COLLEGE OF AGRICULTURE
ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course Structure for B.Sc. (Hons.) Agriculture
Semester-I (First Year I Semester)

S.No.	Category	Course Number	Course Title	Hours per Week			Credits
				L	T	P	
1	Induction cum foundation course	ICFC	Deeksharambh (induction cum foundation course)	-	-	-	2 Weeks Non-gradial
2	Common Course	AU-AGRO-100	Farming based livelihood systems	2	0	2	3(2+1)
3	Core Course	AU-AGRO-101	Fundamentals of Agronomy	2	0	2	3(2+1)
4	Other Course	AU-STAM-101	Introductory Mathematics	0	0	2	1(0+1)
5	Core Course	AU-SSAC-121	Fundamentals of Soil Science	2	0	2	3(2+1)
6	Core Course	AU-HORT-181	Fundamentals of Horticulture	2	0	2	3(2+1)
7	Common Course	AU-AEXT-191	Communication skills	1	0	2	2(1+1)
8	Core Course	AU-AEXT-192	Rural Sociology and Educational Psychology	2	0	0	2(2+0)
9	Skill Enhancement course	AU-SEC-I	Seed Production and Testing Technology	0	0	4	2(0+2)
10	Skill Enhancement course	AU-SEC-II	Commercial Horticulture	0	0	4	2(0+2)
		AU-SEC-XI	Agriculture Waste Management				
11	Core Course	AU-NCC-I/ AU-NSS-I	National Service Scheme (NSS-I) / National Cadet corps (NCC-I)	0	0	2	1(0+1)
						Total Credits	**22**

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Course No.	**:**	**AU-AGRO 100**
Course Title	**:**	**Farming-Based Livelihood Systems**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

1. To make the students aware about farming-based livelihood systems in agriculture
2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood

Course Outlines

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood- Definition, concept and livelihood pattern in urban & rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional & modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro-forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming. Risk & success factors in farming-based livelihood systems, Schemes & programmes by Central & State Government, Public & Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization & changing lifestyle.

Practical

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming based livelihood models/ systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models, Field visit of innovative farming system models. Visit of Agri-based enterprises & their

functional aspects for integration of production, processing & distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming-based livelihood systems along with cost & profit analysis, Case study of Start-Ups in agri-sectors.

A) Theory Lecture Outlines

Lec.No.	Topics
1.	Status of agriculture in India and AP- History of Agriculture pre- and post- independence - green revolution
2.	Crops and cropping systems with respect to climate, soil and irrigation factors
3.	Area under cultivation of different crops- Production, productivity at national and state level-Scope and prospects of foreign exchange from different crops
4.	Income of farmers and rural people from Agriculture and allied enterprises in India and AP
5.	Livelihood- Definition, concept and livelihood pattern in urban and rural areas in AP
6.	Agricultural Livelihood Systems (ALS)- Meaning, Concept, Approaches and Framework
7.	Indicators to study livelihood systems and Agricultural Livelihood Systems (ALS)
8.	Farming systems - Farming based livelihood Systems- Definition, concept, objectives Scope and Importance of Farming based livelihood Systems
9.	Prevalent Farming Systems in India and AP- Contribution to Livelihood
10.	Types of Traditional and Modern farming systems- Merits and demerits
11.	Components of Farming systems/ Farming – based Livelihood Systems- Crops and cropping Systems, sericulture, apiary, mushroom, Livestock (Diary, Piggery and rabbit)
12.	Components of Farming systems/ Farming – based Livelihood Systems - Crops and cropping Systems, Livestock (Goatry, Poultry and Duckery etc)
13.	Small, medium and large enterprises -Value chains - secondary enterprises for Crops and cropping Systems and Livestock (Diary, Piggery, sericulture, apiary, mushroom and rabbit)
14.	Small, medium and large enterprises- Value chains - secondary enterprises for Crops and cropping Systems and Livestock (Goatry, Poultry and Duckery etc.)
15.	Production potential and interaction between the components of Horticultural Crops- Agro- Forestry systems, Aquaculture and Duck production
16.	Production potential and interaction between the components of Horticultural Crops- Agro- Forestry systems and Poultry cum Fish production
17.	Production potential and interaction between the components of Horticultural Crops - Agro- Forestry systems, Dairy cum Fish and Piggery cum fish production
18.	Small, medium and large enterprises -Value chains and secondary enterprises for Horticultural Crops -Agro- Forestry systems, Aquaculture, Duck.
19.	Small, medium and large enterprises- Value chains and secondary enterprises for Horticultural

Crops- Agro- Forestry systems, Poultry cum Fish

20. Small, medium and large enterprises -Value chains and secondary enterprises for Horticultural Crops- Agro- Forestry systems, Dairy cum Fish, Piggery cum fish
21. Factors affecting integration of various enterprises of farming for livelihood - climatic, Socio- economical, degree of commercialization and water availability
22. Feasibility of different farming systems for different Agro- climatic zones of AP
23. Commercial Farm based livelihood models supported by NABARD, ICAR and other Organizations
24. Case studies on different livelihood enterprises associated with the farming
25. Farming – based livelihood systems-Risk and success factors
26. Schemes and Programmes by Central and State Government in promotion of farming-based livelihood opportunities
27. Schemes and Programmes by Public and Private Organizations in promotion of farming- based livelihood opportunities
28. Circular economy- green economy-concept, significance - Role of Farming based livelihood enterprises in 21st century- quantification and mitigation of GHG's
29. Role of Farming based livelihood enterprises in 21st century in view of climate change, meaning and concept of climate change
30. Mitigation and adaptation strategies of climate change with special emphasis to Farming systems and nexus with green economy and circular economy
31. Digitalization- meaning, concept, Supply- demand-history, marketing of produce, Market fluctuations
32. Digitalization in Agriculture- different digital /online platforms, successful apps in Agriculture with changing lifestyle

B) Practicals

1. Survey of farming Systems and Agricultural based Livelihood enterprises
2. Study of components of important Rainfed Farming based livelihood models/ Systems in different Agro-climatic Zones (Wetland)
3. Study of components of important Rainfed Farming based livelihood models/ Systems in different Agro-climatic Zones (Lowland)
4. Study of components of important Rainfed Farming based livelihood models/ Systems in different Agro-climatic Zones (Garden land)
5. Study of production and profitability of crop based, livestock-based livelihood models (poultry/ goatry/ sheep)
6. Study of production and profitability of crop based, livestock-based livelihood models (Duckery/Aquaculture)
7. Study of production and profitability of crop based, livestock-based livelihood models (Diary)

8. Study of production and profitability of processing-based livelihood models
9. Study of production and profitability of integrated farming-based livelihood models
10. Field visit to innovative Farming system models in farmers' fields
11. Field visit to innovative Farming system models in Agricultural Research station
12. Visit to Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors
13. Study of Value chain models- Agri enterprises involved in Industry
14. Study of Value chain models- Agri enterprises involved in service sectors
15. Concept of project formulation on farming-based livelihood systems - cost and profit analysis
16. Case study of start-ups in Agri- sectors

Textbook

1. Farming – Based Livelihood Systems by Aniket Hanumant Kalhapure. Kalyani Publications, New Delhi.

Suggested Readings

1. Sustainable Livelihoods: Lessons from Early Experience by Ashley, C. and Carney, D. Department for International Development: London, UK; Volume 7.
2. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development by Agarwal, A. and Narain, S. Centre for Science and Environment, New Delhi, India
3. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa by Carloni, A. Consultation Document, FAO, Rome, Italy
4. Agricultural Productivity and Production in Developing Countries'. In FAO by Evenson, R.E. The State of Food and Agriculture, FAO, Rome, Italy
5. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment by Panwar et al. Indian Council of Agricultural Research, New Delhi.
6. Farming System and Sustainable Agriculture by S.R. Reddy. Kalyani Publishers, New Delhi.
7. Region Specific Integrated Farming System Models by J.P. Singh. ICAR-Indian Institute of Farming Systems Research, Modi Puram.
8. Farming System and Sustainable Agriculture by Walia, S. S. and Walia, U. S. Scientific Publishers, Jodhpur, Rajasthan.
9. Farming system and sustainable agriculture by Nanwal, R.K. New India publishing agency – Nipa, India.

Course No.	**:**	**AU-AGRO 101**
Course Title	**:**	**Fundamentals of Agronomy**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**I**

Objective

1. To impart the basic and fundamental knowledge of Agronomy.

Course Outlines

Theory

Agronomy and its scope: Definition, Meaning and scope of Agronomy; Art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, Fields crops and classification, importance, ecology and ecosystem, Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc.

Tillage and tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /un-combined forms Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production Integrated Nutrient Management: Meaning, different approaches and advantages of INM Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring , Water management: Water resources of the world, India and the state; Soil Moisture Constants –gravitational water, capillary water, hygroscopic water, Soil moisture constants, Concept of water availability to plants, soil plant-water relationship, crop water requirement, water use efficiency, Methods of irrigation : Scheduling of irrigation, different approaches of scheduling irrigation Weeds: Definition, Importance and basics of classification of weeds and their control Cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation pollution and pollutants, Allelopathy:

Meaning and importance in crop production, Growth and development of crops: Definition, Meaning and factors affecting growth and development.

