

Course Curriculum of Fifth Semester
as per the ICAR-Sixth Deans' Committee Report for
the Academic Programmes in
AGRICULTURE

- ❖ UG-Certificate in Agriculture
- ❖ UG-Diploma in Agriculture
- ❖ UG-Degree: B.Sc. (Hons.) Agriculture



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UG Degree Syllabus State Coordinator

with

UG Degree Syllabus Discipline Coordinators &

DICC - UG Degree Syllabus Core Committee

Submitted to the

Directors of Instruction and Deans (F/A) Coordination Committee

~ w.e.f. AY, 2026-27 ~

**Course Curriculum of Fifth Semester as per the
ICAR-Sixth Deans' Committee Report for Academic Programme in
AGRICULTURE**

Course Layout

B.Sc. (Hons.) Agriculture

Semester: V (New)

***w.e.f.* Academic Year: 2026-27**

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark
1.	MDC-353	Agricultural Marketing and Trade	3(2+1)	--
2.	AGRO-356	Introductory Agroforestry	2(1+1)	--
3.	AGRO-357	Weed Management	2(1+1)	--
4.	GPB-353	Crop Improvement (<i>Kharif</i> Crops) - I	2(1+1)	--
5.	PP-351	Fundamentals of Crop Physiology	3(2+1)	--
6.	AMT-351	Introduction to Agrometeorology	2(1+1)	--
7.	HORT-354	Ornamental Crops, MAPs and Landscaping	2(1+1)	--
8.	PATH-352	Diseases of Field & Horticultural Crops and their Management	3(2+1)	--
9.	ENTO-352	Pest Management in Crops and Stored Grains	3(2+1)	--
10.	AHDS-353	Livestock Breeding and Nutrition	2(1+1)	--
11.	OC-1/ OC-2/...	Online Course(s)/ MOOC(s)	As opted by Student	NG
12.	EDT-351	Educational Tour (10-14 Days)	2(0+2)	NG
Total Credit Hrs. =			24 (14+10)	G
MDC: Multidisciplinary Course, OC: Online Course, G: Gradual, NG: Non-gradual				
[†] Note: It is mandatory for each Student to complete total 10 credits (Non-gradual) of Online Courses from available resources across III to VIII semesters under the guidance of assigned Faculty/Advisor.				

B.Sc. (Hons.) Agriculture: Fifth Semester

Course-wise Syllabus with Teaching Schedules

Semester : V	
Course No. : MDC-353	Credit Hrs. : 3(2+1)
Course Title : Agricultural Marketing and Trade	

SYLLABUS

- Objectives :**
- (i) To understand the fundamentals of Agricultural Marketing and Trade,
 - (ii) To analyse the factors influencing supply and demand in agricultural markets,
 - (iii) To explore different marketing channels and strategies in Agriculture,
 - (iv) To examine the role of Government Policies and Regulations in agricultural markets.

THEORY

Agricultural Marketing: Concepts and Definitions of Market, Marketing, Agricultural Marketing, Market structure, Marketing mix and Market segmentation, Classification and Characteristics of Agricultural markets; Demand, Supply and Producer's surplus of agri-commodities: Nature and Determinants of demand and supply of farm products, Producer's surplus – Meaning and its types, Marketable and Marketed surplus, Factors affecting marketable surplus of agri-commodities; Pricing and promotion strategies: Pricing considerations and approaches – Cost-based and Competition-based pricing; Market promotion – advertising, Personal selling, Sales promotion and Publicity– their meaning and merits and demerits; Marketing process and Functions: Marketing process concentration, dispersion and equalization; Exchange functions – buying and selling; physical functions – storage, transport and processing; Facilitating functions – packaging, branding, grading, quality control and labeling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and Definition of Marketing Channel; Number of channel levels; Marketing channels for different farm products; Integration, Efficiency, Costs and Price spread: Meaning, Definitions and Types of market integration; Marketing efficiency; Marketing costs, margins and price spread; Factors affecting cost of marketing; Reasons for higher marketing costs of farm commodities; Ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- NAFED, TRIFED, NCDC, APEDA, CWC, SWC, FCI, CACP, DMI – their objectives and functions;

Cooperative marketing in India; Risk in marketing: Types of risk in marketing; Speculation and hedging; An overview of futures trading; Agricultural prices and policy: Meaning and functions of price; Administered prices; Need for innovations in agricultural price policy; Trade: Concept of International Trade and its need, Theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian Agriculture; IPR. Role of APMC and its relevance in the present-day context.

PRACTICAL

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, Identification of marketing channels for selected commodity; Collection of data regarding marketing costs, margins and price spread and Presentation of report in the class; Visit to market institutions - NAFED, SWC, CWC, Cooperative Marketing Society etc.- To study their organization and functioning. Application of principles of comparative advantage of International Trade.

TEACHING SCHEDULE

THEORY [MDC-353]

Lecture No.	Topic	Sub-topics / Key Points	Weightage (%)
1	Market and Marketing	Meaning – Definitions – Components of market – Market structure – Meaning – Components – Market conduct – Market performance.	4
2	Agricultural Marketing	Meaning – Definition – Scope – Subject matter – Importance of Agricultural Marketing in economic development.	6
3		Market structure, Marketing mix and Market segmentation.	
4	Classification and Characteristics of Agricultural Market	Classification of Markets – On the basis of Location, Area of coverage, Time span, Volume of transaction, Nature of transaction, Number of commodities, Degree of competition, Nature of commodities, Stage of marketing, Extent of public intervention, Type of population served, Accrual of marketing margins.	4
5	Demand and Supply	Demand, Supply and Producer's surplus of agri-commodities: Nature and Determinants of Demand and Supply of farm products,	4
6	Producer's Surplus	Meaning- Marketable surplus- Marketed surplus- Importance- Factors influencing marketable surplus of agri-commodities	4
7 - 8	Pricing and Promotion Strategies	Pricing and promotion strategies; Pricing Considerations and Approaches – Cost-based and Competition-based pricing	6

Continued...

9	Market Promotion	Advertising, Personal selling, Sales promotion and Publicity – their Meaning and Merits and Demerits	4
10	Marketing Process and Functions	Marketing Process Concentration, Dispersion and Equalization	12
11		Marketing functions – Meaning - Exchange functions – Buying and Selling	
12		Physical Functions – Storage, Transport and Processing	
13		Facilitating Functions – Packaging, Branding, Grading, Quality control and Labeling (AGMARK)	
14	Market Functionaries and Marketing Channels	Types and Importance of agencies involved in Agricultural Marketing	8
15 - 16		Meaning and Definition of Marketing Channel; Number of channel levels; Marketing channels for different farm products	
17	Market Integration	Definition-Types of Market integration- Horizontal, Vertical and Conglomeration-	4
18	Marketing Efficiency	Meaning- Definitions- Technical or Physical or Operational efficiency- Pricing or Allocative efficiency	4
19	Marketing Cost	Marketing Cost- Margins- Price spread- Factors affecting the costs of marketing- Reasons for higher marketing costs of agricultural commodities- Ways of reducing marketing costs for farm products	4
20	Role of Govt. in Agricultural Marketing	Government in Agricultural Marketing- Remedial measures Regulated markets - Definition- Important features of Regulated markets, Functions, Progress and Defects	4
21 - 22	Public Sector Institutions	Objectives and Functions of: ~ National Agricultural Cooperative Marketing Federation (NAFED)- Tribal Cooperative Marketing Development Federation (TRIFED)- National Cooperative Development Corporation (NCDC)- Agricultural and Processed Food Products Export Development Authority (APEDA)- Central Warehousing Corporation (CWC)- State Warehousing Corporations (SWC)- Food Corporation of India (FCI)- Commission for Agricultural Cost and Prices (CACP)- Directorate of Marketing & Inspection (DMI)-	6
23	Cooperative Marketing	Meaning- Structure- Functions of Cooperative Marketing Societies-	2

Continued...

MDC-353...

24	Risk in Marketing	Types of Risk in Marketing-	6
25		Speculation & Hedging-; An overview of Futures trading-	
26	Agricultural Prices and Policy	Meaning and Functions of Price; Administered prices; Need for Agricultural Price Policy	4
27 - 28	International Trade	Concept of International Trade and its Need, International trade- Definition- International vs. Interregional trades- Free trade vs. Protection-	10
29		Theories of Absolute and Comparative Advantage	
30		Present status and Prospects of international trade in Agri-commodities; GATT and WTO	
31		Agreement on Agriculture (AoA) and its implications on Indian Agriculture; Intellectual Property Rights (IPR)	
32	APMC	Role of APMC and its relevance in the present-day context	4
Total =			100

TEACHING SCHEDULE**PRACTICAL [MDC-353]**

Exercise No.	Exercise Title
1	Plotting and Study of demand and supply curves.
2	Calculation of price and income elasticity of demand.
3	Study of the relationship between market arrivals and prices of selected commodities.
4	Computation of marketable and marketed surplus of important commodities.
5	Study of price behaviour (seasonal indices) over time for selected commodities.
6	Construction of simple and weighted price index numbers.
7	Visit to the local market to study different marketing functions performed by different agencies.
8	Study and Identification of marketing channels for selected commodities.
9	Collection of data and estimation of marketing cost, marketing margin and price spread of selected commodities.
10	Introduction to different Public Agricultural Marketing Web Portals- (AgMarkNet, MSAMB).
11	Visit to NAFED - Organisational and Functional Study.
12	Visit to SWC/CWC - Study of Warehousing Operations.
13	Visit to Co-operative Marketing Society - Functional analysis.
14	Visit to Local Processing Unit.
15	Application of Absolute Advantage Theory in International Trade.
16	Application of Comparative Advantage Theory in International Trade.

Suggested Readings [MDC-353]:

1. Acharya S.S. and Agarwal N.L. 2006. Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
 2. Chinna S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Publ., New Delhi.
 3. Dominic Salvatore, Microeconomic Theory. 3rd edn./ Schaum's Outline Series/ McGraw-Hill Publishing Company, New York.
 4. Kohls Richard L. and Uhl Josheph N. 2002. Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
 5. Kotler and Armstrong. 2005. Principles of Marketing, Pearson Prentice-Hall.
 6. Lekhi R. K. and Joginder Singh. 2006. Agricultural Economics. Kalyani Publishers, Delhi.
 7. Memoria C.B., Joshi R.L. and Mulla N.I. 2003. Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
 8. Pandey Mukesh and Tewari Deepali. 2004. Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
 9. Sharma R. 2005. Export Management, Laxmi Narain Agarwal, Agra.
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Semester :	V	
Course No. :	AGRO-356	Credit Hrs. : 2(1+1)
Course Title :	Introductory Agroforestry	

SYLLABUS

- Objectives :**
- (i) To study Agroforestry as an alternate system of land use,
 - (ii) To study different types of Agroforestry for soil and water conservation,
 - (iii) To study the characteristics of Agroforestry in terms its potential for soil moisture conservation practices.

