Course Curriculum of Third 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, 2025-26 ~

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

Course Layout

B.Sc. (Hons.) Agriculture

Semester: III (New) ***w.e.f.*** **Academic Year: 2025-26**

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark
1.	**AEC-235**	Physical Education, First Aid, Yoga Practices and Meditation	2(0+2)	--
2.	**GPB-231**	Principles of Genetics	3(2+1)	--
3.	**AGRO-232**	Crop Production Technology-I (*Kharif* Crops)	3(1+2)	--
4.	**AGRO-233**	Principles and Practices of Natural Farming	2(1+1)	--
5.	**HORT-232**	Production Technology of Fruit and Plantation Crops	2(1+1)	--
6.	**AE-231**	Farm Machinery and Power	2(1+1)	--
7.	**NEMA-231**	Fundamentals of Nematology	2(1+1)	--
8.	**ECON-231**	Principles of Agricultural Economics and Farm Management	2(2+0)	--
9.	**AHDS-232**	Technology of Milk and Milk Products	2(1+1)	--
10.	**SEC-235**	Skill Enhancement Course-V[#] (*To be offered from the list of SEC Courses*)	2(0+2)	--
11.	**OC-1/ OC-2/…**	Online Course(s)/ MOOCs[†]	As opted by student	**NG**
		Total Credits Hrs.=	**22(10+12)**	**G**

AEC: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **OC**: Online Course, **G**: Gradial, **NG**: Non-gradial

[†] **Note:** It is mandatory for each Student to complete **total 10 credits** (Non-gradial) of **Online Courses** from available resources across III to VIII semesters under the guidance of assigned Faculty/Advisor.

Semester	**: III**		
Course No.	**: AEC-235**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**: Physical Education, First Aid, Yoga Practices and Meditation**		
Gradial Common Course across all UG Degrees			

SYLLABUS

Objectives : (i) To make the students aware about Physical Education, First Aid and Yoga Practices,

(ii) To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general wellbeing through Yoga.

PRACTICAL

Physical Education; Training and Coaching- Meaning and concept; Aerobic and Aerobic exercises; Calisthenics, Weight Training, Circuit Training, Interval Training, Fartlek Training; Effect of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition- Effect of Diet on Performance; Physiological Changes due to ageing and Role of exercise on ageing process; Personality, its dimensions and types, Role of Sports in Personality Development; Motivation and Achievements in Sports; Learning and Theories of Learning; Adolescent Problems and its Management; Posture; Postural Deformities, Exercises for Good Posture.

Yoga: History of Yoga, Types of Yoga, Introduction to Yoga.

- Asanas (Definitions and Importance)- - Padmasan, Gaumukhasan, Bhadrasan, Vajrasan Shashakasan, Pashchimothasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan- left & right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Shawasan.
- Suryanamaskar, Pranayama (Definitions and Importance)- Omkar, Suryabhedan, Chandrabhedan, Anulom, Vilom, Shitali, Shitkari, Bhastrika, Bhramari.
- Meditation (Definitions and Importance)- Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
- Mudras (Definitions and Importance)- Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Prutvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra.
- Role of Yoga in Sports.
- Teaching of Asanas- Demonstration, Practice, Correction and Practice.

History of Sports and Ancient games, Governance of Sports in India; Important Sporting events-Awards in sports, History, Latest rules, Measurement of playfield, Specifications of equipment, Skill, Technique, Style and Coaching of major games (Cricket, Football, Table tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics.

Need and Requirement of First Aid: First Aid techniques, Equipment and Upkeep First Aid techniques; First aid-related with respiratory system; First aid-related with Heart, Blood and Circulation; First Aid-related with wounds and injuries; First Aid-related with Bones, Joints muscles related injuries; First Aid-related with Nervous system and Unconsciousness; First Aid-related with Gastrointestinal Tract, Skin Burns; First Aid-related with Bites and stings, poisoning; First Aid-related with Sense organs; Handling and transport of injured traumatized persons- Sports injuries and their Treatments.

TEACHING SCHEDULE

PRACTICAL [AEC-235]

Exercise No.	Topic	Exercise Title / Sub-topics
1	**Physical Education**	To study the training and coaching- Meaning and concept of Physical Education.
2 - 7	**Methods of Training**	To study the method of training - Aerobic and Aerobic Exercises.
		To study the method of training - Calisthenics
		To study the method of training - Weight Training
		To study the method of training - Circuit Training
		To study the method of training - Interval Training
		To study the method of training - Fartlek Training
8	**Effect of Exercise**	To study the effect of exercise on Muscular, Respiratory, Circulatory and Digestive systems.
9	**Balanced Diet and Nutrition**	To study the Balanced Diet and Nutrition- Effect of diet on performance.
10	**Physiological Changes**	To study the physiological changes due to ageing and role of exercise on ageing process.
11	**Personality Development**	To study the dimensions and types - Role of sports in personality development.

Continued…

12	**Motivation and Achievements in Sports**	To study the Motivation and Achievements in Sports
13	**Learning and Theories of Learning**	To study the Learning and Theories of Learning
14	**Adolescent Problems and its Management**	To study the Adolescent Problems and its Management
15	**Posture**	To study the Postural Deformities, Exercises for Good Posture
16 - 22	**Yoga**	To study the Introduction, History and Types of Yoga
		To study the Asanas: Padmasan, Gaumukhasan, Bhadrasan, Vajrasan Shashakasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan- left leg- right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Shawasan.
		To study the Suryanamaskar, Pranayama, Omkar, Suryabhedan, Chandrabhedan, Anulom, Vilom, Shitali, Shitkari, Bhastrika, Bhramari.
		To study the Meditation, Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
		To study the Mudras: Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Prutvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra.
		To study the Role of Yoga in Sports
		To study the Demonstration, Practice, Correction and Practice of Asanas.
23 - 26	**Sports**	To study the History of Sports and Ancient games
		To study the Governance of Sports in India
		To study the Awards in Sports, History, Latest rules, Measurement of playfield, Specifications of equipment in important sporting events.
		To study the Skill, Technique, Style and Coaching of major games (Cricket, Football, Table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho and Athletics).

Continued...

27 - 32	**First Aid**	To study the Need and Requirement of First Aid-First Aid techniques, Equipment and Upkeep.
		To study the First aid related with Respiratory system, Heart, Blood and Circulation.
		To study the First aid related with Wounds and Injuries, Bones, Joints muscles related injuries.
		To study the First aid related with Nervous system Unconsciousness, Sense organs.
		To study the First aid related with Gastrointestinal Tract, Skin Burns, Bites and Stings, Poisoning.
		To study the Handling and Transport of Injured Traumatized Persons- Sports Injuries and their Treatments.

Semester	**:**	**III**		
Course No.	**:**	**GPB-231**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Principles of Genetics**		

SYLLABUS

Objectives : To acquaint the students with both principles and practices in the areas of Classical Genetics, Modern Genetics, Quantitative Genetics and Cytogenetics.