Practical

A visit to Instructional Crop farm and study on field crops, Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of some preparatory tillage implements, Study of inter tillage implements, Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops, Seed germination and viability test of seed, Practice on time and method of application of manures and fertilizers, Measurement of soil moisture by gravimetric and volumetric method and bulk density, Determination of field capacity, Determination of gross and net irrigation requirement, Determination of infiltration rate.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Agronomy- Definition, meaning and scope - Art, science and business of crop production Agronomy in relation with other disciplines of Agricultural Sciences.
2. Agro-climatic zones of India and Andhra Pradesh.
3. Crops – Classification of crops - Field crops- Cereals, Millets, Pulses, Oil seeds, Commercial crops - Scientific names - Economic importance.
4. Tillage and tilth - Objectives of tillage- Characteristics of ideal seed bed- Effect of tillage on soil properties
5. Types of tillage, advantages and disadvantages-Factors affecting tillage and seed bed preparation – Puddling - After cultivation.
6. Modern concepts of tillage - Minimum tillage, zero tillage, strip tillage, conservation tillage and their advantages and limitations.
7. Seeds and sowing – Variety- Characteristics of good quality seed, Seed treatment - Agronomic significance of seed purity and quality
8. Methods of sowing– Broadcasting, drilling, dibbling and transplanting
9. Crop stand establishment - Factors affecting crop stand establishment
10. Growth and development of crops – Definition - Meaning and factors affecting growth and development
11. Crop density and geometry- Planting geometry- Optimum plant density and planting pattern. Plant population – Competition - Types of competition - Inter and intra plant. competition Effect of plant population on growth and yield.
12. Cropping pattern, cropping system- Crop rotation - Principles of crop rotation – Mono cropping and its

disadvantages - Types of cropping systems - Mixed cropping, intercropping, multiple cropping, relay and multi storied cropping.

13. Cropping systems- Factors affecting cropping systems - major cropping patterns and systems in India and Andhra Pradesh.
14. Soil fertility and soil productivity - Soil organic matter and its importance - Loss of soil fertility and its maintenance.
15. Crop Nutrition - Definition of essential nutrients - Criteria of essentiality, functional elements - Classification of essential nutrients - Role of macro and micronutrients.
16. Manures and fertilizers - Source of nutrients - Organic manures and bio- fertilizers, their classification and characteristics - Role of organic manures in crop production.
17. Inorganic fertilizers – classification - Methods of fertilizer application - Integrated nutrient management (INM)- Components and advantages of INM - Nutrient use efficiency.
18. Green manures - Role in crop production – Definition, objectives of green manuring - Desirable characteristics of green manure crops, advantages and limitations of green manures.
19. Dry farming, dryland farming and rainfed farming - Problems of crop production in dry areas - Length of crop growing period
20. Soil and moisture conservation - Water harvesting techniques (in-situ and ex- situ) - Watershed - definition – Objectives.
21. Irrigation- Importance and objectives of irrigation - Water resources of the World, India and Andhra Pradesh
22. Soil moisture constants- FC, PWP and hygroscopic coefficient- Kinds of water- gravitational water, capillary water and hygroscopic water - Crop water requirement – Moisture sensitive stages.
23. Methods of Irrigation – Surface methods - Micro irrigation – Drip and sprinkler methods - Advantages and limitations
24. Weed- Definition – Importance - Harmful and beneficial effects of weeds- Classification of weeds.
25. Crop weed competition – Critical period for crop weed competition – Allelopathy- meaning and its importance in weed management.
26. Weed management principles - Prevention, control and eradication
27. Weed Management - physical, mechanical, cultural, biological and chemical methods - Integrated weed management (IWM).
28. Herbicides – Definition - Classification of herbicides based on selectivity, time and method of application- Advantages and limitations of herbicides.
29. Sustainable crop production – Definition – Importance - Principles and practices - Natural resources and conservation.
30. Harvesting and threshing of crops - Maturity symptoms of major crops (Rice, Maize, Redgram,

Blackgram, Bengalgram, Groundnut, Sunflower, Sesame and Sugarcane)

31. Methods of harvesting - threshing and winnowing, drying and post-harvest storage of grains -Harvest index and BC ratio.
32. Weather- Climate- Differences between weather and climate - Different weather parameters -Weather forecasting- Types of Weather forecasting.

B) Practicals

1. Visit to College farm and study of major crops and varieties
2. Identification of crops, seeds and fertilizers
3. Study of Primary tillage implements
4. Study of Secondary tillage implements
5. Study of seeding equipment and inter cultivation implements
6. Practice of ploughing and puddling
7. Seed germination and viability test
8. Calculation of Plant Population and Seed rate
9. Calculation of fertilizer requirement
10. Study of yield attributes in different crops
11. Estimation of yield in different crops
12. Practice on method of application of manures and fertilizers
13. Study of micro irrigation methods
14. Identification of maturity symptoms of different crops
15. Identification of weeds in field crops and other habitats
16. Herbicide label information, computation of herbicide doses and precautionary measures while using herbicides.

Textbooks

1. Principles of Agronomy by T. Yellamanda Reddy, G.H Sankara Reddy. Kalyani Publications, New Delhi.
2. Principles of Agronomy by S.R Reddy. Kalyani Publications, New Delhi.

Suggested Readings

1. Principles of Weed Science by Rao V S. Oxford and IBH Publishing Co. Ltd. New Delhi.
2. Principles of Agronomy by Reddy Yellamanda T and Shankar Reddy G H. Kalyani Publishers, Ludhiana.
3. Principle of Crop Production by S.R. Reddy. Kalyani Publisher, Ludhiana.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-STAM-101**
Course Title	**:**	**Introductory Mathematics**
Credits	**:**	**1(0+1)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

1. To acquaint student with the basics of Mathematics i.e., Progressions, matrices, Differentiation, Integration and Mathematical models.
2. To provide basic knowledge Mathematics which can be used in other subjects of Agriculture
3. To make students familiar with Mathematics applications in agriculture

A) Practical Lecture Outlines

1. Progressions - Introduction - Arithmetic, Geometric and Harmonic Progressions (nth term and sum of n-terms) and Problems
2. Matrices – Introduction, Definitions – Types- Addition- Subtraction- Multiplication (Upto 3rd order) and its examples
3. Transpose, Minor, cofactor, adjoint of matrices and Inverse of a matrix by adjoint method (Upto 3rd order) and problems
4. Properties of determinants up to 3rd order and simple problems
5. Differentiation – Introduction - derivative of x^n, e^x, sin x and cos x by first principle.
6. Derivatives rules on sum, difference, product and quotient of two functions - Simple problems based on it.
7. Derivative of a function of a function (chain rule), Logarithmic differentiations and problems.
8. Applications of Differentiation- Growth rate, Average cost, Marginal cost and Marginal Revenue and problems.
9. Increasing, Decreasing and Maxima and minima of a function y = f(x) and related problems
10. Partial differentiation- Introduction -Problems on partial differentiation of first and second orders.
11. Problems on Homogeneous function- Euler's theorem.
12. Indefinite Integrals- Introduction- and problems

13. Definite Integrals and problems
14. Integration of product of two functions – Integration by substitution and problems
15. Mathematical Models: Model Definition- Problems on fitting of Linear ($y = a + bx$) and quadratic ($y = a + bx + cx^2$) on experimental data.
16. Mathematical Models - Problems on fitting of exponential models ($y = ae^{bx}\ and\ y = ab^{x}$) on experimental data.

Textbook

1. Agricultural Mathematics by MVSL DN Raju and K.V. Ramana. Kalyani Publishers, New Delhi.

Suggested Readings

1. Engineering Mathematics-I by M. Vishnu Murthy. Falcon Publishers, Hyderabad.
2. Engineering Mathematics-II by M. Vishnu Murthy. Falcon Publishers, Hyderabad.
3. Text Book of NCERT Mathematics for X class.
4. Fundamental Mathematical Statistics by S.C Gupta and V.K. Kapoor. Sultan Chand & Sons, Delhi.

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Course No.	**:**	**AU-SSAC-121**
Course Title	**:**	**Fundamentals of Soil Science**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

1. To impart knowledge on soil genesis, basic soil properties with respect to plant growth

Course Outlines

Theory

Soil- Pedological and edaphalogical concepts. Rocks and minerals, weathering, soil formation, soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

Practical

Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks-igneous, sedimentary and metamorphic rocks; study of a soil profile, collection and processing of soil analysis, study of soil texture-feel method, mechanical analysis, determination of bulk density, particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of so moisture, determination of soil moisture constants field capacity; water holding capacity, Study of infiltration rate of soil

