects and recovery behaviour of important crops
- Estimation of moisture index and aridity index
- Spray of anti-transpirants and their effect on crops
- Collection and interpretation of data for water balance equations
- Water use efficiency
- Preparation of crop plans for different drought conditions
- Study of field experiments relevant to dryland farming
- Visit to dryland research stations and watershed projects

Course Learning Outcomes (CLO)-

CO1-Nutritional ***management*** of crops including manures, fertilizers, mixed fertilizers, the importance of ***water*** in crop production.

CO2-Discuss the definition and characteristics of rainfed ***/dry land farming.***

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	3	2	1	1	2	-	1	-	-	2	1
CO_2	1	1	1	2	1	-	1	-	-	1	1
Average	2	1.5	1	1.5	1.5	-	1		-	1.5	1

Text books:-

1. Das NR. 2007. Tillage and Crop Production. Scientific Publishers.
2. Dhopte AM. 2002. Agrotechnology for Dryland Farming. Scientific Publ.

3. Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India.ICAR.
4. Gupta US. (Ed.). 1995. Production and Improvements of Crops for Drylands. Oxford & IBH.
5. Katyal JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA.
6. Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture.Scientific Publishers.

Reference books:-

1. K.G.Brengal (1982) Principles and practices of dry land farming, Colorado Associated University Press,
2. T.Y. Reddy & G.S. Reddy (2016) Principles of Agronomy, Kalyani Publishers New Delhi.
3. Singh P & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.
4. Singh RP. 1988. Improved Agronomic Practices for Dryland Crops. CRIDA.
5. Singh RP. 2005. Sustainable Development of Dryland Agriculture in India. Scientific Publ.
6. Singh SD. 1998. Arid Land Irrigation and Ecological Management. Scientific Publishers.
7. Venkateshwarlu J. 2004. Rainfed Agriculture in India. Research and Development Scenario. ICAR.

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MSA -203 AGRONOMY OF OILSEED, FIBRE AND SUGAR CROPS 3 (2+1)

Course objective:- To teach the crop husbandry of oilseed, fiber and sugar crops. 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 production.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**40%**
UNIT III	**20%**
UNIT IV	**20%**

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

UNIT I

Rabi oilseeds – Rapeseed and mustard, linseed, etc.

UNIT II

Kharif oilseeds - Groundnut, sesame, castor, sunflower, soybean etc.

UNIT III

Fiber crops - Cotton, jute, sunhemp, Dhaincha etc.

UNIT IV

Sugar crops – Sugar-beet and sugarcane.

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 (LER, CGR, RGR, NAR, LAD) aggressivity, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems
- Judging of physiological maturity in different crops and working out harvest index
- Working out cost of cultivation of different crops
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Determination of oil content in oilseeds and computation of oil yield
- Estimation of quality of 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 Learning Outcomes (CLO)-

CO1-In production of *oilseeds* and pulses may be identified through ***course*** content.

CO2-To the keeping of animals for food and ***fiber*** production and other purposes (e.g., mustard and sunflower; ***sugar crops-sugarcane***, Medicinal and aromatic)

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	1	2	2	1	1	-	1	2	3	1	2
CO_2	3	1	2	1	2	-	1	3	1	3	1
Average	2	1.5	2	1	1.5	-	1	2.5	2	2	1.5

Text books:-

1. Das NR. 2007. Introduction to Crops of India. Scientific Publ.

2. Singh SS. 1998. Crop Management. Kalyani.
3. C. Singh, P. Singh and R. Singh (2009) Modern techniques of raising field crops, Oxford & IBH Publishing Company New Delhi.
4. P. Rajendra (2006) Textbook of Field Crops Production, Volume I & II Published by ICAR.

Reference books:-

1. Das PC. 1997. Oilseed Crops of India. Kalyani.
2. Lakshmikantam N. 1983. Technology in Sugarcane Growing. 2nd Ed. Oxford & IBH.

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MSA-204: Agro meteorology and Crop Weather Forecasting 3 (2+1)

Course objective:- To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions.