THEORY

Pre- and post-Mendelian concepts of heredity, Mendelian principles of heredity; Study of model organisms (Drosophila, Arabidopsis, Garden pea, *E. coli* and Mice), Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, Special types of chromosomes, Chromosomal theory of inheritance-Cell cycle and Cell division- mitosis and meiosis. Probability and Chi-square. Types of DNA and RNA, Dominance relationships, Epistatic interactions with examples, Introduction and Definitions of Cytology, Genetics and Cytogenetics and their interrelation. Multiple alleles, Pleiotropism and Pseudoalleles, Sex determination and sex linkage, Sex-limited and sex-influenced traits, Blood group genetics, Linkage and its estimation, Crossing over mechanism, Chromosome mapping, Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics, Mutation, Classification, Methods of inducing mutations, Mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, Multiple factor hypothesis; Cytoplasmic inheritance; Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.

PRACTICAL

Study of microscope, Study of cell structure, Mitosis and Meiosis cell divisions, Experiments on monohybrid, dihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and Chi-square test, Determination of linkage and cross-over analysis (through two-point test cross data), Study on sex-linked inheritance in Drosophila. Study of models on DNA and RNA structures.

TEACHING SCHEDULE

THEORY [GPB-231]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Genetics	History of Genetics, Relation of Genetics with other fields of science, Introduction and Definitions of Cytology, Genetics, Cytogenetics and their interrelation.	4
2	Pre- and Post-Mendelian Concepts of Heredity: Pre-Mendelian Era-(500 BC-1850 AD); Mendelian Era-(1850-1900); Post-Mendelian Era-(1900>)	*Brief Statement/ Concept and Proposers of ~* 1. Pre-formation Theory 2. Theory of Epigenesis 3. Theory of Acquired Characters 4. Theory of Pangenes 5. Germplasm Theory Other significant contributions during pre-Mendelian, Mendelian and post-Mendelian era and advances after 1900; Impact of Genetics and its Application in Agriculture	
3	Mendelian Principles of Heredity	Mendel's Laws of Heredity, Reasons of Mendel's success and deviations or exceptions or anomalies to Mendelism.	4
4	Study of Model Organisms	Drosophila, Arabidopsis, Garden pea, *E. coli* and Mice (in brief)	2
5	Chromosomes Structure, Morphology, Number, Types and Function	Types and Functions of chromosomes; Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction, telomere and Special types of chromosomes	4
6	Chromosomal Theory of Inheritance	Chromosomal theory of inheritance (in short)	
7-8	Cell Division: Mitosis and Meiosis	Ultra structure of Cell, Cell organelles & their functions; Types of Cells; Differences between Animal cell and Plant cell. Stages of Mitosis and Meiosis. Significance of Mitosis and Meiosis, Differences between Mitosis and Meiosis.	4
9	Probability and Chi-square Test	Definitions of Probability and Chi-square test; Application and requirement of Chi-square test.	2
10	DNA and RNA	Structure, Functions and Types of DNA and RNA	6
11-12	Nature and Replication of Genetic Material	Introduction; DNA as a genetic material, Replication of DNA- Dispersive, Conservative, Semi-conservative. Differences between DNA and RNA	

Continued…

13	Dominance Relationships	Different patterns of Dominance relationship like, Complete dominance, Incomplete dominance, Co-dominance, Overdominance and Lethal gene action.	2
14-16	Gene Interaction, Epistatic interactions with Examples and Ratios	Differences and Similarities between Epistasis and Dominance. 1. Recessive epistasis (Supplementary gene action) 2. Dominant epistasis (Simple epistasis) 3. Dominant Inhibitory epistasis (Inhibitory g. a.) 4. Duplicate recessive epistasis (Complementary g. a.) 5. Duplicate dominant epistasis (Duplicate g. a.) 6. Polymeric gene action 7. Typical dihybrid ratio	8
17	Multiple Alleles Pleiotropism, Pseudo-alleles, Blood Group Genetics	Important features of multiple alleles Examples of multiple alleles 1. Fur colour in a rabbit, 2. ABO blood groups in man. Pleiotropism, pseudo-alleles, penetrance and expressivity	4
18	Sex Determination and Sex Linkage, Sex-limited and Sex-influenced traits	Introduction, Importance of Sex determination, Differences between Autosomes and Allosomes. Allosomal sex determination: 1. XX-XY System 2. XX-XO System 3. XO-XX System 4. ZW-ZZ (XY-XX) System Sex-linked characters: (Colour blindness in human being); Differences between Sex-limited and Sex-influenced traits	6
19	Linkage and its Estimation	Introduction, Features of Linkage, Phases of Linkage, Types of Linkage, Linkage and Pleiotropy, Significance of Linkage	4
20	Crossing over Mechanisms	Introduction, Main features of crossing over, Types of crossing over; Molecular mechanism of Crossing over, Factors affecting crossing over, Significance of Crossing over. Interference and Coincidence (Definitions), Differences between Crossing over and Linkage.	4
21	Chromosome Mapping	Definition and Concept of Chromosome Mapping (in brief)	2

Continued…

22	Structural Variation in Chromosome	Introduction, Types of Structural chromosome changes, Genetic effects and Significance	4
23	Numerical Variation in Chromosome	Introduction, Types of numerical chromosome variation; Genetic effects and Significance. Use of haploids, dihaploids and double haploids in Genetics.	4
24-25	Mutation and Mutagens	Introduction, Characteristics of Mutation, Classification of mutation, Kinds of mutation, Methods of inducing mutations; Mutagenic agents with examples; Application in crop improvement.	8
26	Qualitative and Quantitative Traits, Polygenes and Continuous Variation	Introduction, Characteristics of Qualitative and Quantitative traits, Differences between them, Examples of Qualitative and Quantitative traits.	4
27	Multiple Factor Hypothesis	Introduction; Concept of Multiple factor hypothesis by Nilsson-Ehle in Wheat.	4
28	Cytoplasmic Inheritance	Introduction, Characteristics of Cytoplasmic inheritance, Differences between Mendelian inheritance and Cytoplasmic inheritance; Classes of cytoplasmic inheritance, Plastid and mitochondrial inheritance, Significance of Cytoplasmic inheritance in crop improvement.	4
29-30	Protein Synthesis; Transcriptional and Translational Mechanisms of Genetic Material	Introduction, Overview of Protein Synthesis; • Transcription: Definition, Role of RNA polymerase, Stages/ Steps of transcription/ Regulatory mechanism; Types of RNA, Post-transcriptional modifications; • Translation: Definition, Role of Ribosome & transfer tRNA. Stages/ Steps of transcription/ Regulatory mechanism- Process of peptide bond formation; • Genetic code and its properties.	8
31	Gene Concept: Gene Structure, Function and Regulation	Gene structure, Fine structure of gene, Classical and Modern concept of gene, Benzer's concept of Fine structure of gene; Cistron, Recon and Muton	4
32		Introduction, Mechanism of gene regulation- 1. Negative regulation, 2. Positive regulation Emphasis on the Lac Operon Model	4
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL [GPB-231]

Exercise No.	Exercise Title
1	Study of microscope
2	Study of cell structure
3	Preparation of microscopic slides of mitosis - Onion root tips
4	Preparation of microscopic slides of meiosis - Tradescantia/ Onion/ Wheat inflorescence
5	Methods of finding-out the gametes and gametic recombinations
6	Problems on monohybrid ratio and its modifications
7	Problems on dihybrid ratio and its modifications
8	Experiments on test cross and back cross
9	Gene Interaction-I: Gene interaction without modification of F_2 ratio (comb-shape) and Complementary gene interaction.
10	Gene Interaction-II: Gene interaction with modification of F_2 ratio: Supplementary factor, Epistasis factor, Inhibitory factor
11	Gene Interaction-III: Gene interaction with modification of F_2 ratio: Additive factor, Duplicate factor and Lethal factor
12	Problems on Probability
13	Problems on Chi-square test
14	Determination of linkage and cross over analysis (through two-point test cross and three-point test cross data)
15	Study on sex-linked inheritance in Drosophila
16	Study of models on DNA and RNA structures.