THEORY

Definition and Scope of Agroforestry system, Types of Agroforestry system, Potential of Agroforestry in India, Prevailing Agroforestry systems in India, MPTS - Definition, Role of MPTS in Agroforestry system, its selection for different Agroforestry systems, MPTS of India, Ecological aspects of Agroforestry system, Tree - Crop Interaction – Competition, Nutrient recycling, Traditional Agroforestry as a viable choice to conserve Agro-biodiversity of India, Management of Agroforestry system, Resource management (light, water, nutrients) productivity (yield, LER) sustainability. Role of Agroforestry in soil and water conservation; Windbreak, Shelterbelt - Definition, Objectives, Socio-economic aspects of Agroforestry system, Design (spacing, arrangement, species combination) and Diagnostic study (problems, performance evaluation) of Agroforestry system, Silviculture: Definition and Scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, Field handling of nursery stock, Management of tree species; Silviculture of important tree species, choice of species - site factors, root, crown and bole characteristics, Phenology, Nutritional and Water requirement, Ground operation, Tending, Harvesting utility etc., Horticulture and Forage crops-based Agroforestry Models developed by ICAR-IGFRI; Agroforestry Models developed by Indian Council of Forestry Research & Education (ICFRE).

PRACTICAL

Identification of tree species in Agroforestry, Study of tree growth measurement, Study of environmental parameters affecting AF System, Plant propagation methods, Pre-sowing seed treatment, Preparation of nursery beds, Practicing propagation techniques for trees, Afforestation method, practical training, pruning, coppicing, pollarding etc., Planting pattern and designs for plantation, Natural and artificial regeneration, Design and diagnostic survey of Agroforestry system, Evaluation of Agroforestry system in different agro-climatic zones, Exposure Visit to prevailing Agroforestry systems of the state and related important institutions, Virtual visit of Agroforestry models developed by ICAR-IGFRI, ICFRE.

TEACHING SCHEDULE

THEORY [AGRO-356]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Introduction to Agroforestry	Definition and Scope of Agroforestry system	6
2	Agroforestry Systems	Types of Agroforestry system, Potential of Agroforestry in India, Prevailing Agroforestry system in India	10
3	Multipurpose Trees and Shrubs (MPTS)	Definition, Role of MPTS in Agroforestry system, its selection for different Agroforestry systems, MPTS of India.	10
4	Agroforestry Ecology	Ecological aspects of Agroforestry system, Tree - Crop interaction - Competition, Nutrient recycling	10
5	Traditional Agroforestry	Traditional Agroforestry as a viable choice to conserve Agro-biodiversity of India	4
6	Design and Diagnostic Study of Agroforestry System	Design (spacing, arrangement, species combination) and Diagnostic study (problems, performance evaluation) of Agroforestry system	8
7	Management of Agroforestry System	Resource management (light, water, nutrients) productivity (yield, LER) sustainability	6
8	Role of Agroforestry	Role of Agroforestry in soil and water conservation	4
9	Windbreak and Shelterbelt	Definition, Objectives & brief accounts	4
10	Socio-economic Aspects	Socio-economic aspects of Agroforestry system	4
11 - 12	Propagation and Nursery Management	Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting- stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, Field handling of Nursery stock and AI in Agroforestry and its importance.	10
13	Silviculture and Management of Tree Species	Silviculture: Definition and Scope	6
14 - 15		Management of tree species; Silviculture of important tree species, Choice of species- site factors, root, crown and bole characteristics, Phenology, Nutritional and Water requirement, Ground operation, Tending, Harvesting utility etc.	12
16	ICAR-IGFRI and ICFRE Agroforestry Models	Horticulture and Forage crops-based Agroforestry Models developed by ICAR-IGFRI; Agroforestry Models developed by ICFRE.	6
Total =			100

TEACHING SCHEDULE

PRACTICAL [AGRO-356]

Exercise No.	Exercise Title
1	Identification of tree species in Agroforestry.
2	Study of tree growth measurement.
3	Study of environmental parameters affecting AF System.
4	Plant propagation methods.
5	Pre-sowing seed treatment.
6	Preparation of nursery beds.
7	Practicing propagation techniques for trees.
8	Afforestation method, practical training, pruning, coppicing, pollarding etc.
9 - 10	Planting patterns and designs for plantation.
11	Natural and artificial regeneration.
12	Design and diagnostic survey of Agroforestry system.
13	Evaluation of Agroforestry system in different agroclimatic zones.
14 - 15	Exposure visits to prevailing Agroforestry systems of the state and related important institutions.
16	Virtual visit of Agroforestry models developed by ICAR-IGFRI and ICFRE.

Suggested Readings [AGRO-356]:

1. Dwivedi, A.P. 1993. Textbook of Silviculture. International Book Distributors.
2. Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehradun.
3. Kumar, B. and Nair, P.K.R. (eds). 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Volume 3: Book Series "Advances in Agroforestry". Springer Science, The Netherlands.
4. Chaturvedi, A.N and L.S. Khanna. 2011. Forest Mensuration and Biometry (5th edn). Khanna Bandhu. Dehradun. 364p.
5. Husch, B., Beers, T.W. and Kershaw, J. J.A. 2002. Forest Mensuration (4th edn). John Wiley & Sons, Nature. 456p.
6. Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi, 473p.
7. Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
8. Pathak, P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
9. Chundawat, D.S. and S.K. Gautam. 2017. Textbook of Agroforestry, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
10. Dwivedi, A.P. 1992. Principles and Practices of Agroforestry. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Semester	: V	
Course No.	: AGRO-357	Credit Hrs.: 2(1+1)
Course Title	: Weed Management	

SYLLABUS

Objectives : (i) To learn about Principles of Weed Science,
(ii) To impart practical knowledge of weed management in field and horticultural crops.

THEORY

Introduction to Weeds, Characteristics of weeds and their harmful and beneficial effects on ecosystem; Classification, reproduction and dissemination of weeds; Crop-weed competition, Factors crop-weed competition; Factors affecting growth and development, Studies on Weed Seed Bank, Weed Shifts; Concepts and Principles of weed management; Methods of weed control: Physical, Cultural, Chemical and Biological, Integrated Weed Management (IWM); Implements for weed control, Robotic weed control; Weed management in different field and horticultural crops; Weed management in Organic / Natural Farming; Definition, Classification and properties of important herbicides; Concept of adjuvants, surfactants, herbicide formulations and their use; Nanoherbicides, Precision Weed Management; Modes of action of herbicides and selectivity phenomenon; Concept of herbicide mixture and utility in Agriculture. Herbicide compatibility with agrochemicals and their application. Absorption and translocation of herbicides in plant; Herbicide resistance and its management and fates of herbicides in soil, Aquatic weed management in cropping systems.

PRACTICAL

Techniques of Weed preservation; Weed identification; Losses caused by weeds; Biology of important weeds; Study of weeds in different situations; Study of herbicide formulations and mixture of herbicide; Study of methods of herbicide application; Herbicide spraying equipment, their parts, use, maintenance and calibration; Weed control implements; Calculation of herbicide doses and requirement; Study of weed control efficiency and weed index with calculations; Phytotoxicity of herbicides, Weed management if fallow lands, Management of problematic and parasitic weeds. Use of Robotics and Artificial Intelligence (AI) in weed management; Aquatic weed management.

TEACHING SCHEDULE

THEORY [AGRO-357]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 2	Introduction to Weeds	Definition; Introduction to Weeds; Characteristics of weeds and their harmful and beneficial effects on ecosystem.	10
3 - 4	Classification; Reproduction and Dissemination of Weeds	Classification based on life cycle, habitat and morphology; Reproduction and Dissemination of weeds (sexual and vegetative); Studies on - Weed Seed Bank, Weed Shifts.	10
5	Crop-Weed Competition	Concept of Crop-Weed Competition; Critical period of crop-weed competition; Effects on crop growth and yield; Factors affecting Crop-Weed competition, Environmental and Edaphic factors affecting weed growth.	10
6	Concepts and Principles of Weed Management	Weed Management Concepts; Principles; Prevention, Eradication and Control.	4
7 - 8	Weed Management and IWM	Methods of weed control: Physical, Cultural, Chemical and Biological; Integrated Weed Management (IWM)	12
9		Weed management in different field and horticultural crops; Aquatic weed management; Precision weed management	12
10		Weed Management in Organic/ Natural Farming	6
11	Herbicides	Definition and Classification of Herbicides; Properties of important herbicides; Nanoherbicides.	8
12	Adjuvants and Herbicide Formulations	Herbicide formulations; Concept of adjuvants, surfactants and their uses.	8
13	Modes of Action and Selectivity of Herbicides	Modes of action of herbicides and Selectivity phenomenon.	4
14	Movement of Herbicides in Plant	Absorption and translocation of herbicides in plant.	6
15	Herbicide Mixture and Herbicide Compatibility	Concept of Herbicides Mixture and its Utility in Agriculture; Herbicide Compatibility- (<i>in brief</i>).	6
16	Herbicide Resistance and its Fates in Soil	Herbicide resistance and its management; and Fates of herbicides in soil- (<i>in brief</i>).	4
Total =			100

PRACTICAL [AGRO-357]

Exercise No.	Exercise Title
1	Study of the techniques of weed preservation.
2	Identification of different weeds.
3	Study of the losses caused by weeds.
4	Study of Biology of important weeds.
5	Study of weeds in different situations.
6	Study of herbicide formulations and mixture of herbicides.
7	Study of herbicide compatibility with agrochemicals and their application.
8	Study of methods of herbicide application.
9	Herbicide spraying equipment, their parts, use, maintenance and calibration.
10	Study and use of weed control implement.
11	Calculation of herbicide doses and requirement.
12	Study of weed control efficiency and weed index with calculations.
13	Study of Phytotoxicity of herbicides.
14	Weed management in fallow lands.
15	Management of problematic, parasitic and aquatic weed.
16	Use of Robotics and Artificial Intelligence (AI) in weed management.