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Soil pedological and edaphological concepts- Introduction — spheres of the earth atmosphere, hydrosphere and lithosphere – their characteristics – origin of soil – soil and soil components – mineral matter, organic matter, water and air – definition of soil and various concepts of soil – branches of soil science
2. Rocks – classification of rocks based on mode of origin and formation – igneous rocks, sedimentary rocks and metamorphic rocks – classification of rocks based on silica content – weatherability of rocks
3. Minerals – primary, secondary, essential and accessory minerals – primary minerals – quartz, feldspar,

micas, pyroxenes, amphiboles and olivine's – weatherability of primary minerals

4. Secondary minerals- non-silicate minerals – P, Ca, Mg, S and micronutrient containing minerals – secondary silicate minerals – basic structural units
5. Weathering – types of weathering – physical weathering of rocks – agents of physical weathering and their role - Biological weathering – role of flora and fauna in weathering process
6. Chemical weathering – solution, hydration, hydrolysis, carbonation, oxidation and reduction
7. Soil formation – soil forming factors – classification – climate, biosphere, parent material, topography, time and their role in soil formation – catena – definition
8. Pedogenic processes – basic processes (gains, losses, transformation and translocations) – Fundamental pedogenic processes- eluviation, illuviation, humification, Specific pedogenic processes -calcification, decalcification laterization, podzolization, gleization, salinization, desalinization, alkalization, dealkalization and pedoturbation
9. Soil profile – detailed description of a theoretical soil profile – differences between surface soil and sub soil
10. Soil physical properties – soil texture – definition – various inorganic components in soil and their properties – various textural classes in soil and their properties
11. Particle size analysis –Stoke's Law – assumptions and limitations – significance of soil texture
12. Soil structure – classification – types, classes and grades of soil structure – formation of soil structure - importance of soil structure and its management.
13. Density of soil – bulk density and particle density – factors affecting density parameters – importance of bulk density of soil – soil compaction – its importance – calculation of porosity
14. Soil consistence – consistence of wet and dry soils – soil crusting – soil plasticity – Atterberg's plastic limits – factors affecting plastic limits – significance of soil consistence
15. Soil strength and its importance – soil colour – components – significance of soil colour
16. Soil temperature – sources of heat – heat capacity and conductivity –factors influencing soil temperature – modification of soil thermal regimes – measurement of soil temperature – importance of soil temperature on crop growth – management of soil temperature and importance
17. Soil air – compositions of atmospheric air and soil air – gaseous exchange – influence of soil air on plant growth, soil properties and nutrient availability – ODR, measurement of oxygen diffusion rate – measures to improve soil aeration
18. Soil water – forces of soil water retention – pF concept – soil moisture characteristic curves – importance of soil water
19. Soil water potential – components of water potentials – soil moisture constants – field capacity, wilting coefficient, hygroscopic water and saturation – available water and methods for determining soil moisture constants – pressure plate and pressure membrane apparatus
20. Water content – soil water movement – Darcy's Law – saturated, unsaturated and vapour flows – infiltration, percolation and permeability – distribution of water in profile in different soils – soil drainage

and its importance

21. Soil reaction, pH, soil acidity and alkalinity, buffering capacity, effect of pH on nutrient availability
22. Soil colloids – definition – general properties – shape, surface area, electrical charge, adsorption, flocculation, deflocculation, plasticity, cohesion, swelling, shrinkage, Tyndall effect and Brownian movement
23. Secondary silicate clay minerals –classification based on structure - properties of kaolinite, illite, montmorillonite and chlorite – properties – allophones.
24. Origin of charge in organic and inorganic colloids – negative and positive charges – differences between organic and inorganic soil colloids
25. Adsorption of ions – types of ion exchange – cation and anion exchange –cation and anion exchange capacities of soil – base saturation – factors affecting ion exchange capacity of soils – importance of Cation Exchange Capacity (CEC) of soils – calculation of base exchange capacity and exchangeable acidity
26. Soil biology – biomass – flora and fauna – their important characteristics – role of beneficial organisms – organic matter decomposition, mineralization and immobilization
27. Nitrogen fixation, denitrification, solubilization of phosphorus and biological control of plant diseases – promotion of plant growth promoting substances –harmful activities of soil organisms
28. Soil organic matter – various sources – composition – compounds in plant residues – their decomposability – humus – definition – synthesis of humus
29. Importance of soil organic matter and humus – fractionation of soil humus – carbon cycle – carbon: nitrogen (C: N) ratio of commonly available organic residues – significance of C:N ratio in soil fertility
30. Soil classification – early system of soil classification – diagnostic horizons- surface and sub- surface horizons
31. Soil taxonomy – Keys to soil orders, - criteria at each category of Order suborder, great group, subgroup, family and series – nomenclature according to soil taxonomy
32. Soils of India – major characteristics – potentials and limitations - alluvial soils, black soils, red soils, laterite soils salt affected, desert soils, Forest and hilly soils and peat and marshy soils

B) Practicals

1. Study of general properties of minerals –silicate and non -silicate
2. Study of igneous, sedentary and metamorphic rocks
3. Study of soil sampling tools, collection of representative soil sample, its processing and storage
4. Description of soil profile in the field
5. Determination of texture by feel method
6. Determination of mechanical composition of soil using Bouyoucos Hydrometer
7. Determination of bulk density of soil
8. Determination of particle density of soil and porosity

9. Determination of soil moisture content by gravimetric method
10. Determination of infiltration rate of soil
11. Determination of soil moisture constants- Field capacity
12. Determination of pH and EC of soil
13. Aggregate analysis by wet sieving method
14. Determination of water holding capacity of soil
15. Determination of cation exchange capacity of soil
16. Determination of soil colour

Textbooks

1. Introductory Soil Science by D.K. Das. Kalyani publishers, New Delhi.
2. Fundamentals of Soil Science by Goswami N N. ISSS publications, New Delhi.

Suggested Readings

1. Soil Fertility and Nutrient Management by S S Singh. Kalyani Publishers, New Delhi.
2. Introductory Soil Science by D. K. Das. Kalyani publishers, New Delhi
3. Soil Fertility and Fertilizers by Samuel Tisdale, Nelson Werner L, Beaton James D and Havlin John L, Macmillan Publishing Co., New York.
4. The Nature and properties of soils by Harry, O Buckman and Nyle C. Brady. Macmillan Publishing Co., New York
5. A textbook of Pedology –concepts and applications by Sehagal, J. Kalyani publishers, New Delhi.

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Course No.	**:**	**AU-HORT-181**
Course Title	**:**	**Fundamentals of Horticulture**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

1. To provide knowledge on different branches of horticulture viz. pomology, olericulture, floriculture and landscaping, spices and medicinal plants.
2. To provide knowledge on orchard management, propagation methods, cultural Operations and nutrient management of horticultural crops.
3. To provide knowledge on different physiological aspects of horticultural crops

Course Outlines

Theory

Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops. Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship. Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation, unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization and parthenocarpy, importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.

Practical

Identification and nomenclature of fruit, Layout of an orchard, pit making and system of planting, Nursery raising techniques of fruit crops, Understanding of plant propagation structures, Propagation through seeds and plant parts, Propagation techniques for horticultural crops, Container, potting mixture, potting and repotting, Training and pruning methods on fruit crops, Preparation of fertilizer mixture and application, Preparation and application of PGR, Layout of different irrigation systems, Maturity studies, harvesting, grading, packaging and storage.

A) Theory Lecture Outlines

Lec.No **Topics**

1. Horticulture- Definition- Divisions of horticulture with suitable examples
2. Scope and Importance of horticulture - Importance of horticulture in terms of income, employment generation, industry, religious, aesthetic, food & nutritive value and export
3. Horticultural botanical classification – nature and continuation of growth- types of fruit- plant part used- ripening – ethylene evolution – bearing habit
4. Horticultural classification based on soil, salinity, acidity – climate – temperature and photoperiod
5. Climate and soil for horticultural crops - Influence of environmental factors on horticultural crop production – temperature, humidity, wind, rainfall and solar radiation – influence of soil factors – soil type, pH, EC
6. Propagating structures – Mist chamber, green house, lath house, hot bed, cold bed
7. Plant propagation- Definition - Sexual and asexual – merits and demerits
8. Seed dormancy - Definition and types - Seed germination - Polyembryony
9. Plant propagation by stem and root cuttings – definition of cutting– types of stem cuttings – leaf cuttings root cuttings
10. Propagation by Layering- types of layering - tip, simple, compound, mound, trench, air layering
11. Propagation by natural modifications of layering (runners, suckers, stolon, offset)
12. Propagation by Separation-bulbs, corms; division (rhizome, stem tuber, tuberous roots)
13. Grafting- Rootstock and scion selection –grafting methods- attached scion methods of grafting, simple or approach grafting, detached scion methods of grafting (side grafting- veneer grafting; apical grafting- epicotyl grafting, double, soft wood grafting, cleft grafting, tongue grafting, whip grafting)
14. Graft incompatibility – types – translocated and localized incompatibility; Top working
15. Budding – Methods of budding – T-budding, inverted T-budding, patch budding and ring budding.
16. Principles of Orchard establishment – site selection for the establishment of orchards
17. Steps in orchard establishment - layout of orchards
18. Systems of planting - square, rectangle, quincunx, hexagonal and contour systems of planting-their merits and demerits
19. High Density Planting – components (dwarf scions, rootstocks, training and pruning, use of growth regulators) – Advantages and disadvantages

20. Principles and methods of training - Definition of training, objectives and training - methods of training in fruit crops-open centre, closed centre and modified leader systems their merits and demerits
21. Principles and methods of pruning - Definition of pruning, objectives of pruning, methods of pruning of in horticultural crops.
22. Juvenility and Methods for shortening juvenility - Application of growth regulators (Gibberellins, Auxins, Cytokinins, Abscissic acid, Ethylene), environmental methods (photoperiod, temperature), Cultivation techniques (grafting, pruning, girdling, irrigation, nutrition)
23. Flower bud differentiation – bearing habit - types of bearing habits in horticultural crops
24. Unfruitfulness – definition - factors - physiological, phylogenical, management, parasitical, climatological factors
25. Pollination – factors for Self and Cross pollination, pollinizers and pollinators
26. Fertilization and Parthenocarpy-Definition and its types
27. Vegetable gardens – Types – Kitchen Garden, Market Garden, Truck Garden, Vegetable Forcing, Garden for Processing, Seed production garden and Floating Garden.
28. Ornamental garden types– Formal – Informal – Wild Garden – Parts/features of an ornamental garden
29. Lawn making – Suitable Grasses – Methods of planting – Sowing of Seeds – Dibbling – Turfing – Turf plastering - Maintenance of lawn – Weeding – Liming – Rolling – Mowing – Sweeping – Scraping – Raking –Irrigation – Management of pests & diseases.
30. Irrigation methods in horticulture crops - Different methods followed in horticultural crops (flood, basin, check basin, ring basin, furrow, pitcher, funnel, drip, sprinkler, bubbler etc.)
31. Fertilizer application- Different methods of application to horticultural crops- Broad casting, top dressing, localized placement, contact placement Band placement, row placement, pellet, foliar application, starter solution, fertigation.
32. Importance of plant bio-regulators (PBR) in horticulture – Introduction – Applications of PBR in fruit crops