Suggested Readings [GPB-231]:

1. Principle of Genetics. E.J. Gardner, M.J. Simmons, D.P. Snustad. Wiley India (P) Ltd.
2. Genetics. P.K. Gupta, Rastogi Publication, Meerut (UP).
3. Fundamentals of Genetics. B.D. Singh, Kalyani Publication, New Delhi.
4. Genetics. M.W. Strickberger, Pearson Education, Inc.
5. Elements of Genetics. Phundan Singh, Kalyani Publication, New Delhi.
6. Genetics. Sushant Elrod and William Stansfield, McGraw Hill Publishing Co. Ltd., New Delhi.
7. Principles of Genetics. Edmund W. Sinnott, L.C. Dunn, Th. Dobzhansky. New York; London: McGraw-Hill, 1950.

Semester	**:**	**III**	
Course No.	**:**	**AGRO-232**	**Credit Hrs. : 3(1+2)**
Course Title	**:**	**Crop Production Technology-I (*Kharif* crops)**	

SYLLABUS

Objectives : (i) To impart basic and fundamental knowledge on principles and practices of *kharif* crop production,

(ii) To impart knowledge and skill on scientific crop production and management.

THEORY

Origin, Geographical distribution, Economic importance, Soil and climatic requirements, Varieties, Cultural practices and Yield of *Kharif* crops. Cereals- Rice, Maize, Sorghum, Pearl millet, Finger millet and Other Minor millets (Foxtail millet, Proso millet, Barnyard millet); Pulses- Pigeon pea, Mungbean, Urdbean and Horse gram; Oilseeds-Groundnut, Soybean, Sesame, Niger and Castor; Fibre crops- Cotton and Jute; Forage crops- Sorghum, Cowpea, Cluster bean, Maize, Guinea and Napier.

PRACTICAL

Rice- Nursery preparation and transplanting; Sowing of Soybean, Pigeon pea and Mungbean, Maize, Groundnut and Cotton; Effect of seed size on germination and seedling vigour of *Kharif* crops; Effect of sowing depth on germination of *Kharif* crops; Identification of weeds in *Kharif* crops; Top dressing and foliar feeding of nutrients; Study of yield contributing characters and yield calculation of *Kharif* crops; Study of crop varieties and important agronomic experiments at experiential farm; Recording biometric observations; Study of forage experiments; Morphological description of *Kharif* crops; Visit to research centres of related crops.

Allotment of 2 R area to each student for undertaking various cultural operations as part of *Practical Work Experience*, specifically for raising *Kharif* crop(s) on the allotted plot, to be carried-out concurrently with the above-mentioned practical sessions.

TEACHING SCHEDULE

THEORY [AGRO-232]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1 - 5	Cereals and Millets – Rice, Maize, Sorghum, Pearl millet Finger millet and other Minor millets, (Foxtail millet, Proso millet and Barnyard millet)	Origin, Geographical distribution, Economic importance, Soil and climatic requirements, Varieties/ Hybrids, Cultural practices: Land preparation, Seeds and Sowing, Irrigation and Nutrient Management Intercultural operations including weed management, Plant Protection (Major pests and diseases and their management), Harvesting, Yield and Crop specific post-harvest processing	30
6 - 8	Pulses – Pigeon pea, Mungbean, Urdbean and Horse gram		20
9 - 11	Oilseeds – Groundnut, Soybean, Sesame, Niger and Castor		20
12 - 14	Fiber crops – Cotton and Jute		15
15 - 16	Forage crops: Cereal forages: Maize, Sorghum, Leguminous forages: Cowpea, Cluster bean, Grasses: Napier and Guinea		15
		Total =	**100**

PRACTICAL [AGRO-232]

Part-I (Practical/ Demonstration Sessions)	
Exercise No.	**Exercise Title**
1 - 3	To study the tillage, sowing and transplanting operations in major *Kharif* crops, like: Rice (Nursery preparation and transplanting) **or / &** Soybean, Pigeonpea, Mungbean, Maize, Groundnut, Cotton (Sowing) and Forage crops
4 - 5	To study the effect of seed size on germination of *Kharif* crops
	To study effect of sowing depth on germination of *Kharif* crops
6	Calculations of plant population, seed rate and fertilizers doses.
7	Identification of weeds in *Kharif* crops.
8 - 9	Top dressing and foliar feeding of nutrients.
10 - 11	Study of yield contributing characters and yield calculation of *Kharif* crops.
12	Study of *Kharif* crop varieties.
13	Study of agro-morphological description of *Kharif* season crops.
14	Harvesting and threshing of cereals, pulses, oilseeds and cash *Kharif crops*.
15	Mechanization in *Kharif* crop cultivation.
16	Visit to Research Centers of related crop(s) and Study of important Agronomic Experiments at Agronomy Instructional Farm.

Continued…

Part-II (Work Experience)	
Exercise No.	**Exercise Title**
Allotment of 2 R area to each student towards carrying-out various following agronomic operations for raising *kharif* crop(s) in the allotted plot in parallel mode with Part-I:	
1	Study of package of practices of given *kharif* crop(s)
2	Preparation of calendar of operations for the allotted crop(s)
3 - 4	Study of preparatory, secondary tillage and seed bed preparation
5	Seed treatment and sowing
6	Study of integrated nutrient management (INM)
7	Study of water management
8	Assessment of agro-morphological traits, yield and its contributing characters
9 - 10	Interculturing and weed management in allotted *kharif* crop(s)
11	Study of integrated insect pest and disease management
12	Study of crop maturity signs and harvesting
13 - 14	Threshing, drying, winnowing, storage, preparation of produce for marketing
15	Study of cost of cultivation and working out net returns per student
16	Preparation of 'Summary Report on Crop Production Technology' applied in given crop.

Suggested Readings [AGRO-232]:

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidda Singh.1997. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume-II, ICAR Publication.
4. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
6. UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.
7. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.