Suggested Readings [AGRO-357]:

1. Crafts, A.S. and Robbins, W.W. (1973). Weed Control (3rd ed.). Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. Gupta, O.P. (1984). Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi.
3. Gupta, O.P. (2015). Modern Weed Management. Agrobios (India), Jodhpur.
4. Naidu, V.S.G.R. (2005). Handbook of Weed Identification. Directorate of Weed Science Research, Jabalpur.
5. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. (2015). Weed Management of Horticultural Crops. Agrobios (India), Jodhpur.
6. Ramamoorthy, K. and Subbian, P. (2013). Predominant Weed Flora in Hill Eco-Systems. Agrobios (India), Jodhpur.
7. Rao, V.S. (2000). Principles of Weed Science (2nd ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Semester	: V	
Course No.	: GPB-353	Credit Hrs. : 2(1+1)
Course Title	: Crop Improvement (<i>Kharif</i> Crops) - I	

SYLLABUS

- Objectives** : (i) To provide knowledge about self-pollinated and cross-pollinated *kharif* crops,
(ii) To learn about origin and distribution of *kharif* crops,
(iii) To design breeding objectives of major *kharif* crops,
(iv) To impart information on different crop varieties for *kharif* season.

THEORY

Centres of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds, fibres, fodders and cash crops, vegetable and other horticultural crops; Plant genetic resources, its utilization and conservation; Study of Genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet, Cotton and Pigeonpea; Ideotype concept, Climate-resilient crop varieties for future.

PRACTICAL

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. Rice, Jute, Maize, Sorghum, Pearl millet, Ragi, Pigeonpea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Castor, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different *kharif* crops. Handling of germplasm and segregating populations by different methods like- pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in *kharif* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

TEACHING SCHEDULE

THEORY [GPB-353]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 2	Centres of Origin, Distribution of Species and Wild Relatives in different <i>Kharif</i> Crops	Vavilov's Centres of Origin, Geographical Distribution of Crop species, their Wild relatives in following different <i>Kharif</i> crops: Cereals: Rice, Maize, Sorghum, Pearl millet, Finger millet; Pulses: Pigeonpea, Urdbean, Black gram, Mungbean, Cowpea, Soybean; Oilseeds: Groundnut, Castor, Sesame, Sunflower;	4
		Fiber & Cash crops: Cotton, Jute & Sugarcane, Tobacco; Fodders: Berseem, Lucerne, Rice bean; Vegetables: Major Solanaceous & Cucurbitaceous crops; Fruit crops: Mango, Cashew nut, Citrus, Guava, Pomegranate.	4
3	Plant Genetic Resources, its Utilization and Conservation	Definitions, Significance and Classification of PGRs, Kinds of Germplasm; Germplasm collection, characterization and evaluation; Gene pool concept, Genetic erosion; <i>In situ</i> and <i>ex situ</i> conservation; Gene Banks; Utilization of PGRs in breeding programmes.	10
4	Floral Biology (in brief)	Flower structure and morphology; Formula (Overview); Flowering behaviour and Phenology (in brief); Anthesis and Dehiscence. Emasculation techniques and Modes of pollination (Definitions, Types, Important Examples)	4
5	Quantitative and Qualitative Characters	Definitions, Characteristics/ Genetic control and inheritance; Differences between Qualitative and Quantitative traits; Gene actions; Pleiotropy, Penetrance and Expressivity, Threshold character and Modifying genes; Inheritance of quantitative characters- Multiple factor hypothesis, Transgressive segregation. Role of environment in quantitative inheritance.	8

Continued...

6 - 8	Breeding Objectives and Breeding Methods	<u>Major Breeding objectives</u> (with Major <i>Kharif</i> crop-wise examples) including adaptability and stability; Basic concepts and Breeding Methods/Procedures in Self-pollinated, Cross-pollinated and Vegetatively propagated crops (Lists); <u>Conventional/ Classic breeding methods:</u> Mass selection, Pure line selection, Pedigree method, Bulk method, Synthetic and Composite variety development, Single Seed Descent (SSD), Heterosis breeding, Backcross breeding, Recurrent selections, Clonal selection, Mutation breeding; Advantages and limitations; Applications and achievements of conventional breeding methods with suitable <i>kharif</i> crop and variety examples. <u>Modern breeding approaches:</u> (<i>Brief accounts on ~</i>) Somatic hybridization, Transgenic breeding and Marker-Assisted Selection (MAS); Achievements with suitable <i>kharif</i> crop and variety examples.	12
9	Breeding for Biotic Stress	Breeding for Disease Resistance: Introduction; Mechanisms of disease resistance; Types of genetic resistance; Gene-for-gene hypothesis; Genetics of resistance; Sources of resistance/tolerance; Breeding methods and practical achievements.	8
10	Breeding for Abiotic Stress	Breeding for Insect Resistance: Introduction; Mechanisms of insect resistance; Basis of insect resistance; Genetics of insect resistance, Sources of insect resistance; Breeding methods and Practical achievements.	8
11	Breeding for Abiotic Stress	Breeding for Drought Resistance: Drought- Introduction; Drought resistance; Mechanism of drought resistance; Basis of drought resistance, Sources of drought resistance; Breeding methods and Practical achievements/ examples. Breeding for Salinity Resistance-: Breeding for salt tolerance, Screening techniques, Breeding methods and Practical achievements/ examples.	10
12	Breeding for Quality Traits	Breeding for quality: (Physical, Chemical, Nutritional); Introduction, Quality traits, Nutrition and nutrients, Nutritional quality of cereals and pulses; Genetics of nutritional traits, Sources of nutritional quality; Screening techniques, Breeding for low toxic substance, Breeding approaches & Practical achievements.	10

Continued...

13 - 14	Hybrid Seed Production Technologies	Hybrid seed production technologies in major <i>kharif</i> crops ~ Maize, Rice, Sorghum, Pearl millet, Cotton and Pigeonpea.	12
15 - 16	Ideotype Breeding and Climate Resilient Crops	Ideotype concept in crop improvement- Definition and Introduction, Types of ideotype, Characteristics of Ideotype; Major steps in Ideotype breeding; Ideotypes of Maize, Rice, <i>Kharif</i> Sorghum and Pigeonpea; Practical achievements, Concept and Characteristics of Climate-resilient crops; Breeding strategies for climate resilience/ Role of conventional and molecular breeding approaches; Examples in major <i>kharif</i> crops and Future prospects.	10
Total =			100

TEACHING SCHEDULE

PRACTICAL [GPB-353]

Exercise No.	Exercise Title
1	Identification and Study of morphological and botanical features of major <i>Kharif</i> crops.
2	Study of floral biology, emasculation and hybridization techniques in Rice, Maize and/or Jute.
3	Study of floral biology, emasculation and hybridization techniques in Sorghum, Pearl millet and/or Ragi.
4	Study of floral biology, emasculation and hybridization techniques in Pigeonpea, Urdbean or Mungbean or Cowpea, and Soybean.
5	Study of floral biology, emasculation and hybridization techniques in Groundnut or Sesame, and Sunflower.
6	Study of floral biology, emasculation and hybridization techniques in Tobacco or/ & Castor and Cotton.
7	Study of floral biology, emasculation and hybridization techniques in Brinjal or Okra and Cucurbitaceous crops.
8	Maintenance breeding procedures in major <i>Kharif</i> crops.
9 - 10	Study of field techniques for seed production and hybrid seeds production in <i>major Kharif</i> crops.
11	Study of different methods of handling of germplasm and segregating populations by different methods (Pedigree, Bulk and Single seed decent method).

Continued...

12	Study on estimation of heterosis, inbreeding depression and heritability.
13	Study of layout of field experiments.
14	Study of quality characters, donor parents for different characters.
15	Visit to Seed Production Plots of <i>Kharif</i> crops.
16	Visit to University and/or AICRP Breeding Trials/ Plots of <i>Kharif</i> crops.

Suggested Readings [GPB -353]:

1. Breeding Field Crops - I by V.L. Chopra.
 2. Genetic Improvement of Field Crops by C.B. Singh and D. Khare.
 3. Genetics and Breeding of Pulse Crops by D.P. Singh.
 4. Vegetable Breeding: Principles and Practices by Hari Har Ram.
 5. Breeding Field Crops by D.A. Sleper and J.M. Poehlman.
 6. Plant Breeding Theory and Practice by S.K. Gupta.
 7. Breeding Asian Field Crops by J.M. Poehlman and D.N. Barthakur.
 8. Practical Manual on Crop improvement I (*Kharif* crops) by Rajendra Kumar Yadav.
 9. Breeding of Field Crops by D.N. Bhardwaj.
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Semester : V	
Course No. : PP-351	Credit Hrs. : 3(2+1)
Course Title : Fundamentals of Crop Physiology	

SYLLABUS

- Objectives :**
- (i) To study plant cell structure and plant water relations,
 - (ii) To study vital physiological processes viz., transpiration, photosynthesis, respiration, Carbon metabolism and reproductive Physiology.
 - (iii) To study mineral nutrition, plant hormones, growth analysis and plant growth and development.

THEORY

Definitions of Plant Physiology and Crop Physiology, Importance of Crop Physiology, Relationship of Crop Physiology with other branches of Crop science; Diffusion and osmosis, Physiological roles of water to crop plants, Definition of Water potential and components of water potential; Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation, Water use efficiency. Significance of transpiration. Stomatal opening and closing mechanisms, Anti-transpirants - types and examples; Essential and beneficial elements, Passive and active transport of mineral element: Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms; Foliar nutrition and root feeding-significance; Imbibition, Field capacity, permanent wilting point and available soil moisture; Hydroponics, Aeroponics and sand culture; Ascent of sap- theories and mechanisms; Apoplast, symplast and transmembrane, Soil - Plant -Atmospheric continuum., Definition of Cavitation and embolism; Overview of plant cell-organelle and their functions; Brief outlines of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.), Difference between chlorophyll a and chlorophyll b, Structure of Chlorophyll a and Chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I & II; Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy, Source of O₂ during photosynthesis: Hill reaction, Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to C₃, C₄ and CAM pathways: Calvin Cycle, Hatch & Slack Cycle, CAM Cycle, Significance of these pathways (concept of photorespiration, absence of photorespiration in C₄ plant: Productivity of C₄ plant, CAM: an adaptive mechanism), Factors affecting photosynthesis (light, temperature, CO₂, O₂ etc); Outline of the process of respiration: Definition and importance, Glycolysis, Krebs Cycle and ETC, Factors affecting respiration (O₂, temperature, CO₂ etc.); Terminologies/ Definitions: Growth,

Development and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR etc. Short discussion on factors affecting growth and development; Photoperiodism: Classical works of Garner and Allard. Photoperiodic Classification of plants: Short Day plant, Long Day plant, Day Neutral plant etc. Introduction to Photoperiodic induction Site of photo-inductive perception, Role of Phytochrome; Introduction to Vernalization (Meaning, De-vernalization etc.), Classification. Abscission. Physiological and biochemical changes during senescence, Abscission and its significance, Concept of stay green, Hormonal regulation of senescence; Terminologies / Definitions: Plant hormone, Plant growth regulators (PGR), Plant growth inhibitor. Recognized classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene and Absciscic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2,4-D, GAs, Kinetin etc).