Theory

Detail Contents

UNIT I	**25%**
UNIT II	**25%**
UNIT III	**25%**
UNIT IV	**25%**

Unit-I

Agro meteorology: aim, scope and development in relation to crop environment, composition of atmosphere, distribution of atmospheric pressure, Solar radiation : characteristics, energy balance of atmosphere system, radiation distribution in plant canopies, radiation utilization by field crops, photosynthesis and efficiency of radiation utilization by crops, energy budget of plant canopies.

Unit-II

Environmental temperature: soil, air, canopy temperature, temperature profile in air, soil and crop canopies, soil and air temperature effects on plant processes, regulation of air, soil temperature for protection against frost and hot winds, Environmental moisture and evaporation, measures of atmospheric moisture, temperature, relative humidity, vapour pressure and their relationship, evapo-transpiration and meteorological factors determining evapo-transpiration.

Unit-III

Modification of plant environment: artificial rain making, controlling heat load, heat trapping and shedding, protection from cold, reduction in sensible and latent heat flux, Monsoon: monsoon and their origin, characteristics of monsoon, onset and progress of monsoon, withdrawal of monsoon.

Unit-IV

Weather forecasting in India: short, medium and long range forecasting, benefits of weather service to agriculture, forecasting of destructive frost, soil moisture forecast, phenological forecast, crop yield forecast, Aero-space science and remote sensing : application in agriculture, present status of remote sensing in India, Atmospheric pollution and its effect on climate and crop production.

Practical

Agro-meteorological observatory- classes, site selection, layout and installation of meteorological instruments; handling of meteorological instruments; measurement of weather parameters; working out agro-climatic indices; maintenances of record; calculation of daily, weekly and monthly means; visit to state remote sensing centre, Jodhpur/Jaipur; measurement of soil temperature in different soil conditions/depths; interpretation and use of weather data; rainfall analysis for variability; moisture availability indices for an arid and a humid district, length of growing season, fitting cropping systems; preparation of weather r maps, synoptic charts and weather reports; preparation of crop weather calendars, to become familiar with agro advisory service bulletins visit to ARS, Kanpur.

Course Learning Outcomes (CLO)-

CO1-To impart knowledge about agro-meteorology and crop weather forecasting.

CO2-Studies on impact of weather factors on crop production, modification of plant environment in open and control condition, weather forecasting etc.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	1	2	1	1	2	-	1	-	1	2	1
CO_2	2	2	2	1	1	-	1	-	3	1	1
Average	1.5	2	1.5	1	1.5	-	1		2	1.5	1

Text books:-

1. Lenka D.1998. Climate, Weather and Crops in India. Kalyani.

2. Mavi H.S.1994. Introduction to Agro-meteorology. Oxford & IBH.
3. Mavi HS & Tupper GJ. 2004. Agrometeorology: Principles and Application of Climate Studies in Agriculture. Haworth Press.
4. Agrobios. Variraju R & Krishnamurty 1995. Practical Manual on Agricultural Meteorology. Kalyani.
5. Varshneya MC & Balakrishana Pillai P. 2003. Textboók of Agricultural Meteorology. ICAR.

Reference books:-

1. T.Y. Reddy & G.S. Reddy (2016) Principles of Agronomy, Kalyani Publishers New Delhi.
2. S. R. Reddy(2005) Principles of Agronomy, Kalyani Publishers New Delhi.
3. Chang Jan Hu 1968. Climate and Agriculture on Ecological Survey. Aldine Publ.
4. Critchfield HJ.1995. General Climatology. Prentice Hall of India.
5. Das PK.1968. The Monsoons. National Book Trust Publ.
6. Lal DS.1998. Climatology. Sharda Pustak Bhawan.

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MAS-205 Basic of Experimental Design 3 (2+1)

Course objective: - Introduction to Basic of Experimental Design including selection and layout of plots, data analysis software and data interpretation.

Theory

Detail Contents

UNIT I 25%
UNIT II 25%
UNIT III 25%
UNIT IV 25%

Unit-I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control, Uniformity trials, size and shape of plots and blocks;

Unit-II

Analysis of variance; Completely randomized design, randomized block design and Latin square design, Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

Unit-III

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs.