Semester : III		
Course No. : AGRO-233	**Credit Hrs. : 2(1+1)**	
Course Title : Principles and Practices of Natural Farming		

SYLLABUS

Objectives : (i) To provide comprehensive understanding and knowledge to students about natural farming.
(ii) To teach students the concept, need and principles of native ecology-based production under natural farming.
(iii) To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

THEORY

Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in view of climate change, soil health, water use carbon sequestration, biodiversity conservation, food security and nutritional security, and sustainable development goals (SDGs), Concept of natural farming; Definition of natural farming; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/schools of natural farming. Characteristics and design of a natural farm, Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems, Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches on a natural farm, Rearing practices for animals under natural farming, Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming; Mechanization in natural farming, Certification and standards in natural farming, marketing and export potential of natural farming produce and products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Entrepreneurship opportunities in natural farming.

PRACTICAL

Visit of Natural farm and Chemical-free Traditional Farms to study the various components and operations of Natural Farming principles at the farm; Indigenous Technical Knowledge (ITKs) for seed, tillage, water, nutrient, insect-pest, disease and weed management; On-farm inputs preparation methods and protocols, Studies in green manuring in-situ and green leaf manuring, Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and pest and disease management; Weed management practices in natural farming; Techniques of Indigenous seed production- storage and marketing, Partial and complete nutrient and financial budgeting in natural farming; farming; Evaluation of ecosystem services in natural farming (Crop, Field and System). Case studies and Success stories in natural farming and chemical-free traditional farming,

TEACHING SCHEDULE

THEORY [AGRO-233]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1	Natural Farming	Indian Heritage of Ancient Agriculture; History of Natural Farming	6
2-3	Importance of Natural Farming	Importance of natural farming in view of- i. Climate change ii. Soil health iii. Water use iv. Carbon sequestration v. biodiversity conservation vi. Food security vii. Nutritional security and viii. Sustainable development goals (SDGs)	8
4	Concept of Natural Farming	Definition, Objectives, Essential characteristics and Principles of Natural Farming	8
5	Scope, Importance and Pillars of NF	Scope and importance of Natural Farming, Main Pillars of Natural Farming (*Jivamrit, Beejamrit,* Mulching *Whapasa*)	8
6	Natural farming and farm	Methods/Types/Schools of Natural Farming, Characteristics and Design of a Natural farm	8
7	Ecological Balance in Natural Farming *vs* Other Farming	Concept of Ecological Balance, Ecological Engineering and Community Responsibility in Natural versus Other farming systems	8
8	Foot print	Introduction to Concept of Ecological, Water, Carbon and Nitrogen footprints	8
9-10	Integration Approaches on Natural Farm	Integration of crops, trees and animals, Cropping system approaches, Biodiversity, Indigenous seed production, Farm waste recycling, Water conservation and Renewable energy use approaches on a Natural farm	12
11-13	Animal rearing and nutrient, insect, pest, disease and Weed management	Rearing practices for animals under Natural Farming**;** Nutrient management in Natural Farming and their sources; Insect, pest, disease and weed management under Natural Farming	16
14	Mechanization	Mechanization in Natural Farming	7
15	Promotion of Natural Farming	Initiatives taken by Government (Central/State), NGOs and other organizations for promotion of Natural farming and Chemical-free agriculture	6
16	Entrepreneurship in Natural Farming	Entrepreneurship opportunities in Natural Farming; Marketing and Export potential of Natural Farming produce and products.	5
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL [AGRO-233]

Exercise No.	Exercise Title
1	Visit of natural farm and chemical-free traditional farms to study the various components and operations of Natural farming principles at the farm
2 - 3	Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management
4	On-farm inputs preparation methods and protocols
5	Studies in green manuring in-situ and green leaf manuring
6 - 7	Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth,
8	Nutrient management in Natural Farming
9 - 10	Insect and pest and disease management in Natural Farming
11	Weed management practices in Natural Farming
12	Techniques of Indigenous Seed Production- Storage and marketing,
13	Partial and complete nutrient and financial budgeting in Natural Farming.
14	Evaluation of ecosystem services in Natural Farming (Crop, Field and System)
15 - 16	Case studies and Success stories in Natural Farming and Chemical-free Traditional Farming.

Suggested Readings [AGRO-233]:

1. Ayachit, S.M. 2002. *Kashyapi Krishi Sukti* (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
3. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 To 7, Indian Council of Agricultural Research, New Delhi.
4. Ecological Farming -The Seven Principles of a Food System That Has People at its Heart. May 2015, Greenpeace.
5. FAO. 2018. The 10 Elements of Agro-ecology: Guiding the Transition to Sustainable Food and Agricultural system. https://www.fao.org/3/i9037en/i9037en.pdf Agro-ecosystem Analysis for Research and Development Gordon R. Conway.1985.
6. Fukuoka, M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp.

7. Fukuoka, M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
8. Hill S.B and Ott. P. (Eeds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
9. HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A Report by the High-Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. https://fao.org/3/ea5602en/ea5602en.pdf.
10. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
11. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
12. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non-Translatable- The Importance of Sanskritizing English. Amaryllis, New Delhi, India.
13. Nalini, S. 1996. *Vrikshayurveda* (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telengana), India. 94 pp.
14. Nalini, S. 1999. *Krishi-Parashara* (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
15. Nalini, S. 2011. *Upavana Vinoda* (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 64p REPORT OF THE ICAR-SIXTH DEANS' COMMITTEE -78.
16. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, *et al*. (2022)
17. Natural Farming Techniques: Farming without Tilling by Prathapan Paramu (2021). Plenty for All: Natural Farming A to Z; Prayog Pariwar Methodology by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021)
18. Reyes Tirado. 2015. Ecological Farming- The Seven Principles of a Food system that has People at its Heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
19. Shamasastry, R. 1915. Kautilya's Arthashastra.
20. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016).
21. U.K. Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.

Semester : III		
Course No. : HORT-232	**Credit Hrs. : 2(1+1)**	
Course Title : Production Technology of Fruit and Plantation Crops		

SYLLABUS

Objectives : (i) To educate about the different forms of classification of fruit crops.
(ii) To educate about the origin, area, climate, soil, improved varieties and cultivation practices.
(iii) To educate about the physiological disorders of fruit crops, palms and plantation crops.

THEORY

Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; Nutritional value of fruit crops; Classification of fruit crops, Area, Production, Productivity and Export potential of fruit and plantation crops. Crop production techniques in Tropical, Sub-tropical and Temperate fruit crops: Climate and soil requirements, Varieties, Propagation and Use of rootstocks, Planting density and systems of planting: High density and Ultra-high-density planting, Cropping systems, After care -Training and Pruning; Water, Nutrient and Weed management, Fertigation, Special horticultural techniques, Plant growth regulation. Important disorders, Maturity indices and harvest, Value addition.

Fruit crops: Mango, Banana, Papaya, Guava, Sapota, Citrus, Grape, Litchi, Pineapple, Pomegranate, Apple, Pear, Peach, Strawberry, Nut crops, Jackfruit and Minor fruits-date, Ber, Apple; Plantation crops-coconut, Arecanut, Cashew, Tea, Coffee and Rubber.

Crop production techniques in Palms and Plantation crops: Climate and soil requirements, Varieties, Propagation, Nursery management, Planting and planting systems, Cropping systems, After care, Training and pruning for plantation crops, Water, Nutrient and Weed management, Intercropping, Multi-tier cropping system, Mulching, Special horticultural practices, Maturity indices, Harvest and yield, Pests and diseases, Processing- Value addition.