B) Practicals

1. Identification of tools and implements
2. Identification and nomenclature of horticultural crops
3. Layout of an orchard, pit making and system of planting
4. Nursery raising techniques of fruit crops
5. Propagation through seeds
6. Propagation through cuttings and divisions

7. Propagation through grafting
8. Propagation through budding
9. Propagation through layering
10. Containers, potting mixture, potting and repotting
11. Training and pruning methods on fruit crops
12. Preparation of fertilizer mixture and application
13. Preparation and application of PGR
14. Layout of different irrigation systems
15. Maturity studies of horticultural crops
16. Visit to commercial nurseries/ orchards

Textbooks

1. Basic Horticulture by Jitendra Singh. Kalyani Publishers, New Delhi.
2. Fundamentals of Horticulture by Jitendra Singh. Kalyani Publishers, New Delhi.

Suggested Readings

1. Basics of Horticulture by Jitendra Singh. Kalyani Publishers, New Delhi.
2. Introduction to Horticulture by N. Kumar. Oxford and IBH Publishing (CBS Publishers), New Delhi.
3. Handbook of Horticulture by Indian Council of Agricultural Research, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- AEXT-191**
Course Title	**:**	**Communication Skills**
Credits	**:**	**2 (1+1)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication

Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication. Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/Abstracting/Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions. Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbal's; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

Practical

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. **Communication:** Definition, Meaning, Concept, Nature, Significance / Functions of Communication and Magic of effective Communication Process.
2. **Self Esteem:** Building Self-Esteem and Overcoming Fears.

3. **Communication Process:** Elements, Characteristics, Models.
4. **Types of Communication**: Verbal and Non-Verbal Communication: Definition, Meaning, Types, Characteristics, Advantages and Disadvantages.
5. **Communication Barriers**: Linguistic and Non-Linguistic Barriers to Communication and Reasons behind Communication Gap / Miscommunication.
6. **Listening Skills:** Definition, Meaning, Types, Stages in the Process and Techniques of increasing Listening Efficiency and **Speaking Skills:** Definition, Meaning, Types and Steps in the Preparation of Speech
7. **Reading Skills:** Definition, Meaning, Types and **Writing Skills:** Definition, Meaning, Characteristics, Principles, Process, Types of Writing Styles, Forms of Written Communication, Pointers and Tips for effective Written Communication, Advantages and Disadvantages.
8. **Precise Writing:** Definition, Meaning, Characteristic Features of Good Précis, Do's and Don'ts of Précis Writing / Abstracting / Summarizing. **Technical / Professional Communication**: Importance, Choice of Words and Phrases, Clichés, Jargons, Foreign words and Phrases and Style of Technical / Professional Communication.
9. **Curriculum Vitae / Resume Writing:** Personal, Social, Educational, Professional, Training, Achievements, Hobbies and Reference Profile Making
10. **Vocabulary and Analogy:** Innovative Methods to enhance Vocabulary: Words often Confused, Correct and Incorrect Words and Homophones and Analogy Questions.
11. **Structural Grammar:** Sentence Structure and Modifiers, Connecting Words and Verbal's.
12. **Structural Grammar:** Phrases and Clauses
13. **Structural Grammar:** Case - Subjective Case, Possessive Case: Objective Case.
14. **Structural Grammar:** Correct usage of Nouns, Pronouns and Antecedents, Adjectives, Adverbs and Articles.
15. **Functional Grammar:** Agreement of Verb with the Subject: Tense, Mood, Voice.
16. **Functional Grammar:** Writing effective Sentences; Basic Sentence Faults.

B) Practicals

1. Listening Skill

- Lecture cum Discussion on Types and Stages in the Listening Process
- Simulated Exercise on Listening Skill:

  (a) Viewing 10 - 20 Minutes Video on Agricultural Production Technology (b) Answering to 5 Minutes Quiz.

2. Note Taking

- Recapitulation on Techniques of Note Taking, Suggestions for Note Taking and Uses

- Reading Chapter on "Audio – Visual Aids and Information Communication Technology (ICT)" in Book on 'Fundamentals of Agricultural Extension Education' authored by SAGAR MANDAL
- Assignment for depicting Topic through different Methods of Note Taking

3. Writing Skills

- Recapitulation on Definition, Meaning, Characteristics, Principles, Process, Forms of Written Communication, Pointers and Tips for effective Written Communication, Things to keep in mind while Writing, Advantages and Disadvantages and Type of Writing Styles.
- Simulative Exercise on Writing Styles and Writing 20 Sentences on any Topic.
- Finding out the Defects in Sentence Construction by Students

4. Precis Writing, Summarizing and Abstracting

- Recapitulation on Definition, Meaning, Characteristic Features of Good Precis, Do's and Don'ts of Precis Writing / Abstracting / Summarizing.
- Allocation of any one Topic and finding out the Precis Writing / Abstracting /Summarizing Skills of Students

5. Reading and Comprehension (Written and Oral) of General Articles.

- Exercise to make Personal Observations on Writing Styles followed in the Informal Journals / Magazines: Intensive Agriculture; Indian Farming, Indian Horticulture, Yojana and Kurukshetra.

6. Reading and Comprehension (Written and Oral) of Technical Articles

- Exercise to make Personal Observations on Technical Writing Styles followed in the Formal Journals Journal of Research, ANGRAU: Andhra Agricultural Journal; Andhra Pradesh Journal of Agricultural Sciences, Research Journal of Agriculture; Indian Journal of Agricultural Sciences, Indian Journal of Extension;

7. Micro - Presentations

- Lecture cum Discussion on Definition, Meaning, Structure, Types, Tips, Guidelines (Do's and Don'ts) and Purpose
- Five Minutes Extempore Presentation by students on any Topic instantaneously given

8. Impromptu Presentations

- Lecture cum Discussion on Definition, Meaning, Types, Formats, Structure, Techniques, Tips and Benefits
- Assigning Group Exercise to students on different Formats of Impromptu Presentations

9. Feedback on Presentations

- Lecture cum Discussion on Definition, Meaning, Functions, Types, Evaluation Criteria for Feedback, Importance, Tips for effective Feedback
- Assigning Group Exercise to derive Feedback on any Modern Agricultural Technology.

10.Stage Manners: Grooming and Body language

- Lecture cum Discussion on Definition, Meaning, Basics, Attributes and Factors of Good Grooming, Body Language: Meaning, Definition, Elements, Tips and 5 Cs of Body Language, Role and Importance in Communication
- Assigning Topics on any Modern Agricultural Technology to derive Feedback after PPT Presentation.

11.Stage Manners: Voice Modulation and Speed:

- Voice Modulation: Definition, Meaning, Elements / Components and Importance and Speed of Delivery for different occasion
- Assigning Topics on Agriculture to derive Feedback after PPT Presentation

12.Group Discussions:

- Lecture cum Discussion on Small Group Discussion Methods, Objectives, Purposes, Procedure, Roles of Chairman and Members, Evaluation Criteria and Merits and Demerits
- Simulated Exercise on group Discussion to find out the General Problem in Village and Specific Problems in any Crop Production Technology

13. Public Speaking

- Lecture cum Discussion on Definition, Meaning, Benefits, Elements, Steps of Preparation for Public Speaking.
- Assigning Topics for Presentation on Types of Public Speaking

14. Vocabulary Building Exercise

- Definition, Meaning of Meaning of Antonyms, Synonyms, Homonyms, Homophones, Words often Confused, Correct and Incorrect Words, Words connected with Parts of Speech, Idioms and Phrases; Usages, Sayings and Abbreviations; Anglicized Words
- Assigning Topics to find out the Words often Confused, Correct and Incorrect Words

15. Interview Techniques

- Lecture cum Discussion on Definition, Meaning, Types, Techniques, Purpose, Body Language, Types of Questions to be asked in Interview and Strategies of Effective Interview
- Group Exercise on Types of Interviews

16. Organization of Events:

- Lecture cum Discussion on Definition, Meaning, Purpose, Steps and Tips in Organisation and Evaluation of Event
- Group Exercise on Organisation and Evaluation of Event

Textbooks

1. A Text Book on Communication Skills by Seema Jat. Shubha Awasthi Scientific Publishers, Rajasthan.
2. Communication Skills by Kumar, S. and Pushpa Lata. Oxford University Press.