Unit-IV

Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

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 without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces.

Course Learning Outcomes (CLO)-

CO1-Describe some of the factors affecting reproducibility and external validity. List the different types of formal experimental designs (e.g. completely randomized, block, repeated measures, Latin square and factorial experimental designs).

CO2-Explain the concept of variability, its causes and methods of reducing it. Describe possible causes of bias and ways of alleviating it. Identify the experimental unit and recognize issues of non-independence (pseudo-replication).

CO3-Describe the six factors affecting significance, including the meaning of statistical power and "p-values". Identify formal ways of determining sample size.

CO4-Explain the fundamental principles behind the output of an ANOVA, including "blocking" and "interactions".

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	1	3	1	1	1	-	2	-	-	2	1
CO_2	3	1	2	2	3	-	1	-	-	1	2
CO_3	2	3	1	1	1	-	1	-	-	2	1
CO_4	1	2	2	2	2	-	2	-	-	1	1
Average	1.7	2.25	1.5	1.5	1.75	-	1.5		-	1.5	1.25

Text books:-

1. Federer WT. 1985. Experimental Designs. MacMillan.
2. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
3. Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.

4. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.

Reference books:-

1. Cochran WG & Cox GM. 1957. Experimental Designs.
2. 2nd Ed. John Wiley. 2. Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.
3. Design Resources Server: www.iasri.res.in/design

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MSA-301: PRINCIPLES AND PRACTICES OF WEED MANAGEMENT **3 (2+1)**

Course objective:- To familiarize f the students about the weeds, herbicides and methods of weed control.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

UNIT I

Weed biology and ecology, crop-weed competition including allelopathy, principles and methods of weed control and classification; weed indices.

UNIT II

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

UNIT III

Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allele chemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.

UNIT IV

Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems, to control the aquatic weed, annual weed, biennial weed and perennial weed.

UNIT V

Integrated weed management; cost: benefit analysis of weed management.

Practical

- Identification of important weeds of different crops
- Preparation of a weed herbarium
- Weed survey in crops and cropping systems
- Crop-weed competition studies
- Preparation of spray solutions of herbicides for high and low-volumesprayers
- Use of various types of spray pumps and nozzles and calculation of swathwidth
- Economics of weed control
- Herbicide resistance analysis in plant and soil
- Bioassay of herbicide resistance
- Calculation of herbicidal requirement

Course Learning Outcomes (CLO)-

CO1-To provide basic and applied knowledge on principles and practices in weed management holistically.

CO2-Weed migration, herbicide application, persistence and degradation, bio herbicide etc.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	1	1	1	2	1	-	2	-	1	3	2
CO_2	2	2	2	1	1	-	1	-	2	2	2
Average	1.5	1.5	1.5	1.5	1	-	1.5	-	1.5	2.5	2

Text books:-

1. T. J. Monaco, S. C. Weller and F. M. Ashton (2002). Weed Sciences: Principles and Practices, John Wiley and Sons Inc. New York

Reference books:-

1. T.Y. Reddy & G.S. Reddy (2016) Principles of Agronomy, Kalyani Publishers New Delhi.
2. S. R. Reddy (2005) Principles of Agronomy, Kalyani Publishers New Delhi.

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MSA-302 AGRONOMY OF FODDER AND FORAGE CROPS

3 (2+1)

Course objective:- To teach the crop husbandry of different forage and fodder crops along with their processing.

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

UNIT I

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like maize, jowar, 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, Cenchrusetc.

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 poor quality fodder.

UNIT V

Economics of forage cultivation uses and seed production techniques.

Practical

- Practical raining of farm operations in raising fodder crops;
- Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops
- Anti-quality components like HCN in sorghum and such factors in other crops
- Hay and silage making and economics of their preparation

Course Learning Outcomes (CLO)-

CO1-The goal of the subject is to acquire knowledge, skills and competencies in the area of forage crops cultivation and production in areas with climate of central Europe. The issue of permanent grasslands (meadows and pastures) will be shortly introduced.

CO2-Students will learn about management of temporary mixtures of grasses and legumes and annual forage crops, including harvest technology and their preservation.