Palms: Coconut, Arecanut, Oil palm and Palmyrah.

Plantation crops: Tea, Coffee, Cocoa, Cashewnut, Rubber.

PRACTICAL

Propagation techniques, Selection of Planting material, Varieties, Important cultural practices for Mango, Banana, Papaya, Guava, Sapota, Grapes. Citrus (mandarin and acid lime), Pomegranate, Jackfruit, Preparation and application of PGR's for propagation, Micropropagation, Protocol for mass multiplication and Hardening of fruit crops, Identification and description of varieties, Mother palm and Seed nut selection, Nursery practices, Seedling selection, Fertilizers application, Nutritional disorders, Pests and diseases of Coconut, Arecanut and Cocoa, Tea and Coffee, Rubber and Cashew; Visit to Commercial Orchard and Plantation Industries.

TEACHING SCHEDULE

THEORY [HORT-232]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Present status and Importance of Fruit and Plantation crops	Status, Importance and Scope; Area and Production; Productivity, Export and Nutritional Value of Fruits and Plantation crops' Industry in India.	5
2	Classification	Classification of fruit crops (Different forms with Examples).	5
3	Mango	Climate and Soil requirements, Varieties, Propagation and use of rootstocks; Planting density and Systems of planting: High density and Ultra-high-density planting, Cropping systems; After care - Training and pruning; Water, Nutrient and Weed Management, Fertigation; Special horticultural techniques, Plant growth regulation; Important disorders; Maturity indices and Harvest, Value addition.	10
4	Banana		10
5	Citrus		25
6	Grape		
7	Guava		
8	Papaya, Sapota		
9	Jackfruit Litchi		5
10	Apple, Pear, Peach		5
11	Pineapple, Pomegranate, Strawberry		5
12	Date and Ber		5
13	Palms: Coconut, Arecanut, Oil palm & Palmyrah	Climate and soil requirements; Varieties, Propagation, Nursery management, Planting density and planting systems; Cropping systems; After care, Training and Pruning for plantation crops, Water, Nutrient and Weed management, Intercropping, Multi-tier cropping system, Mulching, Special horticultural practices, Maturity indices, harvest and yield, Pests and diseases, Processing- Value addition.	10
14 - 15	Plantation Crops: Tea, Coffee, Rubber, Cocoa,		10
16	Cashew		5
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [HORT-232]

Exercise No.	Exercise Title
1	Identification and brief description of propagation techniques in fruit crops.
2	Selection of planting material in fruit crops.
3	Identification and description of fruit crop varieties.
4 - 5	Important cultural practices for Mango, Banana, Papaya, Sapota, Guava, Grapes, Citrus (Mandarin and Acid lime), Pomegranate, Jackfruit.
6	Preparation and application of PGRs for propagation.
7	Fertilizer applications in fruit crops and plantation crops.
8	Nutritional disorders in fruit crops.
9	Micropropagation protocol for mass multiplication and hardening of fruit crops.
10	Identification and description of plantation crop varieties.
11	Mother palm and seed nut selection in palms.
12	Nursery practices in plantation crops.
13	Seedling selection in Palms.
14	Study of maturity indices of different fruit and plantation crops.
15	Pests and diseases of - Coconut, Arecanut, Cocoa, Tea, Coffee, Rubber and Cashew.
16	Visit to Commercial Orchard and Plantation Industries.

Suggested Readings [HORT-232]:

1. Banday, F.A. and Sharma, M.K. 2010. Advances in Temperate Fruit Production. Kalyani Publishers, Ludhiana.
2. Bose, T.K., S.K. Mitra and D. Sanyal. 2001. Fruits: Tropical and Subtropical (2 Volumes) Naya Udyog, Calcutta.
3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture, Vol.1. Naya Prokash, Calcutta.
4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi.
5. Chadha, T.R. 2001. Textbook of Temperate Fruits. ICAR, New Delhi.
6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 Volumes). Kalyani Publishers, Ludhiana.
7. Chattopadhyay 1998. A Textbook on Pomology (su,-tropical fruits) Vol. III. Published by Kalyani Publishers, Ludhiana, New Delhi, Noida UP.
8. Chudawat, B.S.1990. Arid Fruit Culture, Oxford & IBH, New Delhi.
9. Das, B.C. and Das S.N. Cultivation of Minor Fruits. Kalyani Publishers, Ludhiana.
10. David Jackson and N.E. Laone, 1999. Subtropical and Temperate Fruit Production. CABI Publications.
11. H.P. Singh and M.M. Mustafa, 2009. Banana- New Innovations Westville Publishing House, New Delhi
12. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, Tamil Nadu.

Semester	**:**	**III**		
Course No.	**:**	**AE- 231**	**Credit Hrs.**	**: 2 (1+1)**
Course Title	**:**	**Farm Machinery and Power**		

SYLLABUS

Objectives : To enable the students to understand the need of farm power, basic principles and parts of IC engine, different tillage, sowing, intercultural, plant protection equipment, working principles of threshers, harvesting of field and horticultural crops.

THEORY

Status of Farm Power in India; Sources of Farm Power, I.C. engines, working principles of I.C. engines; comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems; Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor; Familiarization with Power transmission system : clutch; gear box, differential and final drive of a tractor; Tractor types; Cost analysis of tractor power and attached implement; Criteria for selection of tractor and machine implements. Familiarization with Primary and Secondary Tillage implement; Implement for hill agriculture; implement for intercultural operations; Familiarization with sowing and planting equipment; calibration of a seed drill and solved examples; Familiarization with Plant Protection equipment; Familiarization with harvesting and threshing equipment.

PRACTICAL

Study of different components of I.C. engine. Study of air cleaning and cooling system of engine; Familiarization with clutch, transmission, differential and final drive of a tractor; Familiarization with lubrication and fuel supply system of engine; Familiarization with brake, steering, hydraulic control system of engine; Learning of tractor driving; Familiarization with operation of power tiller; Implements for hill agriculture; Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow; Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, Planters and transplanters; Familiarization with different types of sprayers and dusters; Familiarization with different inter-cultivation equipment; Familiarization with harvesting and threshing machinery; Calculation of power requirement for different implements.