Suggested Readings

1. Personality: A Psychological Interpretation by Allport, G. W. Holt, New York.
2. How to Interview and be interviewed by Brown Michele and Gyles Brandreth. Sheldon Press, London.
3. The Quick and Easy Way to Effective Speaking by Carnegie Dale. Pocket Books, New York.
4. Soft Skills and Professional Communication by Francis Peter. Tata McGraw Hill, New Delhi.
5. Communication Skills by Kumar, S. and Pushpa Lata. Oxford University Press. UK.
6. Intercultural Communication A Contextual Approach by James W Neuliep. Houghton Mifflin Co Boston.
7. Body Language by Pease, Allan. Sudha Publications, Delhi.
8. Business Communication by Raman, M. and Singh. Oxford University Press, UK.
9. Oxford Guide to Effective Writing and Speaking by J. Seely. Oxford University Press, UK.
10. A Practical English Grammar by Thomson, A. J. and Martinet. Oxford University, UK.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AEXT-192**
Course Title	**:**	**Rural Sociology and Educational Psychology**
Credits	**:**	**2 (2+0)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

Provide knowledge on concept and importance of sociology and rural sociology as well as the relationship with Extension Education

Course Outlines

Theory

Extension Education and Agricultural Extension – Meaning, Definition, Scope, and Importance. Sociology and rural sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension, and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies. Social Groups- Meaning, Definition, Classification, Factors considered information and organization of groups, Motivation in group formation and Role of social groups in Agricultural Extension. Social Stratification- Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification- Characteristics and- Differences between Class & Caste System. Cultural concepts- Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions- Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in agricultural Extension. Social Institutions- Meaning, Definition, Major institutions in Rural Society, Functions, and their Role in agricultural Extension. Social Organizations- Meaning, Definition, Types of organizations and role of social organizations in agricultural Extension. Social Control- Meaning, Definition, need of social control and Means of Social Control. Social change- Meaning, Definition, Nature of Social Change, Dimensions of social change and factors of social change. Leadership- Meaning, Definition, Classification, Roles of leader, Different methods of Selection of Professional and Lay leaders. Training of Leaders Meaning, Definition, Methods of training, Advantages and Limitations in use of local leaders in Agricultural Extension, Psychology and Educational Psychology- Meaning, Definition, Scope, and Importance of Educational Psychology in Agricultural Extension. Intelligence- Meaning, Definition,

Types, Factors affecting intelligence and Importance of intelligence in Agricultural Extension. Personality- Meaning, definition, Types, Factors influencing the Personality and Role of personality in agricultural Extension. Teaching- Learning process- Meaning and Definition of Teaching, Learning, learning experience and Learning situation, Elements of learning situation and its characteristics. Principles of learning and their implication of teaching.

A) Theory Lecture Outlines

Lec. No.	**Topics**
1.	Extension Education and Agricultural Extension: Meaning, definition, scope, Emerging Trends in Agricultural Extension
2.	Importance Sociology and importance of rural sociology in India
3.	Meaning, definition, scope, Modernization of rural societies, importance of rural sociology in Agricultural Extension
4.	Interrelationship between rural and urban societies, Changing trends in Rural Livelihoods and their role in Agricultural Extension
5.	Indian Rural Society: important characteristics
6.	Differences and relationship between rural and urban societies. Effects of urbanization on rural societies
7.	Social Groups: Meaning, definition, factors considered in formation, organization of groups, motivation in group formation
8.	Characteristics of groups, groups vs society, groups vs community, functions of groups, role of social groups in Agricultural Extension
9.	Social Stratification: Meaning, definition, functions, basis for stratification
10.	Forms of social stratification-characteristics, Social Mobility, Gender based Social Stratification in Rural Communities and differences between class and caste system
11.	Cultural concepts. Culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension.
12.	Importance of culture, structure of culture, socialization and elements of culture
13.	Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension
14.	Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension
15.	Social Organizations: Meaning, definition, types and elements of organizations and role of social organizations in agricultural Extension
16.	Social control: Meaning, definition, need of social control and means of social control. Traditional vs. Modern Mechanisms of Social Control in Rural Societies

17. Social change Meaning, definition, nature of social change, dimensions of social change and factors of social change.
18. Leadership: Meaning, definition, classification, roles of leader
19. Different methods of selection of professional and lay leaders
20. Training of leaders: Meaning, definition, methods of training
21. Advantages and limitations in use of local leaders in Agricultural Extension
22. Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension. Behavioural Psychology in Adoption of Agricultural Innovations
23. Domains of learners Behaviour and Levels of Learners behaviour
24. Emotions, Meaning Types and effect of Emotion Human behaviour on techniques improve positive emotions
25. Frustration, meaning Definition types, Factors for frustration importance of Frustration in Agricultural extension
26. Intelligence Meaning definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension. Artificial Intelligence in Supporting Extension Services
27. Theories of intelligence, measurement and factors affecting intelligence and importance of intelligence in Agricultural Extension
28. Personality: Meaning, definition, types, factors influencing the personality and role of personality in agricultural extension
29. Teaching: Learning process: Meaning and definition of teaching, learning, learning experience and learning situation. E-learning Tools
30. Elements of learning situation and its characteristics. Blended Learning Approaches in Agricultural Education.
31. Steps in Extension teaching, teaching methods
32. Principles of learning and their implication of teaching. Gamification in Learning for Agricultural Extension

Textbook

1. Introductory Rural Sociology by J.B. Chitambar. New Age International Publishers, New Delhi.
2. Textbook on Rural Sociology and Educational Psychology by R. Velusamy. Daya Publishing House, New Delhi

Suggested Readings

1. Rural Sociology in India by A.R. Desai. The Indian Society of Agricultural Economics (ISAE), Bombay

2. Education and Communication for Development by Dahama O. P. and Bhatnagar, O. P. Oxford & IBH Publishing Company, New Delhi
3. Essential of psychology by M.B. Ghorpade. Himalaya Publishing House, Mumbai.
4. Extension Communication and Management by Ray, G. L. Kalyani Publishers. New Delhi.
5. Textbook on Agricultural Communication by Sandhu A. S. CBS Publishers & Distributors, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- SEC-I**
Course Title	**:**	**Seed Production and Testing Technology**
Credits	**:**	**2(0+2)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

1. To provide knowledge on concepts and importance of seed production technology.
2. To impart skills on varietal and hybrid seed production techniques in major crops.
3. To educate about seed testing for quality seed production.
4. To impart practical skills by arranging visits to various seed production fields, seed industries, seed testing labs, seed processing plants, seed storage godowns etc.

A) Practical Lecture outlines

1. Study of floral biology of angiospermic plants.
2. Study of modes of reproduction – sporogenesis – Gametogenesis.
3. Study of modes of pollination – Self pollination – Cross pollination – Often cross pollination.
4. Breeding tools for hybrid seed production –Breeders Kit- emasculation and pollination techniques.
5. Seed production vs Crop production.
6. Types of seed production – Varietal & Hybrid seed production
7. Structure of seed industry in India – Formal and informal systems – Seed supply chain.
8. Agronomic principles of seed production.
9. Genetic principles of seed production.
10. General steps involved in production of quality seed.
11. Classes of seed and generation system of seed multiplication.
12. Hybrid Seed - Methods of development of hybrids; use of male sterility and self- incompatibility and CHAs in hybrid seed production.
13. Planting design for hybrid seed production - rice, maize, pearl millet, cotton, red gram, sunflower.
14. Study on methods of achieving synchronization in flowering and practicing supplementary pollination.
15. Practicing roguing operation - identification of off-types, pollen shedders, shedding tassels, partials, selfed bolls.

16. Methods and techniques of seed production in varieties and hybrids of rice.
17. Methods and techniques of seed production in varieties and hybrids of maize.
18. Varietal and hybrid seed production in pulses – red gram
19. Varietal and hybrid seed production in oil seeds – sunflower.
20. Varietal and hybrid seed production in fibre crops – cotton.
21. Hybrid seed production techniques in vegetables – Tomato, Chillies, Brinjal.
22. Seed production planning and economics of seed production - varieties
23. Seed production planning and economics of seed production – hybrids.
24. Layout of seed testing laboratory, identification and handling of instruments used in seed testing laboratory.
25. Preparation of seed album and identification of seeds.
26. Visit to seed production fields.
27. Visit to public sector seed industry
28. Visit to private sector seed industry.
29. Visit to seed testing laboratory.
30. Visit to seed processing plant.
31. Visit to seed certification agency.
32. Visit to seed storage godowns.

Textbooks

1. Malavika Dadlani and Devendra K. Yadava. 2023. Seed Science and Technology Biology, Production, Quality, Springer, Singapore.
2. Agarwal R L. 2021. Seed Technology**,** Oxford and IBH Publication Co., New Delhi.

Suggested Readings

1. Seed Science and technology by Singhal NC. Kalyani Publishers, New Delhi
2. Seed Technology by Dhirendra Khare and Mohan S. Bhale. Scientific Publishers (India), Jodhpur
3. Hybrid Seed Production in Field crops by Singhal NC. Kalyani Publishers, New Delhi
4. Principles of Seed Science and technology by Copeland, L.O and McDonald. Kluwer Academic Publishers, USA
5. Techniques in seed science and Technology by Agarwal P K and Dadlani M. South Asian Publishers, New Delhi.
6. Principles of Seed technology by Agarwal P K. ICAR, New Delhi.