CO3-Students get acquainted with qualitative parameters forage, development in growing areas compared to other states. The classes include also principles of the forage production plans on farm level for cattle and about crop rotations which support improvement of soil health and fertility.

CO4-Students will acquire specialized skills and abilities and will be able to integrate knowledge from related fields.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	3	2	1	-	3	-	1	2	1	3	1
CO_2	1	3	1	2	2	-	1	1	-	2	2
CO_3	2	1	3	1	2	-	2	3	2	3	1
CO_4	2	1	2	3	3	-	1	1	1	1	3
Average	2	1.75	1.75	1.25	2	-	1.25	1.5	1	2.25	1.75

Text books:-

1. Chatterjee BN. 1989. Forage Crop Production - Principles and Practices. Oxford & IBH.
2. Narayanan TR & Dabadghao PM. 1972. Forage Crops of India. ICAR.
3. Singh P & Srivastava AK. 1990. Forage Production Technology. IGFRI, Jhansi.
4. Tejwani KG. 1994. Agroforestry in India. Oxford & IBH.

Reference books:-

1. C. Singh, P. Singh and R. Singh (2009) Modern techniques of raising field crops, Oxford & IBH Publishing Company New Delhi.
2. P. Rajendra (2006) Textbook of Field Crops Production, Volume I & II Published by ICAR.
3. Das NR. 2007. Introduction to Crops of India. Scientific Publ.
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MSA-303 CROPPING SYSTEMS AND SUSTAINABLE AGRICULTURE 3 (2+1)

Course objective:- To acquaint the students about prevailing cropping systems in the country and practices to improve their productivity.

Theory

Detail Contents

UNIT I	**15%**
UNIT II	**25%**
UNIT III	**25%**
UNIT IV	**25%**
UNIT V	**10%**

UNIT I

Cropping systems: definition, indices and its importance, physical resources, soil and water management in cropping systems, assessment of land use, Crop Rotation: role & importance

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; multistoried 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.

UNIT V

Plant ideotypes for drylands; plant growth regulators and their role in sustainability, effect & their importance of crop

Course Learning Outcomes (CLO)-

CO1-The student will be able to explain the major aspects of agricultural practices and traditions through time and throughout the world.

CO2-The student will be able to explain in general the relationships among culture, economics, politics, science, and agricultural development. A solid understanding of the cross-cultural interactions and exchange that linked the world's people and facilitated agricultural development is also expected.

CO3-The student will study and analyze the refereed-journal articles, texts, and practices that represent the perspectives of different societies and agricultural traditions.

CO4-To show how agricultural scientists are attempting to minimize agricultural pollution and sustain food production adequate for the world's population.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	2	1	1	1	1	1	2	-	1	2	3
CO_2	3	1	1	2	2	1	1	-	1	1	2
CO_3	1	1	2	1	2	1	1	-	1	2	1
CO_4	2	2	1	2	1	1	1	-	2	3	2
Average	2	1.25	1.25	1.5	1.5	1	1.25		1.25	2	2

Text books:-

1. Palaniappan SP & Sivaraman K. 1996. Cropping Systems in the Tropics; Principles and Management. New Age.

2. Panda SC. 2003. Cropping and Farming Systems. Agrobios.

Reference books:-

1. A.K. Dahama (1996 & 1997) Organic farming for sustainable agriculture I & II ,Agro House, Behind Nasrani Cinema, Chopasani Road Jodhpur.
2. T.Y. Reddy & G.S. Reddy (2016) Principles of Agronomy, Kalyani Publishers New Delhi.
3. S. R. Reddy (2005) Principles of Agronomy, Kalyani Publishers New Delhi.
4. Sankaran S & Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ. Co.
5. Singh SS. 2006. Principles and Practices of Agronomy. Kalyani.
6. Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1997. Soil Fertility and Fertilizers. Prentice Hall.

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MSA-304: MODERN CONCEPTS IN CROP PRODUCTION

2 (2+0)

Course objective:- To teach the basic concepts of soil management and crop production

Theory

Detail Contents

UNIT I	**20%**
UNIT II	**20%**
UNIT III	**20%**
UNIT IV	**20%**
UNIT V	**20%**

UNIT I

Crop growth analysis in relation to environment; agro-ecological zones of India, concept of potential yield, modern concepts in tillage - zero, minimum and conservation tillage.