TEACHING SCHEDULE

THEORY [AE-231]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage %
1	Farm Power	Status of Farm Power in India; Sources of Farm Power.	8
2 - 3	I.C. Engines	I.C. engines, Working principles of I.C. engines; Comparison of two-stroke and four-stroke cycle engines, Study of different components of I.C. engine, I.C. engine Terminology and Solved problems.	12
4 - 6	Systems of I.C. Engines	Familiarization with different systems of I.C. engines: Air cleaning, Cooling, Lubrication, Fuel supply and Hydraulic control system of a tractor.	10
		Familiarization with Power transmission system: Clutch; Gear box, Differential and Final drive of a tractor.	10
7 - 8	Tractor	Tractor types; Cost analysis of tractor power and attached implement; Criteria for selection of tractor and Machine implements.	10
9 - 10	Tillage	Familiarization with Primary and Secondary Tillage implement.	12
11 - 12	Implements	Implement for hill agriculture; implement for intercultural operations.	10
13 - 14	Sowing Equipment	Familiarization with sowing and planting equipment; Calibration of a Seed drill and Solved examples.	10
15	Plant Protection Equipment	Familiarization with Plant Protection equipment.	8
16	Harvesting and Threshing Equipment	Familiarization with harvesting and threshing equipment.	10
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [AE-231]

Exercise No.	Exercise Title
1	Study of different components of I.C. engine.
2	To study air cleaning and cooling system of engine.
3	Familiarization with clutch, transmission, differential and final drive of a tractor.
4 - 5	Familiarization with lubrication and fuel supply system of engine.
6	Familiarization with brake, steering, hydraulic control system of engine.
7	Implements for hill agriculture.
8 - 9	Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow.
10	Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and trans planter.
11	Familiarization with different types of sprayers and dusters.
12	Familiarization with different inter-cultivation equipment.
13	Familiarization with harvesting and threshing machinery.
14	Calculation of power requirement for different implements.
15	Familiarization with operation of power tiller.
16	Learning of tractor driving.

Suggested Readings [AE-231]:

1. Jagdiswar Sahay – Elements of Agricultural Engineering.
2. Jain, S.C. and C.R. Rai- Farm Tractor and Maintenance and Repair. Standard Publishers, 1705-B, Naisarak. Delhi - 110 006.
3. Ojha, T.P. and Michael, A.M. Principles of Agricultural Engineering. Vol. I. Jain Brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005
4. Surendra Singh- Farm machinery –Principles and Applications, ICAR, New Delhi
5. Deogirikar Amit Ashokrao, Kishor Ganpat Dhande, Atul Ganesh Mohod (2018): A Text Book on Farm Machinery and Power. Publ. Shri Rajlaxmi Prakash.

Semester	**:**	**III**			
Course No.	**:**	**NEMA-231**	**Credit Hrs.**	**:**	**2 (1+1)**
Course Title	**:**	**Fundamentals of Nematology**			

SYLLABUS

Objectives : (i) To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.

(ii) To impart knowledge on nematode pests of different crops of national and local importance and their management.

THEORY

Introduction: History of Phyto-nematology, habitats and diversity, Economic importance of nematodes. General characteristics of plant parasitic nematodes. Nematode: definition, general morphology and biology. Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit. Symptomatology, Role of nematodes in disease development, Importance of entomopathogenic nematodes. Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses. Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseeds and fiber crops, citrus and banana, tea, coffee, coconut, guava, pomegranate and spices. Different methods of nematode management: Cultural methods, Physical methods, Biological methods, Chemical methods, Plant Quarantine, Plant resistance and Integrated Nematode Management.

PRACTICAL

Sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following Cobb's sieving and decanting technique, Baermann funnel technique, Picking and counting of plant parasitic nematode. Identification of economically important plant nematodes up to generic level with the help of keys and description: *Meloidogyne, Pratylenchus; Heterodera, Tylenchulus, Xiphinema, Radopholus* and *Helicotylenchus*, etc. Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops, etc. Methods of application of nematicides and organic amendments. Mass production of entomopathogenic nematodes.

TEACHING SCHEDULE

THEORY [NEMA-231]

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
1	Introduction	Definitions of ~ Nematology, Plant Nematology, Agricultural Nematology, Phytonematology, Helminthology	15
	History of Phytonematology	Important Milestones in Development of Nematology in World and India	
2	Habitats and Diversity	Key types of habitats and Diversity of nematodes	
	Economic Importance of Nematodes	Economic importance of nematodes to Agriculture with suitable examples	
3	General Characteristics of Plant Parasitic Nematodes	General Characteristics of Phytonematodes	10
4	Nematode: Definition, General Morphology and Biology	Definition of Nematode; General morphology: Body shape, size, posture, segmentation, coloration, symmetry, organization, regions; outer body tube, inner body tube (alimentary canal)	10
5		Reproductive, nervous, excretory, respiratory and circulatory systems; Life cycle of nematode	
6	Classification of Nematodes up to Family level	With emphasis on groups containing economically important genera (examples)	5
7	Classification of Nematodes on the basis of Feeding/ Parasitic habit.	Ectoparasites, Semi-endoparasites and Endoparasites	10
8	Symptomatology; Role of Nematodes in Disease Development	Above and below ground symptoms; Understanding the role of nematodes in disease development;	10

Continued…

9	Interaction between Plant Parasitic Nematodes and Disease-causing Fungi, Bacteria and Viruses; Importance of EPN	Pathogenic interaction of Phytonematodes with disease-causing fungi, bacteria and virus; Various entomopathogenic nematodes and their role in insect pests management	10
10	Nematode Pests of Crops: Rice, Wheat, Vegetables, Pulses, Oilseed and Fiber crops	Feeding habit, Symptoms, Impact and Management of nematode pests of Rice, Wheat and Vegetables	10
11		Feeding habit, Symptoms, Impact and Management of Nematode pests of Pulses, Oilseeds and Fiber crops	
12	Nematode Pests of Crops: Citrus, Banana, Tea, Coffee, Coconut, Guava, Pomegranate and Spices.	Feeding habit, Symptoms, Impact and Management of nematode pests of Citrus, Banana, Tea, Coffee	10
13		Feeding habit, Symptoms, Impact and Management of nematode pests of Coconut, Guava, Pomegranate and Spices	
14	Different Methods of Nematode Management	Cultural methods, Physical methods and Biological methods	10
15		Chemical methods, Plant quarantine and Plant resistance	
16		Integrated Nematode Management	
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [NEMA-231]

Exercise No.	Exercise Title
1	Sampling methods, collection of soil and plant samples.
2	Extraction of nematodes from soil and plant tissues following Cobb's sieving and decanting technique, Baermann funnel technique.
3	Picking and counting of plant parasitic nematode
4	Identification of economically important plant nematodes up to generic level with the help of keys and description.
5	Study of *Meloidogyne*
6	Study of *Pratylenchus*
7	Study of *Heterodera*
8	Study of *Tylenchulus*
9	Study of *Xiphinema*
10	Study of *Radopholus* and *Helicotylenchus*
11 - 13	Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops etc.
14 - 15	Methods of application of nematicides and organic amendments.
16	Mass production of entomopathogenic nematodes.

Suggested Readings [NEMA-231]:

1. Text Book on Introductory Plant Nematology – by R.K. Walia and H.K. Bajaj.
2. A Text Book of Plant Nematology – by K.D. Upadhyay & Kusum Dwivedi, Aman Publishing House.
3. Economic Nematology- Edited by J.M. Webster.
4. Plant Parasitic Nematodes (Vol-1) - by Zukerman, Mai, Rohde.
5. Plant Parasitic Nematodes of India: Problems and Progress - by Gopal Swarup, D.R. Dasgupta, P.K. Koshy.

Semester	**:**	**III**	
Course No.	**:**	**ECON-231**	**Credit Hrs.: 2(2+0)**
Course Title	**:**	**Principles of Agricultural Economics and Farm Management**	

SYLLABUS

Objectives : (i) To aware the students about broad areas covered under agricultural Economics and farm management,

(ii) To impart knowledge on judicious use of resources for optimum production.