PRACTICAL

Study on structure and distribution of stomata; Demonstration of imbibition, osmosis, plasmolysis, estimation of water potential, relative water content; Tissue test for mineral nutrients, identification of nutrient deficiency and toxicity symptoms in plant; Identification of nutrients by hydroponics; Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration; Plant growth analysis; Study on senescence and abscission, hormonal regulation of senescence; Demonstration of the effects of different PGRs on plants; Leaf anatomy of C₃ and C₄ plants.

TEACHING SCHEDULE

THEORY [PP-351]

Lecture No.	Topic	Sub-topics / Key points	Weightage (%)
1	Introduction to Plant Physiology and Crop Physiology	Definition, its importance in Agriculture, Relationship of Crop Physiology with other Branches of Crop Science.	6
2	Plant Cell	Plant Cell - Structure, Diagram; Overview, Study of Cell organelles and their roles.	5
3 - 4	Plant-Water Relations	Definitions/ Formulae: Diffusion & Osmosis, DPD, Osmotic Pressure, Osmotic Potential, Water Potential, its components; Physiological roles of water to crop plants, Role of osmosis in plants.	5
5 - 6	Absorption of Water	Pathways of movement of water; Mechanism of absorption of water; Concept & Differences between Active and Passive absorption; Water loss by plants, Types of water losses, Factors affecting absorption of water. [Definitions: Imbibition, Field Capacity, Permanent Wilting Point and Available Soil Moisture].	6
7 - 8	Ascent of Sap, Cavitation and Embolism	Definition, Theories of Ascent of sap, Apoplast, Symplast and Transmembrane; Soil - Plant - Atmospheric Continuum, its concept; Definitions: Cavitation and Embolism, Causes of embolism formation.	6
9 - 10	Transpiration	Transpiration- Definitions, Types, Structure of stomata, Physiology of stomata, Mechanism of opening and closing of stomata; Factors affecting transpiration, its Significance; Water use efficiency & Factors affecting W.U.E.; Guttation; Anti-transpirants: Types and Examples.	6
11 - 12	Mineral Nutrients of Plants	Classification of Mineral Elements, Criteria of Essentiality; General and specific roles of mineral elements and deficiency symptoms; Correction measures for nutrient deficiency symptoms; Passive & Active transport of mineral elements; Foliar nutrition and root feeding, their significance.	6
13	Hydroponics	Definition, Working principle, Types of Hydroponics, Components, Benefits; Hogland solution its composition.	6
14	Aeroponics	Definition, Working principle, Components, Benefits; Sand culture technique.	

Continued....

15 - 17	Photosynthesis	Definition, Significance; Brief outlines of: Photosynthetic apparatus, Pigment system, Quantum requirement and quantum yield, Ultrastructure of Chloroplast, Examples of different photosynthetic pigments (Chlorophyll, Carotenoids, Phycobilins etc.); Structures of Chlorophylls, Difference between Chlorophyll a and Chlorophyll b; Red drop effect, Emerson enhancement effect.	6
18 - 19		Mechanism of Photosynthesis: <u>Light reaction</u> : Absorption of light energy, Photosystems (PS I and PS II), Photolysis of water, Hill reaction; Electron Transport Chains- Cyclic and Non-cyclic Photophosphorylation and Differences between them; Production of Assimilatory powers.	10
20 - 22		<u>Dark reaction</u> : C ₃ , C ₄ and CAM plants- Introduction; Calvin Cycle, Hatch & Slack Cycle, CAM Cycle; Significance of these pathways (Concept of Photorespiration, Absence of photorespiration in C ₄ plant: Productivity of C ₄ plant; CAM: an adaptive mechanism); Factors affecting Photosynthesis.	
23 - 24	Respiration	Definition, Importance, Types of Respiration, Respiratory substrates, Respiratory quotient; Outline, Mechanism of respiration; Glycolysis, its significance.	12
25 - 26		Kreb's cycle and Electron transport chain; Factors affecting Respiration.	
27	Plant Growth	Terminologies/Definitions, Types of growth, Phases of growth, Measurement of Plant growth (fresh weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR; Definitions- Differentiation & Re-differentiation; Factors affecting on plant growth & development (in short).	6
28 - 29	Plant Hormones/ Plant Growth Regulators	Terminologies/Definitions: Plant hormone, Plant growth regulators (PGR); Plant growth inhibitor; Recognized Classes of PGRs (Auxins, Gibberellins, Cytokinins, Ethylene and Absciscic acid), Sites of biosynthesis, and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2,4-D, GAs, Kinetin etc.)	10

Continued...

PP-351 ...

30 - 31	Photoperiodism	Classical works of Garner & Allard; Definition, Types, Classification- SDP, LDP and Day neutral plants- Phytochrome, its role, Photoperiodic induction, Perception of photoperiodic stimulus; Vernalization and De-vernalization Definition, its types; Advantages of vernalization.	5
32	Senescence and Abscission	Definitions, Physiological and Biochemical changes during Senescence; Hormonal regulation of senescence, Significance of Abscission; Concept of Stay green.	5
Total =			100

TEACHING SCHEDULE

PRACTICAL [PP-351]

Exercise No.	Exercise Title
1	Study of structure of stomata: Estimation of stomatal index and stomatal frequency.
2	Demonstration of imbibition of water by different types of seeds.
3	Study of osmosis: i. Study of process of osmosis in a simple osmometer, ii. Study of process of osmosis by potato osmoscope, iii. Demonstration of endosmosis and exosmosis.
4	Study of plasmolysis.
5	Measurement of water potential in plants.
6	Estimation of relative leaf water content of tissue.
7	i. Rapid tissue tests for macro-elements and micro-elements, ii. Identification of NPK deficiency by hydroponics.
8	Measurement of rate of photosynthesis by dry weight methods.
9 - 10	Measurement of rate of transpiration- i. Demonstration of transpiration by Bell jar method, ii. Measurement of rate of transpiration by Potometric method, iii. Measurement of rate of transpiration by Cobalt chloride method.
11	Study of separation of photosynthetic pigment through Paper chromatography.
12 - 13	Measurement of rate of respiration- i. Demonstration of CO ₂ releases during respiration, ii. Measurement of CO ₂ produced during root respiration, iii. Measurement of rate of respiration by Ganong's respirometer.

Continued...

14	Measurement of plant growth by Arc auxanometer.
15	Demonstration of the effects of PGRs on plants: ii. Effect of Ethylene on fruit ripening, iii. Effect of Kinetin on leaf senescence, iv. Effect of Gibberellins on growth, v. Effect of Absciscic acid /Coumarin on germination.
16	Study of leaf anatomy of C ₃ and C ₄ plants.

Suggested Readings [PP-351]:

Sr. No.	Name of Book	Authors
1	Plant Physiology	M. Devlin and Francis H. Witham
2	Plant Physiology	Lincoln Taiz and Eduardo Zeiger
3	Plant Physiology	Frank B. Salisbury and Cleon W. Ross
4	Fundamentals of Plant Physiology	Lincoln Taiz, Eduardo Zeiger, Ian Max Mølle and Angus Murphy
5	Devlin's Exercises in Plant Physiology	Robert Devlin, Francis H. Witham and David F. Blaydes
6	A Text Book - Plant Physiology*	Dr. V. Verma
7	Plant Physiology*	S. N. Pandey and B. K. Sinha
8	Practical Plant Physiology* 1967	Amar Singh
9	Plant Physiology* 2005	C. P. Malik
10	Plant Physiology@	K. N. Dhumal, T. N. More and M. R. Munnali
11	Plant Physiology@	H. S. Shrivastava
12	Crop Physiology*	C. N. Chore, S. R. Ghadekar and R. K. Patil
13	Plant Physiology@ 2005	S. Mukharji and A. K. Ghosh
14	Plant Physiology*2010	Taiz and Zeiger, E.
15	Introductory Plant Physiology* 2013	G. Roy Noggle and George Friz
16	A Text Book Plant Physiology* 2005	C. P. Malik and A. K. Srivastava
17	Plant Physiology@1993	S. Chandra Datta
18	Experiment in Plant Physiology – A Laboratory Manual* 1998	Dayan and Bajracharya
19	Plant Physiology – Fundamentals & Applications@ 2005	Arvindkumar and S. S. Purohit
20	Modern Plant Physiology@ 2007	R. K. Sinha
21	Physiology of Crop Plants (2 nd edn.)	Franklin P. Gardner, R. Brent Pearce and Roger L. Mitchell

* Textbooks; @ Reference Books

Semester : V	
Course No. : AMT-351	Credit Hrs. : 2(1+1)
Course Title : Introduction to Agrometeorology	

SYLLABUS

- Objectives :**
- (i) To introduce the students to the concept of weather and climate and underlying physical processes occurring in relation to plant and atmosphere,
 - (ii) To impart the theoretical and practical knowledge of instruments/equipment used for measurement of different weather variables in an Agrometeorological Observatory,
 - (iii) To study the meteorological aspects of climate change in Agriculture and allied activities.

THEORY

Meaning and Scope of Agricultural Meteorology; Earth atmosphere: its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Application of Thermal time concept and Crop/ Pest weather calendar; Energy balance of earth; Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon-mechanism and importance in Indian agriculture; Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and National Agriculture.

PRACTICAL

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording, Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law, Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS; Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, Measurement of soil temperature and computation of soil heat flux, Determination of vapor pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of windrose, Measurement, tabulation and analysis of rain, Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET, Use of synoptic charts, Weather reports, Weather forecasting- types and methods, Crop weather calendar.

TEACHING SCHEDULE

THEORY [AMT-351]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Introduction to Agricultural Meteorology and Earth's Atmosphere	Meaning, Definition, Scope and Importance of Meteorology and Agricultural Meteorology; Composition of atmosphere; Extent of atmosphere; Vertical structure of atmosphere – Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere; importance of atmosphere.	8
2	Atmospheric Weather Variables	Definitions and Concepts of Weather and Climate; Differences between Weather and Climate; Weather elements – temperature, rainfall, humidity, wind, sunshine, evaporation, cloudiness.	5
3	Atmospheric Pressure	Definition and Concept of atmospheric pressure; Units of pressure; Horizontal and vertical variation of pressure; Pressure gradient; Isobars; Measurement of atmospheric pressure	6
4	Wind System	Definition and Causes of wind; Forces responsible for production of wind, Pressure gradient force; Coriolis force; Centrifugal force; Types of winds – planetary, seasonal, local and variable winds (land breeze and sea breeze); Daily and seasonal variation in wind speed; Cyclone and anticyclone; Land breeze and sea breeze; Importance of wind in Agriculture	8
5	Solar Radiation	Nature and Properties of solar radiation; Electromagnetic spectrum; Solar constant; Depletion and scattering of solar radiation; Absorption and reflection; shortwave and longwave radiation; Terrestrial radiation; Thermal radiation; Net radiation; Albedo; Radiation Use Efficiency (RUE); Importance in crop growth.	7
6	Atmospheric Temperature	Definitions and Measurement of temperature; Heat transfer processes; Lapse rate; Environmental lapse rate; Temperature inversion; Daily and seasonal variation of temperature; Vertical profile of temperature; isotherms; Effect of temperature on crop growth	7

Continued...