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Course No.	**:**	**AU- SEC-II**
Course Title	**:**	**Commercial Horticulture**
Credits	**:**	**2(0+2)**
Year	**:**	**I**
Semester	**:**	**I**

Practical Lecture outlines

1. Importance of commercial Horticulture - Identification of horticultural crops
2. Tools and implements used for horticultural crops production
3. Preparation of nursery beds and sowing of seeds
4. Seed propagation- methods of breaking seed dormancy
5. Types of growing media used in raising nursery
6. Production of high value vegetables/flowers under protected cultivation
7. Containers used for growing of horticultural crops
8. Preparation of potting media- Potting and re-potting of ornamental crops
9. Pro-tray raising of seedlings
10. Propagation through cuttings (Stem, leaf and root)
11. Propagation through separations and divisions
12. Practicing the different methods of layering
13. Practicing methods of grafting in horticultural crops
14. Practicing methods of budding in horticultural crops
15. Hands on experience on making hanging pots/Ornamental crops
16. Practicing different methods of training in horticultural crops
17. Practicing different methods of pruning in horticultural crops
18. Irrigation management in horticultural crops
19. Weed management in horticultural crops

20. Nutrient management in horticultural crops
21. Vertical gardening
22. Roof gardening
23. Methods for dry flower making – hands on experience in making potpourri, skeletonization, garland etc.)
24. Hands on experience in making carpet beds, flower beds, topiaries
25. Hands on experience in making terrarium
26. Study of different packaging material
27. plant growth regulators in propagation - Preparation and practicing
28. Storage of propagation material – bulbous/corms/rhizomatous horticultural crops
29. Styles of floral arrangements
30. Visit to commercial nurseries
31. Visit to commercial orchards
32. Visit to fruit, flower and vegetable market

Textbooks

1. Floriculture in india- G.S. Randhawa and A. Mukthopadhyay- Allied publishers pvt Ltd.
2. Commercial floriculture and landscaping- Rajendra singh- current publications

Suggested Readings

1. Basic Horticulture by Jitendra Singh. Kalyani Publishers, New Delhi.
2. Fundamentals of Horticulture by Jitendra Singh. Kalyani Publishers, New Delhi.
3. Introduction to Horticulture by Kumar N. Oxford and IBH Publishing (CBS Publishers), New Delhi.
4. Plant propagation- Principles and Practices by Hartmann and Kester. Pearson College Div, UK
5. Floriculture and landscaping by G.S. Randhawa and Amitabha Mukhopadhyay. Allied publishers pvt Ltd, Chennai.

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Course No.	**:**	**AU- SEC-XI**
Course Title	**:**	**Agricultural Waste Management**
Credits	**:**	**2(0+2)**
Year	**:**	**I**
Semester	**:**	**I**

Objectives

1. To understand the sources, classification, characteristics, generation, and environmental implications of agricultural, industrial, plastic, and electronic wastes, along with principles of sustainable waste management.
2. To acquire knowledge and practical skills in waste treatment, recycling, composting, vermicomposting, biogas production, waste-to-energy technologies, wastewater reuse, and wealth creation from agricultural wastes

Practical Lecture outlines

1. Agricultural Waste- Generation of waste – Sources of wastes – Classification - Waste categorization
2. Waste management- Functions- production, collection, storage, treatment, transfer, utilization- Nature and characteristics of agricultural waste - Kinds of waste- Problems of waste - Hazardous and non-hazardous waste
3. Sources of waste - Crop residues - Process residues- status of production - Challenges- Management options for sustainability
4. Technologies for waste management- Smart waste bins- Waste level sensors- AI recycling robots Garbage truck weighing mechanisms- Pneumatic waste pipes-Solar-powered trash compactors- E-waste kiosks- Recycling apps
5. Plastic waste -E waste – Collection- Sorting- Disassembly- Repurposing— Recycling 3 R's Concept Challenges- Implications - Opportunities- Extended producers' responsibility - Environmental impact.
6. Waste Management - Waste-to-energy conversion- Bio methanation - Bio char - Gasification Incineration- Pyrolysis- Anaerobic digestion- Land fill recovery-Bio fuel (Bio CNG)- Bio oil- Benefits – Challenges and Considerations
7. Composting- Methods of composting- Types of composting- (ADCO, Activated, Bangalore, Coimbatore, NADEP, Rainwater, Mechanical, sugarcane trash compost)- Advantages.

8. Vermicomposting – Vermitechnology-Types - Raw materials- Starters-Methods of preparation – Advantages
9. Bio gas production technology - Janata, Deena bandhu, Pragathi - Components- Benefits – Applications Challenges and Future prospects.
10. Management of bedding and litter-types of bedding and litter material- Litter amendments and litter utilization
11. Waste decomposer – Role of decomposers-Types- (Ghaziabad & Amaravathi) Procedure for preparation Usage- Environmental impact- Management of residues through waste decomposer.
12. Waste recycling–Farming systems approach- Rice- Livestock, Rice-Fish- Rice- Fish and Poultry.
13. Creating wealth from waste- Materials needed (paddy straw- Maize Cobs-Coconut fronds-Cotton stalks-Banana stem). Idea generation- Design and planning and creation.
14. Occupational hazards-associated with waste handling-Infections-Chronic Diseases-Effect of heavy metals on human health.
15. Waste Management equipment – Operation procedure of Waste management machineries-criteria for selection of waste handling equipment- (Hand scrapers, shovels, brooms, washers) - Waste transfer - (Augers and conveyors)- Waste storage equipment- Waste treatment equipment (Agitators, stirrers, mixers)
16. Visit to Agro based industries-Sugar/ Dairy/ Paper/ food processing/Bio fuel/ Agro processing industries-Cereal/ fruit and vegetable/Dairy
17. Visit to Wealth from waste centers /Solid waste management yards/recycling centers/ Solid waste collection centres /Recycling plants/ Composting units/Waste to energy plants and Landfills
18. Determination of moisture through gravimetric method
19. Preparation waste sample and analysis of waste sample and Determination of pH, EC, CEC
20. Determination of heavy metals- Lead- Nickel- Chromium
21. Determination of BOD, COD
22. Determination of TDS, NH_4
23. Determination of total P
24. Determination of N in agricultural waste
25. Determination of K in agricultural waste
26. Determination of Calcium Magnesium and Sulphur in agricultural waste
27. Determination of micronutrients in agricultural waste
28. Determination organic carbon and C: N ratio
29. Survey of different agri-wastes from livestock, dairy and poultry
30. Survey of different agri-wastes from food processing, fruit and vegetable and agrichemicals
31. Waste water treatment for re use in Agriculture
32. Visit to sewage treatment plant /bio gas plant

Textbook

1. Agricultural Waste Management by M. Devender Reddy, M. Roja, CH. Deepthi, Kalyani Publication, New Delhi.

Suggested Readings

1. Integrated Solid Waste Management: Engineering Principles and Management Issues by Tchobanoglous, G., Theisen, H., & Vigil, S.A. McGraw-Hill Education.
2. Organic Farming: Theory and Practice by Palaniappan, S.P. & Annadurai, K Scientific Publishers, Jodhpur.
3. Vermiculture and Organic Farming by Sathe, T.V. Daya Publishing House, New Delhi.
4. Handbook on Waste Management and Recycling by NIIR Board of Consultants and Engineers. National Institute of Industrial Research (NIIR), New Delhi.

COLLEGE OF AGRICULTURE
ANNAMACHARYA UNIVERSITY

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(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)
RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-NCC-I/ AU-NSS-I**
Course Title	**:**	**National Service Scheme/National cadet corps**
Credits	**:**	**1 (0+1)**
Year	**:**	**I**
Semester	**:**	**I**

NCC -I

Objectives

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Practical Lecture Outlines

1. Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline
2. Drill- aim, general words of command, attention, stands at ease, stand easy and turning.
3. Sizing, numbering, forming in three ranks, open and close order march, and dressing
4. Saluting at the halt, getting on parade, dismissing, and falling out.
5. Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
6. Marking time, forward march, and halt. Changing step, formation of squad and squad drill
7. Command and control, organization, badges of rank, honors, and awards
8. Nation Building- cultural heritage, religions, traditions, and customs of India.
9. National integration. Values and ethics, perception, communication, motivation, decision
10. making, discipline and duties of good citizens.
11. Leadership traits, types of leadership. Character/personality development.
12. Civil defense organization, types of emergencies, firefighting, protection.
13. Maintenance of essential services, disaster management, aid during development projects.
14. Basics of social service, weaker sections of society and their needs, NGO's and their contribution,

15. contribution of youth towards social welfare and family planning.
16. Structure and function of human body, diet and exercise, hygiene and sanitation.
17. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health.
18. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control

NSS-I

Objective

1. Introduction and basic components of NSS, NSS programmes and activities, Understanding youth, Community mobilization, social harmony and national integration, Volunteerism and shramdan, Citizenship, constitution and human rights, Family and society.

Practical Lecture Outlines

1. Orientation-History, objectives, principles, symbol and badge
2. Organizational structure of NSS, basic components of NSS-code of conduct for NSS volunteer's, points to be considered by NSS volunteer's awareness about health.
3. NSS programmes and activities-Concept of regular activities.
4. Special camping, day camps, basis of adoption of villages/slums.
5. Conducting survey, analyzing financial patterns of the scheme.
6. Youth programme / schemes of GOI, coordination with different agencies and maintenance of diary.
7. Understanding youth - definition, profile, categories, issues and challenges of youth; opportunities for youth who is agent of the social change.
8. Community mobilization-mapping of community stakeholders, designing the message as per problems and their culture.
9. Identifying methods of mobilization, involving youth-adult partnership.
10. Social harmony and national integration.
11. Indian history and culture, role of youth in nation building, conflictre solution and peace-building.
12. Volunteerism and shramdan - Indian tradition of volunteerism, its need, importance, motivation and constraints.
13. Shramdan as part of volunteerism.
14. Citizenship, constitution and h1uman rights - basic features of constitution of India, fundamental rights and duties.
15. Human rights, consumer awareness and right to information
16. Family and society-Concept of family, community (PRIs and other community-based organisations) and society.