THEORY

Economics: Meaning, Scope and Subject matter, Definitions, Activities, Approaches to economic analysis; Micro- and macro-economics, Positive and normative analysis. Nature of economic theory; Rationality assumption, Concept of equilibrium, Economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural Economics: Meaning, Definition, Characteristics of agriculture, Importance and its role in economic development. Agricultural planning and development in the country. Demand: Meaning, Law of demand, Demand schedule and Demand curve, Determinants, Utility theory; Law of diminishing marginal utility, Equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, Concept of consumer surplus. Elasticity of demand: Concept and measurement of price elasticity, Income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale. Cost: Cost concepts, Short run and long run cost curves. Supply: Stock v/s Supply, Law of supply, Supply schedule, Supply curve, Determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. National income: Meaning and importance, Circular flow, Concepts of national income accounting and approaches to measurement, Difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, Natural and socio-economic determinants, Current policies and Programmes on population control. Money: Barter system of exchange and its problems, Evolution, Meaning and Functions of money, Classification of money, money supply, General price index, Inflation and deflation. Economic systems: Concepts of economy and its functions, Important features of capitalistic, socialistic and mixed economies, Elements of economic planning. Forms of business organizations, international trade and balance of payments. GST and its implication on Indian economy.

TEACHING SCHEDULE

THEORY [ECON-231]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Economics	Meaning, Scope and Subject matter, Definitions of Economics, Divisions of Economics - Traditional and Modern approach	3
2	Approaches to Economic Analysis	Micro- and Macro-economics, Positive and Normative analysis	3
3	Nature of Economic Theory	Rationality assumption, Concept of equilibrium, Economic Laws as generalization of human behavior.	3
4	Basic Concepts	Goods and Services, Classification of goods, Characteristics of goods and services, Desire, Want, Demand, Utility, Cardinal and Ordinal approaches, Characteristics of utility - Forms of utility. Cost and price, wealth, capital, income and welfare	5
5	Agricultural Economics	meaning, definition, characteristics of agriculture, importance and its role in economic development.	4
6	Demand	Meaning, Definition, Types of demand - Income demand, Price demand, Cross demand. Demand schedule, Demand curve, Law of demand - contraction and extension, increase and decrease in demand, Determinants of demand	4
7	Law of Diminishing Marginal Utility	Utility theory, Statement, Assumptions of Law, Explanation, Limitations and importance of it.	4
8	Law of Equi-marginal Utility	Meaning, Assumptions, Explanation of the Law, Practical importance and Limitations of it.	4
9	Consumer's Equilibrium and Derivation of Demand Curve, Consumer's Surplus	Meaning, Assumptions, Explanation, Difficulties in measuring Consumer's Surplus, Importance.	3
10 - 11	Elasticity of Demand	Definition, Elastic and Inelastic demand, Kinds of elasticity of demand, Concept and measurement of price elasticity, Income elasticity and Cross elasticity of demand, Factors affecting demand, Practical importance of elasticity of demand	4
12	Production	Concept and Meaning, Process, Creation of utility, Factors of production, Input-output relationship.	3
13	Laws of Returns	Meaning, Concept of Law of variable proportions and Law of returns to scale	4
14	Cost Concepts	Short run and Long run cost curves.	3
15 - 16	Supply	Meaning, Definition, Concept of Stock v/s Supply, Law of supply, Supply schedule, Supply curve, Increase and decrease in supply, Contraction and extension in supply, Factors affecting supply.	3

Continued…

17 - 18	Elasticity of Supply	Meaning and Kinds of Elasticity of Supply - Perfectly elastic, Perfectly inelastic, Relatively elastic, Relatively inelastic and Unitary elastic – Factors affecting elasticity of supply.	5
19 - 20	Distribution Theory	Meaning, Factor market and Pricing of factors of production. Concepts of rent, wage, interest and profit.	8
21 - 22	National Income	Meaning and Importance, Circular flow, Concepts of National Income Accounting- Gross domestic product, Gross national product, Net national product, Net domestic product- National income at factor cost, Personal income, Disposable income.	4
23	Approaches of Measurement of National Income	Methods/Approaches of measurement of National income- Product method, Income method and expenditure method, Difficulties in measurement.	3
24	Population	Importance, Malthusian and Optimum Population Theories	3
25	Natural and Socio-economic Determinants and Policies	Natural and Socio-economic determinants, Current policies and programmes on Population Control	4
26 - 27	Money	Barter system of Exchange and its problems, Evolution, Meaning and functions of money, Classification of money and Money supply	6
28	Inflation	General price index, Concept and Recent trend of inflation and deflation.	3
29	Economic Systems	Concepts of Economy and its Functions	4
30	Important Economic Systems	Important features of Capitalistic, Socialistic and Mixed Economies, Elements of Economic Planning.	4
31	International Economics	Forms of Business Organization, International trade and Balance of payment	3
32	Goods and Service Tax (GST)	Goods and Service Tax (GST), Meaning and its Implications on Indian Economy.	3
		Total=	**100**

Suggested Readings: [ECON-231]

1. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi. 2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
2. Johl,S. And T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers Dewett, K.K. and Chand, A. 2009 Modern Economic Theory S.Chand and Co., New Delhi.
3. Dewett, K.K. and Varma, J.D. 1986 Elementary Economics S.Chand and Co., New Delhi.
4. Jhingan, M.L.1990 Advanced Economic Theory Vikas Publishing House, New Delhi.
5. Nagpure S.C., and Patil E.R.2011, 2014, Principles of Agricultural Economics by, Agroment Publishers, 52B, Indraprasta, Opp. Asha Mangal, Dharampeth, Nagpur- 440010 (MS) India.

Semester	**:**	**III**		
Course No.	**:**	**AHDS-232**	**Credit Hrs.**	**: 2(1+1)**
Course Title	**:**	**Technology of Milk and Milk Products**		

SYLLABUS

Objectives : (i) To provide foundational knowledge of milk science and diverse dairy processing technologies for safe and quality product development.
(ii) To develop practical skills in dairy products manufacturing, fostering readiness for industry roles and entrepreneurial ventures.
(iii) To understand the socio-economic significance of the dairy sector for sustainable development and livelihood enhancement

THEORY

Milestone and present status of dairy industry in India. Terminology of milk, its composition, physicochemical properties and nutritional importance of milk and its constituents. The factors affect the yield and composition of milk. Microbiology of milk, microorganisms associated to milk and its desirable and undesirable changes in milk, Microbial standards for different market milk and milk products. Procurement, pricing policy, transportation and reception of milk. Chilling/cooling and storage of milk, its importance and methods of cooling. Term-pasteurization and its methods, Concept of homogenization of milk. Classification of milk products and their standards/ status and composition. Desirable and undesirable characteristics of various traditional dairy products. Introductory approach for western dairy products: Cheese its definition, market prospectus, Different types/classification and preparation of cheddar and mozzarella cheese. Standards related to milk and milk products; BIS, FSSAI, CAC and HACCP. Preservation of milk and milk products and different methods of milk preservation. Utilization of dairy by-products like, whey and high acid milk. Packaging of milk and milk products with modern techniques.