UNIT II

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

UNIT III

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

UNIT IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress,

UNIT V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.]

Course Learning Outcomes (CLO)-

CO1-To impart knowledge on basic concepts of crop growth, responses to growth factors, crop production of recent time.

CO2-Ideal plant type, Source sink studies, Yield gap analysis etc.

PO & PSO / CO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4
CO_1	2	3	1	1	3	-	2	-	1	2	3
CO_2	3	1	2	2	2	-	1	-	2	1	1
Average	2.5	2	1.5	1.5	2.5	-	1.5		1.5	1.5	2

Text books:-

1. Reddy SR. 2000. Principles of Crop Production. Kalyani Publ.
2. S. C. Panda (2014). Modern Concepts and Advances Principles in Crop Production, Agribios.

Reference books:-

1. T.Y. Reddy & G.S. Reddy (2016) Principles of Agronomy, Kalyani Publishers New Delhi.
2. S. R. Reddy (2005) Principles of Agronomy, Kalyani Publishers New Delhi.
3. Balasubramaniyan P & Palaniappan SP. 2001. Principles and Practices of Agronomy. Agrobios.
4. Sankaran S & Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ.

5. Singh SS. 2006. Principles and Practices of Agronomy. Kalyani.

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MSA-305: AGROSTOLOGY AND AGRO-FORESTRY 3 (2+1)

Course objective:- To teach crop husbandry of different forage, fodder and agro-forestry crops/trees along with their processing.

Theory

Detail Contents

UNIT I	**25%**
UNIT II	**25%**
UNIT III	**25%**
UNIT IV	**25%**

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, agri-silviculture, silvipasture, agri-silvipasture, agri-horticulture, aqua-silviculture, alley cropping and energy plantation.

UNIT IV

Crop production technology in agro-forestry 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

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
- Tour & Visits

Course Learning Outcomes (CLO) –

CO1-Students will understand recognize various harvesting, transportation, and processing systems used in the management of forest resources and production of forest products.

CO2-Students will understand develop and evaluate management plans with multiple objectives and constraints. They will learn how to develop and apply silvicultural prescriptions appropriate to management objectives.

CO3-Students will understand analyze forest inventory information and project future forest, stand, and tree conditions.

PO & PSO	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PSO_1	PSO_2	PSO_3	PSO_4

CO											
CO_1	2	1	2	1	2	2	3	-	2	-	2
CO_2	1	2	1	2	1	3	2	-	1	-	1
CO_3	3	2	1	3	1	2	1	-	1	-	1
Average	3	1.66	1.33	2	1.33	2.33	2		1.33	-	1.33

Text books:-

1. Dwivedi AP. 1992. Agroforestry- Principles and Practices. Oxford & IBH.
2. Indian Society of Agronomy. 1989. Agroforestry System in India. Research and Development, New Delhi.
3. Pathak PS & Roy MM. 1994. Agroforestry System for Degraded Lands. Oxford & IBH.
4. Singh SP. 1994. Handbook of Agroforestry. Agrotech Publ. Solanki KR. 2000. Multipurpose Tree Species: Research, Retrospect and Prospects. Agrobios.
5. Tejwani KG.1994. Agroforestry in India. Oxford & IBH.
6. S. R. Reddy and C. Nagamani, Introduction to Forestry Kalyani Publisher, New Delhi.
7. A. J. Raj and S. B. Lal (2014) Agro forestry Theory and Practices, Scientific Publishers, New Delhi.

Reference books:-

1. Narayan TR & Dabadghao PM. 1972. Forage Crop of India. ICAR, New Delhi.
2. Sen NL, Dadheech RC, Dashora LK & Rawat TS. 2004. Manual of Agroforestry and Social orestry. Agrotech Publ.
3. Shah SA.1988. Forestry for People. ICAR. Singh Panjab, Pathak PS & Roy MM.1994. Agroforestry System for Sustainable Use. Oxford & IBH.

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