Suggested Readings

1. Rural development principles, policies and management by Kartar Singh, Anil Shisodia. Atlantic publishers and distributors (P) ltd. New Delhi.
2. Family in Society. Boundaries and relationships by Linda Mc. and Sarah Cunningham B. Bristol University Press, U.K.
3. Indian history and culture of the Indian people by Mathur R. C. Bharatiya Vidya Bhavan, Mumbai.
4. National service scheme manual (revised), Government of India, Ministry of Youth affairs and Sports, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course Structure for B.Sc. (Hons.) Agriculture

Semester-II (First Year II Semester)

S. No	Category	Course Number	Course Title	Hours per Week			Credits
				L	T	P	
1.	Common Course	AU-AGMT-101	Environmental Studies and Disaster Management	2	0	2	3(2+1)
2.	Core Course	AU-LSPM-101	Livestock and poultry Management	1	0	2	2(1+1)
3.	Core Course	AU-SSAC-122	Soil Fertility Management	2	0	2	3(2+1)
4.	Core Course	AU-ENTO-131	Fundamentals of Entomology	2	0	2	3(2+1)
5.	Core Course	AU-PATH-171	Fundamentals of Plant Pathology	2	0	2	3(2+1)
6.	Common Course	AU-AEXT-193	Personality Development	1	0	2	2(1+1)
7.	Skill Enhancement course	AU-SEC-III	Floriculture and Landscaping	0	0	4	2(0+2)
		AU-SEC-VII	Biofertlizer and biopesticide production				
		AU-SEC-XIII	Plantation Crop Production and Processing				
8.	Skill Enhancement course	AU-SEC-IV	Introduction to Python Programming	0	0	4	2(0+2)
		AU-SEC-X	Beneficial insect farming				
9.	Common Course	AU-NCC-II/ AU-NSS-II	National Cadet corps (NCC-II)/ National service Scheme (NSS- II)	0	0	2	1(0+1)
						Total Credits	**21**

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- AGMT-101**
Course Title	**:**	**Environmental Studies and disaster Management**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**II**

Objectives

1. To expose and acquire knowledge on the environment and its protection
2. To gain the state-of-the-art - skill and expertise on management of disasters

Course outlines

Theory

Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity Environmental Pollution: Definition, cause, effects and control measures of a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Disaster management - Disaster definition - Types -

Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Practical

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Energy: Biogas production from organic wastes. Visit to windmill / hydro power / solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and unpolluted system. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of E. coli in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond/river/hills. Visit to areas affected by natural disaster.

A) Theory Lecture Outline

Lec. No. Topics

1. Definition, scope and importance of Environmental studies, multidisciplinary nature of environmental studies-need for public awareness
2. Contribution of different scientists, social activists and institutions in relation to environmental studies
3. Segments of Environment: Spheres of Earth - Lithosphere, Hydrosphere, Atmosphere- Different layers of atmosphere. Natural Resources: classification
4. Forest resources: Forest functions- Ecological Significance- Deforestation-Causes and consequences of deforestation on environment- Mangroves protection and significance. Forest protection-Chipko movement and Joint Forest management
5. Water resources: Sources of water- consumption pattern- reasons for decline of ground water – sustainable water management -Public water distribution system- Benefits and problems of dams- Environmental movements against large dams - Narmada bachav andolan
6. Mineral resources: Types of Mineral Resources- Fuel, metallic and non-metallic mineral resources uses and exploitation- distribution of mineral resources - Methods of Mineral Exploration and their effects on environment
7. Food resources: World food problems and environmental concerns-Concept of food security-

Options to Achieve Food Security

8. Energy resources: Classification- Types of renewable energy resources- advantages and disadvantages -environmental impact of different renewable energy resources
9. Types of non-renewable energy resources - advantages and disadvantages - environmental impacts of different non- renewable energy resources.
10. Land resources: Land degradation - mechanisms and causes that initiate land degradation Desertification -causes and control- Land use planning- policies in Land use planning - case studies
11. Soil resources: Types of soils -Types of soil erosion- causes and consequences of soil erosion - strategies for soil conservation- Role of an individual in conservation of natural resources
12. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem- Types of ecosystems- Characteristic features of crop ecosystem
13. Biodiversity and its conservation: Introduction, definition, types of biodiversity, methods to measure biodiversity- Biogeographical classification of India
14. Importance and Value of biodiversity: Biodiversity hot spots- Threats and Conservation of biodiversity- Biodiversity act 2022- National biodiversity authority and its functions
15. Environmental Pollution: Definition, causes, effects and control measures of Air pollution-Air quality standards of Central pollution control board
16. Definition, causes, effects and control measures of groundwater pollution and surface water pollution- concepts of eutrophication and bio-magnification- case studies
17. Definition, causes, effects and control measures of Marine pollution- case studies on marine oil spills
18. Definition, causes, effects and control measures of Soil pollution and Noise pollution
19. Definition, causes, effects and control measures of Thermal pollution and light pollution
20. Solid Waste Management- Classification of solid wastes and management methods- Composting, Incineration, Pyrolysis, Biogas production- Causes, effects and control measures of urban and industrial wastes. Government policies and schemes on waste management – Swachh Bharat mission- National action plan on waste management (Hazardous waste, E- waste, municipal solid waste, bio medical waste, plastic waste and batteries management)-
21. Social Issues and the Environment: Urbanization and urban problems related to energy- Water conservation, rain water harvesting and watershed management- case studies
22. Environmental ethics: Issues and possible solutions- causes and consequences of global warming- Climate change and its influence on agricultural productivity- measures to reduce GHGs-Acid rain- Ozone layer depletion.
23. Salient features and provision of Environment Protection Act, 1986- Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act-

Forest Conservation Act

24. Environment and human health: Human Population and the Environment- various initiatives of government on Human Rights-Value Education- Women and Child Welfare
25. Role of Information Technology in Environment and human health- case studies
26. Disaster - definition and Types of disasters - Natural Disasters - Floods, drought, cyclone, earthquakes- their effects and management
27. Natural disasters -landslides, avalanches, volcanic eruptions, Heat and cold waves -El Nino-La Nina- their effects and management
28. Man Made Disasters - Nuclear disasters/ nuclear accidents and holocaust, chemical disasters, biological disasters - their effects and management- case studies
29. Man Made Disasters - forest fires, building fire, coal fire, oil fire, road accidents, rail accidents, air accidents, sea accidents- their effects and management
30. Concept of disaster management-International and National strategy for disaster reduction-national disaster management framework and financial arrangements
31. Role of NGOs- community based organizations and media in disaster management- Role of Central, state, district and local administration in disaster control
32. Role of armed forces in disaster response-Police and other organizations in disaster management- National disaster response force-their impact and management – recent case studies

B) Practicals

1. Environmental sampling: Collection, processing, preservation and storage of water samples
2. Water quality analysis: pH, EC, Acidity and Alkalinity
3. Estimation of TDS in water samples
4. Estimation of temporary hardness of water samples
5. Estimation of total hardness of water samples
6. Estimation of DO and BOD in water samples
7. Determination of COD in water samples
8. Visit to a local area to document environmental assets (*viz.*, river/ forest/ grassland/ hill/ mountain) and Visit to a local polluted site
9. Visit to windmill / hydro power / solar power generation units
10. Study of simple ecosystem - Visit to pond/river/hills
11. Assessment of Biodiversity in farming system-Estimation of species abundance
12. Assessment of Suspended Particulate Matter (SPM) in Respirable and Non respirable dust
13. Enumeration of *E. coli* in water samples
14. Estimation of heavy metals in the water samples using AAS

15. Estimation of sound pollution and light pollution
16. Visit to *in-situ* and *ex-situ* conservation sites.

Text book

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha. Universities Press (India) Pvt Limited, Hyderabad.

Suggested Readings

1. Environmental chemistry. Published by De, A.K., New Age International Publishers, New Delhi.
2. Disaster management - India's risk management policy frameworks and key challenges. Dhar Chakrabarti, P.G., Published by Centre for Social Markets (India), Bengaluru.
3. Textbook for Environmental studies. Erach Bharucha. University Grants Commission, New Delhi.
4. Forest, Environment, Biodiversity and Sustainable development. Parthiban, K.T. Vennila, S. Prasanth Rajan, M. Umesh kanna, S. Narendra Publishing House, New Delhi.
5. A textbook on Ecology and Environmental Science. ISBN 81-8321-104
6. Agrotech Publishing Academy, Udaipur S h a r m a , P.D., Ecology and Environment, Rastogi Publications, Meerut, India.
7. Living in the Environment (Concepts, Connections, and Solutions). Tyler, Miller and Spool man, Scot, Brooks/Cole, Cengage learning publication, Belmont, USA.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-LSPM-101**
Course Title	**:**	**Livestock and Poultry Management**
Credits	**:**	**2 (1+1)**
Year	**:**	**I**
Semester	**:**	**II**

Objectives

1. Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and Agriculture Integrated Farming System

Course outlines

Theory

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry. Digestion in livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

Practical

External body parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of farm animals and poultry. Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records. Judging of cattle, buffalo and poultry. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. Clean milk production, milking methods. Hatchery operations, incubation and hatching equipment. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production.