PRACTICAL

Study of platform test and sampling of milk and milk products. Determination of fat by Gerber's method. Determination of Specific gravity, SNF, TS and acidity of milk. Determination of adulteration in milk and milk products. Standardization of milk by Pearson's method and preparation of toned, double toned and standardized milk. Study of cream separator and separation of cream. Preparation of flavoured and chocolate milk. Preparation of Khoa, Peda/ Burfi and Gulab jamun. Preparation of Paneer, Chhana and Rasogolla. Preparation of Dahi, Chakka and Shrikhand. Preparation of Butter and Ghee. Preparation of Ice-cream. Preparation of Basundi, Rabri and Kulfi. Study of cleaning and sanitization of dairy equipments. Layout of milk processing plant. Visit to Milk Processing Plant.

TEACHING SCHEDULE

THEORY [AHDS-232]

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
1	Present Status	Milestones and Present Status of Dairy Industry in India	8
2	Milk & its Composition	Milk and its Composition (in detail)	4
3	Properties of Milk	Physico-chemical properties of milk	5
4	Nutritional Importance	Nutritional importance of milk and its constituents	6
5	Factors affecting Milk Production	Factors affecting of yield and Composition of milk	10
6	Microbiology of Milk	Microbiology of milk: Microorganisms associated to milk, Desirable and undesirable changes by microbes in milk, Microbial standards for different market milk and milk products	4
7	Procurement and Transportation	Procurement, Pricing policy, Transportation and Reception of milk	8
8	Importance of Chilling and Storage of Milk	Chilling and Storage of milk; Importance of chilling/ cooling, Methods of cooling	6
9	Pasteurization and Homogenization of Milk	Pasteurization and its Methods, Homogenization of milk	7
10	Classification of Products	Classification of milk products and their standards/ status and composition milk	6
11	Characteristics of Various Traditional Dairy Products	Desirable and undesirable characteristics of various Traditional dairy products- *(Khoa, Peda, Burfi, Gulabjamun, Basundi, Rabri, Kalakand, Paneer, Rasogolla, Dahi, Lassi, Shrikhand, Butter, Ghee, Ice-cream and Kulfi)*	7
12	Western Dairy Products	Introductory approach for Western dairy products: Cheese- (Definition, Market prospectus, Different types/ Classification and Basic protocol for preparation of Cheddar and Mozzarella Cheese)	6
13	Standards to Milk & Milk Products	BIS, FSSAI, CAC and HACCP in relation to milk and milk products	6
14	Preservation of Milk & Milk Products	Preservation of milk and milk products by chemical, biological and herbal preservatives	6

Continued…

15	Dairy By-products	Utilization of Dairy By-products like, Whey and High acid milk	5
16	Packaging of Milk and Milk products	Packaging of Milk and Milk products with Modern Techniques	6
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [AHDS-232]

Exercise No.	Exercise Title
1	Study of Platform test and Sampling of milk and milk products
2	Determination of fat by Gerber's method
3	Determination of Specific gravity, SNF, TS and Acidity of milk
4	Determination of Adulteration in milk and milk products
5	Standardization of milk by Pearson's method and Preparation of toned, double toned and standardized milk
6	Study of cream separator and separation of cream
7	Preparation of flavoured and chocolate milk
8	Preparation of *Khoa*, *Peda*/*Burfi* and *Gulabjamun*
9	Preparation of *Paneer*, *Chhana* and *Rasogolla*
10	Preparation of *Dahi*, *Chakka* and *Shrikhand*
11	Preparation of *Butter* and *Ghee*
12	Preparation of Ice-cream
13	Preparation of *Basundi*, *Rabri* and *Kulfi*
14	Study of cleaning and sanitization of dairy equipments
15	Layout of Milk Processing Plant
16	Visit to Milk Processing Plant

Suggested Readings [AHDS-232]:

1. Sukumar De, Outlines of Dairy Technology.
2. Sangu K.P.S., Dairy Processing Technology.
3. R.P. Aneja, B.N .Mathur, R.C. Chandan and A.K. Banerjee., Technology of Indian Milk Products.
4. Shivashraya Singh, Dairy Technology Vol. 1 (Milk and Milk Processing).
5. Shivashraya Singh, Dairy Technology Vol. 2 (Dairy Products and Quality Assurance).
6. D.D. Patange, D.K. Kamble and R.C. Ranveer, Text Book on Milk and Milk Products.
7. K.G. Upadhyay, Essentials of Cheese Making.
8. J.S. Yadav, S. Grover and V.K. Batish, A Comprehensive Dairy Microbiology.

B.Sc. (Hons.) Agriculture

List/ Bouquet of Skill Enhancement Courses (SECs)

[in continuation of the SECs' Syllabi prescribed under I and II semesters]

Sr. No.	Course No.	Course Title	Credit Hrs.
1.	**SEC-xxx**	Biofertilizer and Biopesticide Production	2(0+2)
2.	**SEC-xxx**	Mushroom Production Technology	2(0+2)
3.	**SEC-xxx**	Seed Production Technology	2(0+2)
4.	**SEC-xxx**	Post-harvest Processing Technology	2(0+2)
5.	**SEC-xxx**	Beneficial Insect Farming	2(0+2)
6.	**SEC-xxx**	Horticulture Nursery Management	2(0+2)
7.	**SEC-xxx**	Plantation Crops Production and Management	2(0+2)
8.	**SEC-xxx**	Poultry Production and Management Technology	2(0+2)
9.	**SEC-xxx**	Processing of Milk and Milk Products	2(0+2)
10.	**SEC-xxx**	Agrotourism	2(0+2)
11.	**SEC-xxx**	Plantation Crop Production and Processing	2(0+2)
12.	**SEC-xxx**	Agriculture Waste Management	2(0+2)
13.	**SEC-xxx**	Organic Production Technology	2(0+2)
14.	**SEC-xxx**	Fodder Production Technology	2(0+2)
15.	**SEC-xxx**	Marketing and Export of Agricultural Produce	2(0+2)
16.	**SEC-xxx**	Processing of Farm Waste into Organic Inputs	2(0+2)
17.	**SEC-xxx**	Vermicompost Production Technology	2(0+2)
18.	**SEC-xxx**	Apiculture - Commercial Bee Keeping	2(0+2)
19.	**SEC-xxx**	Production Technology of Bioagents	2(0+2)

Note: (i) Skill Enhancement Courses can be added/offered as per the facilities and resources available at the respective universities/colleges based on the relevance to the region and the UG degree subject.

(ii) The host University/ College may also choose suitable SEC courses from those listed under other UG degree programs.

(iii) Above list/ bouquet of SEC courses is an indicative list and subject to modification as applicable therein.

(iv) In case of unavailability of the detailed course-wise syllabus/ teaching schedules of any of above SEC courses, the same can be primarily developed and followed at College/ University level in the current academic year. However, the same can be obtained from the respective UG Degree Coordinator/ Discipline Coordinators and can be followed w.e.f. AY, 2025-26.