7	Thermal Time and Crop Weather Relations	Thermal time concept; Cardinal points; Heat units Growing Degree Days (GDD); Helio thermal units; Photothermal units; Crop weather calendar; Pest and disease calendar.	7
8	Energy Balance	Components of Earth's energy balance; Incoming and outgoing radiation; Latent heat flux; Sensible heat flux; Soil heat flux; Importance in Agriculture.	6
9	Atmospheric Humidity and Condensation	Definitions and Measures of Humidity – Absolute humidity, Relative humidity, Specific humidity and Mixing ratio; Saturation and Vapour pressure; Condensation process; Dew point; Formation of dew, Types of condensation- fog, mist, frost and cloud; Significance in Agriculture.	4
10	Precipitation and Clouds	Definitions and Forms of Precipitation; Precipitation mechanisms- Bergeron process and Collision-coalescence process; Types of Precipitation- rain, drizzle, snow, sleet and hail; Cloud formation; Cloud classification based on height and appearance; Isoneph, Isohyet.	7
11	Artificial Rainmaking and Monsoon	Artificial rainmaking and Cloud seeding; Warm cloud and Cold cloud seeding; Indian Monsoon mechanism; Southwest and Northeast monsoon; Onset and withdrawal of monsoon; Importance of Monsoon in Indian Agriculture.	6
12	Weather Hazards	Drought – Types and Mitigation; Classification of droughts; Floods and flood management; Frost and frost protection; Tropical cyclones; Heat-wave and cold-wave; Impact of extreme weather on crops and livestock; Weather disaster preparedness.	7
13	Agriculture and Weather Relations	Relationship between weather and crop growth; Influence of weather on sowing, germination, flowering, pollination and harvesting; Weather and livestock production.	7
14	Crop Microclimate Modification	Concept of Microclimate; Factors affecting microclimate; Modification through mulching, shelterbelts, irrigation, windbreaks, spacing and intercropping.	5

Continued...

15	Climatic Normals and Weather Forecasting	Climatic Normals and Agro-climatic zones; Climatic requirements of major crops and livestock. Definition and Importance of Weather Forecasting; Types of weather forecasting- short-range, medium-range and long-range forecasts; Use of weather forecasting; Agrometeorological Advisories.	5
16	Climate Change and Global Warming	Climate change and Climatic variability; Greenhouse effect; Global warming; Greenhouse gases; Causes of climate change; its impact on regional and national Agriculture; Adaptation and Mitigation strategies.	5
Total =			100

TEACHING SCHEDULE

PRACTICAL [AMT-351]

Exercise No.	Exercise Title
1	Visit of Agrometeorological Observatory.
2	Site selection of Observatory; Exposure of instruments and weather data recording.
3	Measurement of total, shortwave and longwave radiation and its estimation using Planck's intensity law.
4 - 5	Measurement of albedo and sunshine duration; Computation of Radiation Intensity using BSS.
6	Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis.
7	Measurement of soil temperature and computation of soil heat flux.
8	Determination of vapor pressure and relative humidity.
9	Determination of dew point temperature.
10	Measurement of atmospheric pressure and analysis of atmospheric conditions.
11	Measurement of wind speed and wind direction; preparation of Windrose.
12	Measurement, tabulation and analysis of rain.
13	Measurement of open pan evaporation and evapotranspiration.
14	Computation of PET and AET; Use of synoptic charts, weather reports.
15	Study of Weather forecasting- types, methods and tools of weather forecasting.
16	Study of Crop weather calendar.

Suggested Readings [AMT-351]:

1. Agricultural Meteorology- G.S.L.H.V. Prasad Rao, Kerala Agricultural University Publications.
2. Text book of Agricultural Meteorology – M.C. Varshneya and P. Balkrishna Pillai.
3. Introduction to Agrometeorology- H.S. Mavi.
4. Our Atmosphere – Smita Bhutani.
5. Atmosphere, Weather and Climate – Barry R.G. and Charley R.J. The English Language Book Society and Mathuen and Co. Ltd., Sultolk.
6. Climate, Weather and Crops in India – D. Lenka.
7. Meteorology – S.R. Ghadekar.
8. Fundamentals of Agrometeorology and Climate Change – G.S. Mahi and P.K. Kingra.
9. Introduction to Agrometeorology and Climate Change – Alok Kumar Patra.

Semester	: V	
Course No.	: HORT-354	Credit Hrs. : 2(1+1)
Course Title	: Ornamental Crops, MAPs and Landscaping	

SYLLABUS

- Objectives** :
- (i) To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs,
 - (ii) To educate about concept, designing principles and components of landscaping,
 - (iii) To educate about the physiological disorders of commercial flowers,
 - (iv) To educate about the post-harvest management and value addition in flower crops and MAP.

THEORY

Importance and scope of ornamental, medicinal and aromatic crops and landscaping. Production technology of important cut flowers like Rose, Gerbera, Carnation, Lilium and Orchids under protected conditions; and Gladiolus and Tuberose under open conditions. Package of practices for loose flowers like Chrysanthemum, Marigold and Jasmine under open conditions. Production technology of important medicinal plants like, Ashwagandha, Costus, Isabgol and Geranium. Production technology of Mint, Aloe and Ocimum, Coleus, Glory lily, Periwinkle etc. Production technology of plants like Lemongrass, Citronella, Palmarosa and Vetiver. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, Flower arrangement, Herbaceous Border, Hedge, Edge etc.; Processing and value addition of important ornamental crops. Processing and value addition of MAPs produce.

PRACTICAL

Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants). Propagation of MAPs, Bed preparation and planting of MAPs. Nursery bed preparation and sowing of seasonal flower seeds; Propagation of ornamental plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of Bougainvillea; Planting of Gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden.

TEACHING SCHEDULE

THEORY [HORT-354]

Lecture No.	Topics with Sub-topics/ Key points		Weightage (%)
1	Importance, Scope and Present Status of ~	Ornamental plants; Medicinal and Aromatic crops and Landscaping	10
Production Technology of following important Ornamental Plants; Medicinal and Aromatic Crops: [Origin and distribution, Botanical description, Climatic and Soil requirements, Improved varieties/hybrids, Propagation techniques, Nursery and Protected cultivation practices, Planting and Crop establishment, Nutrient, Water and Weed management, Training and pruning, Plant protection measures, Physiological disorders, Harvesting, Post-harvest management, Value addition, Quality standards, Economics of cultivation and Other recommended package of practices relevant to individual crops.]			
Important Cut Flowers under Protected Conditions ~			
2	Rose		5
4	Gerbera and Carnation		10
5	Lilium and Orchids		5
Important Cut & Loose Flowers under Open Conditions ~			
6	Gladiolus and Tuberose		10
7	Chrysanthemum		5
8	Marigold and Jasmine		10
Important Medicinal and Aromatic Plants (MAPs) ~			
9	Ashwagandha, Costus, Isabgol and Geranium.		10
10	Mint, Aloe, Ocimum, Coleus, Glory Lily and Periwinkle.		5
11	Lemongrass, Citronella, Palmarosa and Vetiver.		10
12	Principles of Landscaping	Elements and Principles of Landscaping: (design, balance, unity, rhythm, variety, proportion, focalization, functionality etc.)	10
13	Landscape Uses of Trees, Shrubs and Climbers	Selection and placement of plant materials; Functional and aesthetic uses of trees; Ornamental and utility value of shrubs in gardens and parks; Uses of climbers and creepers in landscaping.	

Continued...

HORT-354...

14	Home-Landscaping & Other Components	Brief Concept of Home-Landscaping; Carpet bedding, Topiary, Bonsai, Lawn, Flower arrangement, Herbaceous Border, Hedge, Edge etc.	5
15	Processing and Value Addition in ~	Important Ornamental crops- like, Dry flowers, Garlands, Bouquets, Floral crafts, Packaging, Storage and Marketing.	5
16		Important MAPs produce: like, Primary processing, Drying, Distillation, Extraction, Quality standards, Value-added products and Marketing.	
Total =			100

TEACHING SCHEDULE**PRACTICAL [HORT-354]**

Exercise No.	Exercise Title
1	Identification of medicinal and aromatic plants (MAPs).
2	Identification of ornamental plants - (trees, shrubs, climbers, seasonal flower and house plants).
3	To study the propagation of medicinal and aromatic plants.
4	Bed preparation and planting of MAPs.
5	Nursery bed preparation and sowing of seasonal flower seeds.
6	To study the propagation of ornamental plants by terminal/ herbaceous cuttings.
7	To study the propagation of Anthurium.
8	To study the propagation of Orchids.
9	To study the propagation of Bougainvillea.
10	Planting of Gerbera suckers.
11	Planting of Gladiolus corms.
12	Establishment and maintenance of lawn.
13	Preparation of flower preservatives and their use in extending the vase life of cut flowers.
14	Training and pruning of ornamental plants.
15	Raising of hedge and edge.
16	Planning and layout of Garden.

Suggested Readings [HORT-354]:

Sr. No.	Title of Book	Author(s)
1.	Floriculture in India	G.S. Randhawa and Mukhopadhyay
2.	Floriculture and Landscaping	T.K. Bose
3.	Introduction to Spices, Plantation crops, Medicinal and Aromatic Plants	N. Kumar, Abdul Khadder, P. Rangaswamy, I. Irulappam
4.	Textbook of Floriculture and Landscaping.	Anil K. Singh and Anjana Sisodia
5.	Commercial Flowers (Vol. 1 and 2)	T.K. Bose
6.	Fundamentals of Floriculture	Laury
7.	Complete Home Gardening	Dey, S.C.
8.	Landscape Gardening & Design with Plants	Supriya Kumar Bhattacharjee
9.	Landscaping Principles and Practices	Jack E. Ingels

Semester	: V	
Course No.	: PATH-352	Credit Hrs. : 3(2+1)
Course Title	: Diseases of Field and Horticultural Crops and their Management	

SYLLABUS

Objectives : (i) To study the symptoms produced on the host,
(ii) To study the etiology of the diseases,
(iii) To know about the disease cycle of the pathogens during pathogenesis,
(iv) To study the epidemiological factors responsible for disease development,
(v) To study the management techniques for curbing the major diseases of field and horticultural crops.

THEORY

Symptoms, Etiology, Disease cycle, Epidemiology and Management of Major Diseases of the following Field and Horticultural crops-

Cereal crops

Rice: Blast, Brown spot, Sheath blight, False smut, Bacterial leaf blight, Bacterial leaf streak, Tungro, Khaira; **Wheat:** Stem rust, Leaf rust, Stripe rust, Loose smut, Karnal bunt, Powdery mildew, *Alternaria* leaf spot; **Maize:** Banded leaf and sheath blight, Southern and Northern blight, Downy mildew, *Turicum* blight; **Sorghum:** Grain smut, Loose smut, Head smut, Grain mold, Anthracnose; **Bajra:** Downy mildew, Ergot; **Finger millet:** Blast, Leaf spot;

Cash crops

Sugarcane: Red rot, Whip smut, Grassy shoot, Wilt, Pokah Boeng, Ratoon stunting; **Cotton:** Root rot, Anthracnose, Vascular wilts, Black arm, Dahiya (Grey mildew), Leaf curl; **Tobacco:** Black shank, Black root rot and Mosaic.

Oilseed crops

Groundnut: Early and late leaf spots, Rust, Wilt; **Soybean:** *Rhizoctonia* blight, Bacterial spot, Seed and seedling rot and Mosaic; **Mustard:** *Sclerotinia* stem rot, *Alternaria* blight, White rust, Downy mildew; **Sunflower:** *Sclerotinia* stem rot, *Alternaria* blight;

Pulse crops

Chickpea: *Ascochyta* blight, Wilt, Grey mold; **Pigeonpea:** *Phytophthora* blight, Wilt, Sterility mosaic; **Pea:** Downy mildew, Powdery mildew, Rust, Wilt; **Black gram and Green gram:** Leaf spot, Web blight, Anthracnose, Yellow mosaic, *Cercospora*.

Fruit crops

Mango: Anthracnose, Malformation, Bacterial blight, Powdery mildew, Die back, *Loranthus*; **Citrus:** Canker, Gummosis, Greening, Citrus Exocortis; **Guava:** *Fusarium* wilt, Anthracnose; **Banana:** Sigatoka, Panama wilt, Bacterial wilt, Bunchy top; **Papaya:** Foot rot, Mosaic, Leaf curl, ring Spot; **Sapota:** *Phytophthora* fruit rot; **Pomegranate:** Bacterial blight, Wilt; **Apple:** Scab, powdery mildew, Fire blight, Crown gall; **Peach:** Leaf curl; **Grapevine:** Downy mildew, Powdery mildew, Anthracnose; **Strawberry:** Leaf spot.

Vegetable crops

Potato: Early and Late blight, Black scurf, Leaf roll, Mosaic; **Tomato:** *Fusarium* wilt, Early and Late blight, Leaf curl, Mosaic, Damping off; **Brinjal:** *Phomopsis* blight and Fruit rot, *Sclerotinia* blight, Bacterial wilt; **Chilli:** Anthracnose and Fruit rot, Wilt and Leaf curl; **Cucurbits:** Powdery and Downy mildew, Wilts; **Cruciferous vegetables:** *Alternaria* leaf spot, Black rot, Cauliflower mosaic; **Beans:** Anthracnose bacterial blight; **Okra:** Yellow vein mosaic; **Onion:** Purple blotch, Downy mildew, Smudge, *Stemphylium* blight, Smut; **Colocasia:** *Phytophthora* blight; **Watermelon:** Bud necrosis;

Plantation and Spice crops

Coconut: Bud rot, *Ganoderma* wilt; **Arecanut:** Koleroga; **Tea:** Blister blight; **Coffee:** Rust; **Ginger:** Soft rot; **Turmeric:** *Taphrina* leaf spot; **Coriander:** Stem gall; **Black pepper:** Foot rot.

Flower crops

Rose: Dieback, Powdery mildew, Black leaf spot; **Marigold:** *Alternaria* blight, Botrytis blight, Leaf spots.

PRACTICAL

- ❖ To study the symptoms of different diseases of field and horticultural crops: Blast and Brown spot of rice, Sheath blight and Bacterial leaf blight of rice, Downy mildew and Powdery of Cucurbits, *Rhizoctonia* and *Cercospora* leaf spot of Green gram / Black gram, *Alternaria* blight and Downy mildew of Mustard, Early blight and Late blight of Potato and Tomato, *Phomopsis* blight of Brinjal, Powdery mildew and rust of Pea, Stem Gall of Coriander, Anthracnose and Fruit rot of Chilli, *Taphrina* leaf spot of Turmeric, Red rot of Sugarcane.
- ❖ Acquaintance with Fungicides, Antibiotics and Biopesticides and their use in management of diseases of horticultural crops.
- ❖ Identification and histopathological studies of selected diseases of field and horticultural crops covered in Theory.
- ❖ Field visits for the Diagnosis of field problems, Collection and Preservation of plant diseased specimens for Herbarium preparation.
- ❖ Students should submit atleast 50 pressed and well-mounted specimens of above-mentioned plant diseases.

TEACHING SCHEDULE

THEORY [PATH-352]

Lecture No.	Topics with Sub-topics/ Key Points	Weightage (%)
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Cereal crops:		
1	Rice: Blast, Brown spot, Sheath blight, False smut, Bacterial leaf blight, Tungro, Khaira, Bacterial leaf streak.	5
2	Wheat: Stem rust, Leaf rust, Stripe rust, Loose smut, Karnal bunt, Powdery mildew, <i>Alternaria</i> leaf spot.	5
3 - 4	Maize: Banded leaf and sheath blight, Southern and Northern blight Downy mildew, <i>Turcicum</i> blight; Bajra: Downy mildew, Ergot.	4
5	Sorghum: Grain smut, Loose smut, Head smut, Grain mold, Anthracnose; Finger millet: Blast, Leaf spot.	3
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Cash crops:		
6	Sugarcane: Red rot, Whip smut, Grassy shoot, Wilt, Pokah Boeng, Ratoon stunting.	10
7	Cotton: Anthracnose, Vascular wilts, Black arm, Root rot, Dahiya (Grey mildew), Leaf curl.	
8	Tobacco: Black shank, Black root rot mosaic.	
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Oilseed crops:		
9	Groundnut: Early and Late leaf spots, Rust, Wilt.	6
10	Soybean: <i>Rhizoctonia</i> blight, Bacterial spot, Seed and seedling rot, Mosaic.	
11	Sunflower: <i>Sclerotinia</i> stem rot, <i>Alternaria</i> blight	
	Mustard: <i>Sclerotinia</i> stem rot, <i>Alternaria</i> blight, White rust, Downy mildew.	
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Pulses:		
12	Chick pea: <i>Ascochyta</i> blight, Wilt, Grey mold.	6
13	Pigeon pea: <i>Phytophthora</i> blight, Wilt and Sterility mosaic	
14 - 15	Pea: Downy mildew, Powdery mildew, Rust, Wilt.	
	Black gram and Green gram: Leaf spot, Web blight, Anthracnose, Yellow mosaic, <i>Cercospora</i> .	

Continued...

Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Fruit crops:		
16	Mango: Anthracnose, Malformation, Bacterial blight, Powdery mildew, Die back, <i>Loranthus</i> .	4
17	Citrus: Canker, Gummosis, Citrus greening, Citrus Exocortis;	5
18	Banana: Sigatoka, Panama wilt, Bacterial wilt, Bunchy top	5
19	Papaya: Foot rot, Mosaic, Leaf curl, Ring spot; Pomegranate: Bacterial blight, Wilt.	4
20	Apple: Scab, Powdery mildew, Fire blight, Crown gall; Peach: Leaf curl; Strawberry: Leaf spot.	4
21	Grapevine: Downy mildew, Powdery mildew, Anthracnose; Guava: <i>Fusarium</i> wilt, Anthracnose; Sapota: <i>Phytophthora</i> fruit rot.	4
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Vegetable crops:		
22 - 23	Potato: Early and late blight, Black scurf, Leaf roll, Mosaic	4
	Tomato: Damping off, <i>Fusarium</i> wilt, Early and Late blight, Leaf curl, Mosaic.	4
24 - 25	Brinjal: <i>Phomopsis</i> blight and fruit rot, <i>Sclerotinia</i> blight, Bacterial wilt	8
	Chilli: Anthracnose and Fruit rot, Wilt, Leaf curl;	
	Okra: Yellow vein mosaic	
26	Cucurbits: Powdery and Downy mildews and Wilts	4
27	Cruciferous vegetables: <i>Alternaria</i> leaf spot, Black rot, Cauliflower mosaic.	4
28	Beans: Anthracnose, Bacterial blight	3
	Onion: Purple blotch, Downy mildew, Smudge, <i>Stemphylium</i> blight, Smut	
	Colocasia: <i>Phytophthora</i> blight.	
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Plantation and Spice crops:		
29 - 31	Coconut: Bud rot, <i>Ganoderma</i> wilt; Arecanut: Koleroga; Tea: Blister blight; Coffee: Rust.	5
	Coriander: Stem gall; Turmeric: <i>Taphrina</i> leaf spot; Ginger: Soft rot; Black paper: Foot rot.	
Symptoms, Etiology, Disease cycle and Epidemiology and Management of Major Diseases of following Flower crops:		
32	Rose: Die back, Powdery mildew and Black leaf spot; Marigold: <i>Alternaria</i> blight, Botrytis blight, Leaf spots.	3
Total =		100

TEACHING SCHEDULE

PRACTICAL [PATH-352]

Exercise No.	Exercise Title
To study the symptoms of different diseases of field and horticultural crops:	
1	Blast and Brown spot of rice, Sheath blight and Bacterial leaf blight of rice.
2	Downy mildew and Powdery mildew of cucurbits; <i>Alternaria</i> blight and Downy mildew of mustard.
3	<i>Rhizoctonia</i> and <i>Cercospora</i> leaf spot of green gram/ black gram; Red rot of sugarcane.
4	Early blight and Late blight of potato and tomato: <i>Phomopsis</i> blight of brinjal.
5	Powdery mildew and Rust of pea; Stem gall of coriander; Anthracnose and Fruit rot of chilli; <i>Taphrina</i> leaf spot of turmeric.
6 - 7	Acquaintance with Fungicides, Antibiotics and Biopesticides and their use in management of diseases of field and horticultural crops.
Identification and Histopathological studies of selected diseases of field and horticultural crops covered under Theory Teaching Schedule:	
8 - 13	Blast and Brown spot of rice, Sheath blight and Bacterial leaf blight of rice, Downy mildew and Powdery mildew of cucurbits, <i>Alternaria</i> blight and Downy mildew of mustard, <i>Rhizoctonia</i> and <i>Cercospora</i> leaf spot of green gram / black gram, Red rot of sugarcane, Early blight and Late blight of potato and tomato, <i>Phomopsis</i> blight of brinjal, Powdery mildew and Rust of pea, Stem Gall of coriander, Anthracnose and Fruit rot of chilli, <i>Taphrina</i> leaf spot of turmeric.
14 - 16	Field Visits for the Diagnosis of Field problems, Collection and Preservation of Plant Diseased Specimens for Herbarium preparation.

Suggested Readings [PATH-352]:

1. Plant Diseases by: R.S. Singh.
2. Plant Disease Management: Principles and Practices by: Hriday Chaube.
3. Integrated Plant Disease Management by: R.C. Sharma.
4. Plant Pathology by: G.N. Agrios, 2010.

Semester	: V	
Course No.	: ENTO-352	Credit Hrs. : 3(2+1)
Course Title	: Pest Management in Crops and Stored Grains	

SYLLABUS

Objective : Diagnosis and Management of major insect and non-insect pests of crops in field and storage.

THEORY

General description on Nature and Type of damage by different Arthropod pests; Scientific name, Order, Family, Host range, Distribution, Biology and Bionomics; Nature of damage and Management of major insect pests of various field crops, vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments. Structural Entomology and important household pests, their nature of damage and management. Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management. Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non-insect pest of mites, snails and slugs, Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management.

PRACTICAL

Field visit, identification of major insect pests and their damage symptoms. Collection and preservation of major insect pests; Collection of damage samples, their identification and herbarium preparation. Methods of monitoring of pest incidence *in-situ*. Management strategies of insect pests of different crops. Study on structural Entomology and household pests. Storage structures and methods of grain storage. Spraying techniques for selected field and horticultural crops. Vertebrate pest management. Mass multiplication of NPV and entomopathogenic nematodes.

TEACHING SCHEDULE

THEORY [ENTO-352]

Lecture No.	Topic with Sub-topics/ Key Points	Weightage (%)
General description on Scientific name, Order, Family, Host range, Distribution, Biology and Bionomics, Nature and type of damage and Management of following Crop-Insect Pests:		
Cereals:		10
1	Rice: Paddy stem borer, Green leaf hopper, Brown plant hopper, White backed plant hopper, Gall midge, Paddy grasshopper, Blue beetle, Caseworm, Armyworm, Gundhi bug, Hispa, Leaf folder	
2	Sorghum: Shoot fly, Stem borer, Aphids, Delphacids, Grasshopper, Earhead midge, Earhead caterpillars, Fall armyworm	
3	Maize: Shoot fly, Stem borer, Fall Armyworm, Cob earworm	
	Bajra: Shoot fly, Blister beetle, Armyworm	
	Wheat: Stem borer, Aphids, Termites	
	Minor millets: Shoot fly and Armyworm	
Pulses:		5
4	Pigeon pea: Pod borer, Plume moth, Pod fly, Spotted pod borer, Leaf webber, Mites	
	Chickpea: Gram pod borer, Aphids, Cutworm, Wireworm	
	Mung and Urdbean: Aphids, Leaf eating caterpillar, Semilooper, Pod borer, Spotted pod borer	
	Cowpea and Pea: Aphids, Blue butterfly, Pod borer	
Oilseeds:		10
5	Groundnut: Leaf miner, Hairy caterpillar, Tobacco leaf eating caterpillar, Aphids, Thrips, White grub, Pod sucking bug	
6	Castor: Semilooper, Capsule borer, Jassids, Tobacco leaf eating Caterpillar	
	Sunflower: Capitulum borer, Hairy caterpillar, Jassids, Thrips, White fly, Stem borer	
7	Safflower: Aphids, Capitulum borer, Guzia weevil	
	Mustard: Aphids, Sawfly, Leaf webber	
	Linseed: Gallfly, Aphids, Thrips	
8	Soybean: Stem fly, Girdle beetle, Leaf miner, Leaf eating caterpillar, Jassids, White fly, Semilooper	
	Sesamum: Til hawk moth, Gallfly, Leaf eating caterpillar	
	Niger: Semilooper, Gram pod borer	

Continued...

Fiber crops:		
9 - 10	Cotton: Aphids, Jassids, Thrips, White fly, Mealy bugs, Spotted bollworm, American bollworm, Pink bollworm, Tobacco leaf eating caterpillar, Leaf folder, Semilooper, Red cotton bug, Dusky Cotton bug, Mites	5
	Sun hemp and Mesta: Sun hemp hairy caterpillar	
Sugar crops:		
11	Sugarcane: Early shoot borer, Internode borer, Top shoot borer, White fly, Pyrilla, Woolly aphids, Mealy bug, Scale insect, Termites, White grub	5
Vegetable crops:		
12	Brinjal: Brinjal shoot and fruit borer, Jassids/leafhopper, Aphids, White fly, Red Spider Mites, Hadda beetle, Ash weevil. Okra: Shoot and Fruit borer, Leaf hoppers, Aphids, White fly, Leaf Roller, Red Spider Mite, <i>Helicoverpa</i> , Flea beetle, Leaf miner	15
13	Tomato: Fruit borer, Leaf miner- <i>Liriomyza</i> and <i>Tuta absoluta</i> , Aphids, Thrips, White Fly, Mites Chilli: Thrips, White fly, Aphids, Fruit borer (<i>Helicoverpa</i>), Yellow Mites	
14	Potato: Potato tuber moth, Cutworm, Aphids, Thrips, Mites, Jassids Sweet potato: Sweet potato weevil, Sweet potato leaf eating caterpillar/ Sphinx caterpillar	
15	Cruciferous crops (Cauliflower, Cabbage, Broccoli and Knol kol): Diamond back moth, Aphids, Painted bug, Cabbage butterfly, Leaf eating caterpillar, Flea beetle, Head borer and Mustard saw fly	
16	Cucurbitaceous vegetables: Fruit Fly, Aphids, Leaf miner, White fly, Thrips, Pumpkin beetle, Blister beetle Colocasia and Moringa: Leaf eating caterpillar, Webworm, Stem borer, Spodoptera, Aphid, Bud worm	
Fruit crops:		
17	Citrus: Lemon butterfly, White fly, Blackfly, Leaf miner, Fruit sucking moth, (<i>Eudocima fullonica</i> , <i>E. materna</i> L. <i>Achoea janata</i> L.), Citrus psylla, Citrus aphids, Mealy bug, Citrus thrips, Scale insects, Red spider mite	10
18	Mango: Mango stem borer, Mango stone weevil, Mango fruit fly, Mealy bugs, Mango hoppers, Shoot borer, Thrips, Midge fly, Leaf gall	
19	Grapevine: Flea/Udadya beetle, Thrips, Stem Girdler, Mealy bug, Mites	
20	Guava: Fruit fly, Spiralling white fly, Bark eating caterpillar, Fruit Borers – [<i>Conogethes (Dichocrocis) punctiferalis</i> , <i>Deudorix (Virachola) isocrates</i> , <i>Rapala varuna</i>], Green Scale, Mealybug	10
21	Banana: Root stock weevil/ Rhizome weevil, Pseudo stem borer, Aphids, Tingid or Lacewing bug, Leaf eating caterpillar, Skipper Papaya: Papaya mealy bugs, White fly, Green peach aphid, Ash weevils	
22	Sapota: Chiku moth/ Sapota Leaf Webber, Sapota seed borer, Fruit fly, Stem borer, Hairy caterpillar, Leaf folder, Bud borer	

Continued...

23	Coconut: Rhinoceros beetle, Black headed caterpillar, Red palm weevil, Eriophyid mite, Rat, Rugose spiralling White fly Areca nut: Spindle Bug, Inflorescence Caterpillar Cashew nut: Tea mosquito bug, Cashew stem and root borer, Thrips	5
24	Apple: Mites, Codling moth, blotch leaf miner, Apple borer Fig: Jassids, Mites, Stem borer Ber: Ber fruit borer, Ber fruit fly Aonla: Bark Borer, Seed borer	
25	Pomegranate: Anar caterpillar, Fruit sucking moth <i>(Eudocima fullonica, Eudocima materna, Achaea janata L.),</i> Thrips, Shot hole borer, Bark eating caterpillar, Mealy bug, White fly, Aphids Custard apple: Mealy bugs, Fruit fly	
Flower and Ornamental Crops:		
26	Rose, Tuberose, Gerbera, Carnation: Thrips, Mites, White fly, Bud borer, Leaf miner, Aphids, Mealy bugs Ornamental crops: Snail and slugs, Mealy bug, Scale insects	2
Plantation Crops:		
27	Tea: Tea green leaf Hopper, Tea mosquito bug, Mites Coffee: Coffee seed borer, Coffee berry borer	1
Spices and Condiments:		
28	Turmeric and Ginger: Rhizome fly, Shoot borer, Rhizome scale, Leaf roller, Thrips, Onion and Garlic: Thrips, Bulb fly Coriander: Mites, Aphids Curry leaf: Scale insect, Psylla, Lemon butterfly Black pepper: Pollu beetle/Flea beetle, Mealy bugs Betel vine: Mealy bugs, White grub	2
29	Structural Entomology and important household pests, their nature of damage and management; Management of non-insect pest viz., Mites, Snails and Slugs Insect Associated with Human beings: Mosquitoes, House fly, Bed bugs, Cockroaches; Social Insects Associated with Household material: Termites	5

Continued...

30	Factors affecting loss of stored grains ; Stored grain pests: Biology and damage of Primary and Secondary pests Primary store grain pests: Internal feeders - Rice weevil, Lesser grain borer, Pulse beetle and Angoumois grain moth External feeders: Khapra beetle, Indian meal moth Secondary store grain pests: Rust red flour beetle, Saw toothed grain beetle, Long-headed beetle Primary and Secondary store grain pests: Rice moth. Preventive and curative methods of stored grain pests; Storage structures and methods of grain storage and Fundamental Principles of grain store management (<i>in brief</i>); Insect pests, Mites, Rodents, Birds and Microorganisms associated with stored grain and their management.	6
31	IPM: Concept of IPM, Practices, Scope and Limitations of IPM	4
32	Classification of Insecticides, Toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants; Use of Drones and AI in pest management.	5
Total =		100

TEACHING SCHEDULE

PRACTICAL [ENTO-352]

Exercise No.	Exercise Title
1	Field visit, collection of damage samples, their identification and preservation for Herbarium preparation.
Identification of different major insect pests, their damage symptoms and management strategies in following crops:	
2	Pests of Rice and Sorghum.
3	Pests of Maize, Bajra, Wheat and Minor Millets.
4	Pests of Pigeon pea, Chickpea, Mungbean, Urdbean, Cowpea and Pea.
5	Pests of Groundnut, Castor, Sunflower, Safflower, Mustard, Linseed, Soybean, Sesamum and Niger.
6	Pests of Cotton, Sugarcane, Sun hemp and Mesta.
7	Pests of Brinjal, Okra, Tomato, Chilli, Potato, Sweet potato, Major Cruciferous & Cucurbitaceous vegetables, Colocassia and Moringa
8	Pests of Citrus, Mango, Grapevine, Guava and Cashew nut.
9	Pests of Banana, Papaya, Sapota, Coconut and Arecanut.
10	Pests of Apple, Fig, Ber, Aonla, Pomegranate and Custard apple.
11	Pests of Rose, Tuberose, Gerbera, Carnation, Ornamentals, Tea and Coffee.
12	Pests of Turmeric, Ginger, Onion, Garlic, Curry leaf, Black Pepper and Coriander, Betel vine.
13	Methods of monitoring of pest incidence <i>in-situ</i> ; Collection and preservation of major insect pests.
14	Study on Structural Entomology and household pests, storage structures and methods of grain storage.
15	Spraying techniques for selected field and horticultural crops.
16	Mass multiplication of NPV and entomopathogenic nematodes; Vertebrate pest management.

Suggested Readings [ENTO-352]:

1. Atwal, A.S. and Dhaliwal, G.S. (2008). Agricultural Pests of South Asia and their Management. Kalyani Publishers, New Delhi.
2. David, B.V. and Ramamurthy, V.V. (2017). Elements of Economic Entomology (8th ed.). Brillion Publishing, New Delhi.
3. Pedigo, L.P. and Rice, M.E. (2002). Entomology and Pest Management (4th ed.). Prentice Hall, New Delhi.
4. Rao, V.G. (2014). Insect Pest Management. CBS Publishers & Distributors, New Delhi.
5. Khare, B.P. (2000). Stored Grain Pests and their Management (Storage Entomology). Kalyani Publishers, New Delhi.

6. Pradhan, S. (1983). Insect Pests of Crops. National Book Trust, New Delhi.
 7. Awasthi, V.B. (2007). Introduction to General and Applied Entomology. Scientific Publishers, Jodhpur.
 8. Manisekaran, S. and Sunderarajan, S. (2008). Pest Management in Field Crops. Associated Publishing Company, New Delhi.
 9. Srivastava, K.P. and Dhaliwal, G.S. (2017). A Textbook of Applied Entomology (Vol. I & II). Kalyani Publishers, New Delhi.
 10. Dhaliwal, G.S. and Arora, R. (2001). Integrated Pest Management: Concepts and Approaches. Kalyani Publishers, New Delhi.
 11. Thalya, P.R. and Chandra, R. (2022). Essentials of Pest Management: Key Information on Pest Identification and Its Management.
 12. Askary, T.H. (2022). Pest Management: Methods, Applications and Challenges.
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Semester : V	
Course No. : AHDS-353	Credit Hrs. : 2(1+1)
Course Title : Livestock Breeding and Nutrition	

SYLLABUS

- Objectives** :
- (i) Provide basic knowledge to the students about Breeding and Nutritional aspects of livestock rearing,
 - (ii) Entrepreneurship development through livestock production.

THEORY

Origin, History and Concept of Animal Breeding, Basic Population and Quantitative Genetics, Gene: Functions and role in Animal Genetics, Gene actions, Gene and Genotypic frequencies Gene expression and Mutation; Cell and cell division, Oogenesis and Spermatogenesis; Mendelian principles and Hardy-Weinberg law, Factors affecting Hardy-Weinberg law, its application in Animal Breeding, Chromosomes and its abnormalities, Variance; Laws of probabilities and Animal breeding; Variations in economic traits of farm animals, Quantitative and Qualitative traits. Basis of selection, Methods of selection, Effects of Selection, Systems of breeding: Inbreeding, Out-breeding, Breeding Policies/ strategies for cattle, Buffalo, Advance technologies in Animal Breeding viz.; Artificial Insemination Technology, Sex Sorted Semen Technology, *In-vitro* Fertilization Technology, Multiple Embryo Transfer Technology etc.; Classification of feeds and fodders, Important food ingredients (Major Nutrients) and their functions in animal body. Digestive system, digestion and absorption of different nutrients in ruminants and non-ruminants, Feed supplements and feed additives, methods of measuring food values. Feeding standards and their principles, Enrichment of low-quality roughages, Concept of preparation of hay, silage, complete feed block, total mixed ration, Azolla and hydroponic fodder production, Sustainable feeding practices - Efficient use of resources and feed optimization, Circular Bioeconomy- use of by-products and wastes in feeding. Recent advances in Animal Nutrition like pelleting, bypass protein, fat etc.

PRACTICAL

Cell structure, Estimation of gene and genotypic frequency, Estimation of heritability, Estimation of repeatability, Correlation studies, Estimation of Breeding value of cow, Estimation of Regression coefficient, Sire indices, Estimation of genetic gain, Estimation of heterosis, Identification of feeds and fodders, Nutritive value of various feeds and fodders, Characteristics of good ration, Study of nutritive values: Nutritive Ratio (NR), Starch Equivalent (SE), DCP, TDN and GE. Nutrients requirement of different classes of animals. Thumb rule and computation of ration for different livestock, Silage and hay making, Chaffing of fodders, Improving low quality roughages for efficient utilization urea, molasses and salt treatment, Azolla and hydroponic fodder production, Preparation of homemade concentrates, Visit to feed and fodder production unit.

TEACHING SCHEDULE

THEORY [AHDS-353]

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
1	Origin, History and Concept	Origin, History and Concept of Animal Breeding; Basic Population and Quantitative Genetics	8
2	Function and Role in Animal Genetics	Gene: Functions and Role in Animal Genetics, Gene actions, Gene and Genotypic frequencies Gene expression and Mutation	4
3	Cell and Cell Division, Application in Animal Breeding	Cell and Cell division, Oogenesis and Spermatogenesis, Mendelian Principles and Hardy-Weinberg Law, Factors affecting Hardy-Weinberg Law, its application in Animal Breeding, Chromosomes and its abnormalities, Variance	5
4	Laws of Probabilities, Traits in Breeding	Laws of probabilities and Animal Breeding. Variations in economic traits of farm animals, Quantitative and Qualitative traits.	6
5	Selection	Basis of selection, Methods of selection, Effects of selection.	10
6	Systems of Breeding and Breeding Policies	Systems of breeding: Inbreeding, Out-breeding, Breeding Policies/Strategies for Cattle, Buffalo.	4
7	Advance Technologies in Animal Breeding	Advance technologies in Animal Breeding viz. Artificial Insemination Technology, Sex-sorted Semen Technology.	8
8	IVF and ETT	<i>In-vitro</i> Fertilization Technology, Multiple Embryo Transfer Technology etc.	6
9	Classification of Feeds and Fodder	Classification of feeds and fodders, their identification, Examples and Importance	7
10	Food Ingredients and their Functions	Important food ingredients (Major Nutrients) and their functions in animal body.	6
11	Digestive System	Digestive system, Digestion and absorption of different nutrients in ruminants and non-ruminants.	7
12	Feed Supplements & Feed Additives	Feed supplements and feed additives, Method of measuring food values.	6
13	Feeding Standards	Feeding standards and their principles	6
14	Enrichment of Low-quality Roughages	Enrichment of low-quality roughages, Concept of preparation of hay, silage, complete feed block, total mixed ration.	6
15	Azolla and Hydroponic	Azolla and hydroponic fodder production	6
16	Recent Advances in Animal Nutrition	Sustainable feeding practices- Efficient use of resources and feed optimization, Circular Bioeconomy- Use of by-products and wastes in feeding. Recent advances in animal nutrition like- pelleting, bypass protein, fat etc.	5
Total =			100

TEACHING SCHEDULE

PRACTICAL [AHDS-353]

Exercise No.	Exercise Title
1	A) Study and Observation of Cell structure; B) Estimation of gene and genotypic frequency.
2	A) Estimation of Heritability and Repeatability. B) Estimation of Genetic and Phenotypic correlation by Analysis of variance and Co-variance.
3	Estimation of most probable producing ability and breeding value of cow.
4	Study of sire index.
5	Estimation of regression coefficient.
6	A) Estimation of genetic gain; B) Estimation of heterosis.
7	Identification of feeds and fodders.
8	Characteristics of good ration.
9	Study of Nutritive value of various feeds and fodders.
10	Calculation of feed requirement by thumb rule.
11	Nutrient requirement of different classes of animals.
12	Computation of ration for different livestock as per feeding standards.
13	Preparation of hay, silage and chaffing of fodder.
14	Production of Azolla and Hydroponic fodder.
15	Improvement of low-quality roughages; Preparation of homemade concentrates.
16	Visit to Feed and Fodder Production Unit.

Suggested Readings [AHDS-353]:

1. Lasley, J.S. (1978) Genetics of Livestock Improvement, New Delhi, Prentice House of India.
2. Kanakraj, P. (2001) A Textbook of Animal Genetics-I, International Book Distributing Co. Lucknow, India.
3. Jagdish Prasad (1996). Animal Genetics and Breeding Practices, International Book Distribution Co. Lucknow, India.
4. Rice, V.A. and Andrews F.N. (1964). Breeding and Improvement of Farm Animals. 6th edn.
5. Banerjee, G.C. (1998) Feeds and Principles of Animal Nutrition Oxford and IBH Publ., New Delhi.
6. Ranjan, S.K. (1983) Animal Nutrition and Feeding Practices, Kalyani Publ., Ludhiana, New Delhi.
7. Maynard L.A., Loosli J.K., Hintz H.F. and Warner R.C. (1979) Animal Nutrition 7th ed., Tata McGraw-Hill Publishing Co., New Delhi.
8. Reddy, B.V. (2001) Principles of Animal Nutrition and Feed technology oxford and IBH Publ., New Delhi.
9. Mukherjee, D.P. and Banerjee G.C. (1998) Genetics and Breeding of Farm Animals. Oxford IBH Publ. Co., Kolkata.

Semester	:	V
Course No.	:	EDT-351
	Credit Hrs.	: 2(0+2) NG
Course Title	:	Educational Tour

The study / educational tour shall be of 10 to 14 days' duration during the V Semester.

The students shall visit Industries/ Institutions, preferably outside the State, so that, in addition to visiting the Organizations/ Industries (related to the profession); they will also be exposed to the geographical, social, socio-economic and cultural diversity of different places/ states.

After the visit, the students shall submit a 'Report'/ make 'Presentation'.