A) Theory Lecture Outlines

Lec.No. Topics

1. Role of livestock in the national economy.
2. Reproduction in farm animals and poultry.
3. Housing principles, space requirements for different species of livestock and poultry.
4. Management of calves, growing heifers and milch animals.
5. Management of sheep, goat and swine.
6. Incubation, hatching and brooding. Management of growers and layers.
7. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry.
8. Improvement of farm animals and poultry.
9. Digestion in livestock and poultry.
10. Classification of feedstuffs. Proximate principles of feed.
11. Nutrients and their functions.
12. Feed ingredients for ration for livestock and poultry.
13. Feed supplements and feed additives.
14. Feeding of livestock and poultry.
15. Introduction of livestock and poultry diseases.
16. Prevention and control of important diseases of livestock and poultry.

B) Practicals

1. External body parts of cattle, buffalo, sheep, goat, swine and poultry.
2. Handling and restraining of livestock.
3. Identification methods of farm animals and poultry.
4. Visit to Livestock and Poultry farms
5. Study of breeds of livestock and poultry
6. Daily routine farm operations and farm records.
7. Judging of cattle, buffalo and poultry.
8. Culling of livestock and poultry.
9. Planning and layout of housing for different types of livestock.
10. Computation of rations for livestock.
11. Formulation of concentrate mixtures.
12. Clean milk production, milking methods.
13. Hatchery operations, incubation and hatching equipment.
14. Management of chicks, growers and layers.
15. Debeaking, dusting and vaccination.

16. Economics of cattle, buffalo, sheep, goat, swine and poultry production

Text books

1. A Textbook of Animal Husbandry by G. C Banerjee. CBS Publishers and Distributors.
2. A text Book of Livestock Production management in Tropic by D. N. Verma. Kalyani Publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SSAC-122**
Course Title	**:**	**Soil Fertility Management**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**II**

Objectives

1. To provide comprehensive knowledge of soil fertility, plant nutrition, fertilizers and nutrient management

Course Outlines

Theory

Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches. Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary & micronutrient fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. Complex fertilizers, History of soil fertility and plant nutrition. Criteria of essentiality. Role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of macro and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis and rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use methods of application under rainfed and irrigated conditions. STCR/RTNM/IPNS. Efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/IPNS.

Practical

Introduction of analytical instruments and their principles, calibration and applications of Colorimetry and flame photometry; Estimation of alkaline hydrolysable N in soils; Estimation of soil extractable P in soils; Estimation of exchangeable K in soils; Estimation of exchangeable Ca and Mg in soils; Estimation of soil extractable S in soils; Estimation of DTPA extractable Zn in soils; Estimation of N in plants; Estimation of P in plants; Estimation of K in plants; Estimation of S in plants.

A) Theory Lecture Outlines

Lec. No. Topics

1. History of soil fertility and plant nutrition - Concepts of soil fertility, soil productivity, Soil as a source of plant nutrients – Different forms of Nutrient Elements in soil - Arnon's criteria of essentiality – list of essential, functional and beneficial elements
2. Essential nutrients – Classification and their functions in plants- Deficiency symptoms of nutrients- Corrective measures (Nitrogen, phosphorus, potassium, calcium, magnesium, Sulphur, Iron, Copper, Zinc, Manganese, Boron, Molybdenum and Chloride)
3. Toxicity symptoms of nutrients - Mechanism of nutrient transport - Movement of ions from soils to roots – Mass flow, diffusion, root interception and contact exchange. Factors effecting nutrient availability to plants- Chemistry of Macro and Micronutrients
4. Nitrogen - Occurrence, content and distribution. Factors influencing the content of nitrogen in soil. Forms of soil nitrogen. Nitrogen Cycle – Transformations in soils – Mineralization (aminisation and ammonification) - Fate of released ammonia – Factors affecting ammonium fixation. Nitrification – Factors affecting nitrification – Fate of released nitrate nitrogen- – Toxicity symptoms of nitrogen
5. Leaching losses of nitrate nitrogen – Nitrification Inhibitors-Denitrification – Immobilization Nitrogen fixation:- Different types – Biological fixation of nitrogen – Symbiotic and non-symbiotic – Nitrogen balance sheet – Gains and losses.
6. Phosphorus - P – cycle – content in soils – forms of phosphorus in soil - Inorganic and organic phosphorus compounds – Phosphorus fixation – Mechanisms of phosphate fixation. Factors affecting phosphate fixation in soil — Quantity and intensity parameters
7. Potassium - content in soil – Source – forms of soil potassium - Potassium fixation. Factors affecting potassium fixation – Quantity and Intensity parameters – Luxury consumption
8. Calcium - sources and content – forms of calcium in soil, factors affecting the availability of calcium in soil –Magnesium - Sources – Content – Forms of magnesium in soils. Factors affecting availability of magnesium. Functions
9. Sulphur - S – Cycle – Occurrence – Forms of Sulphur in soil. Sulphur transformation in soils – Mineralization and immobilization. Sulphur Oxidation – Factors affecting oxidation in soils. Sulphide injury – Causes, symptoms and remedial measures
10. Zn, Mn - Content – Forms in soils – Critical limits in soils and plants - Factors affecting availability
11. Fe and Cu - Content – Forms in soils – Critical limits in soils and plants. Factors affecting availability
12. Boron and Molybdenum - Content – forms in soil - Critical limits in soils and plants. Factors affecting their availability
13. Chloride - Content – Forms in soils – Critical limits in soils and plants. Factors affecting its

availability –Important functions and properties of beneficial (Sodium, cobalt, vanadium and Silicon) elements and Nickel

14. Soil fertility Evaluation - Approaches – Soil testing – Objectives of soil testing – Chemical methods for estimating available nutrients- Critical levels of different nutrients in soil
15. Plant analysis – Rapid tissue tests – Indicator plants - Biological methods of soil fertility evaluation, A- value.
16. Microbiological methods – Sackett and Stewart techniques – Mehlich technique – Cunning hamella plaque method – Mulder's Aspergillus Niger technique – Mistcherlich's pot culture method
17. Integrated Nutrient Management (INM)- objectives - components – advantages
18. Importance of organic manures - Definition and difference between manures and fertilizers- Classification of manures (Bulky & Concentrated) with suitable examples. Importance of manures in soil fertility management.
19. Bulky organic manures – Preparation of FYM – Methods of collection and storage. Losses of nutrients from FYM during collection and storage -Ways to minimize these losses.
20. Compost and composting – Different methods of composting including the starters and raw materials
21. Methods of preparation of rural and urban compost. Mechanical compost plants – their advantages over conventional composting –Vermi-composting
22. Green manures – Classification with examples. Advantages and limitations of green manuring and green leaf manuring. Biogas plant – Principles of operation and its advantages.
23. Definitions of penning, sewage, sewerage, sullage, Pouderette, Activated compost process. Concentrated organic manures – Oil cakes, blood meal, bone meal, horn meal, fish meal, meat meal and Guano.
24. Carbon sequestration, types of carbon sequestration and carbon trading, carbon credits and carbon markets
25. Chemical fertilizers – Classification with examples — composition and properties of major nitrogenous fertilizers viz., Ammonium sulphate, urea and calcium ammonium nitrate
26. Phosphatic fertilizers – composition of Rock phosphate – Occurrence, types and properties- properties of SSP, TSP and basic slag – Potassic fertilizers –MOP, SOP properties.
27. Secondary nutrient fertilizers- micronutrient fertilizers- Complex fertilizers – types, composition of DAP, MAP, UAP, important nitro phosphates
28. Nano-fertilizers – Water soluble fertilizers- Customized fertilizers, Mixed fertilizers– Advantages and disadvantages over straight fertilizers. - Fertilizer grade – Fertilizer ratio – unit value of fertilizers – Problems
29. Soil amendments –Role of important organic and inorganic amendments and synthetic conditioners as amendments

30. Fertilizer storage – Specifications - problems during storage. Fertilizer Control Order (FCO) – its importance and regulations. Specifications for important fertilizers
31. Methods of fertilizer applications to crops -Nutrient use efficiency :- Soil, plant and management factors influencing Nutrient use efficiency in respect of N, P, K, S, Fe and Zn fertilizers
32. Fertilizers recommendations to crops - Soil test-based fertilizers recommendation (STCR) and RTNM and IPNS.

B) Practicals

1. Introduction to analytical instruments, principles and calibration
2. Estimation of soil organic carbon content by Walkley & black method
3. Estimation of alkaline hydrolysable N in soils
4. Estimation of extractable P in soils using colorimetry
5. Estimation of available K in soils using flame photometry
6. Estimation of available Ca and Mg in soils
7. Estimation of available S in soils
8. Estimation of DTPA extractable Zn in soils using atomic absorption spectroscopy
9. Basics of Plant analysis and Estimation of N in plant sample
10. Estimation of P in plant samples
11. Estimation of K & S in plant samples
12. Estimation of Nitrogen in organic manures
13. Identification of acid radicals in fertilizers
14. Identification of basic radicals in fertilizers
15. Estimation of Nitrogen in Urea ammonium sulphate
16. Estimation of potassium in MOP by flame photometer method

Textbooks

1. Soil Fertility and Fertilizers by Samuel Tisdale, Nelson Werner L, Beaton James D and Havlin John L. MacMillian Publishing Co., New York.
2. Soil Fertility and Nutrient Management by S S Singh. Kalyani Publishers.

Suggested Readings

1. Introductory Soil Science D. K. Das. Kalyani publishers, New Delhi
2. The Nature and properties of soils – Harry O Buckman and Nyle C. Legare Street Press.
3. Comprehensive and competitive soil science – P.Gurumurthy, M.V.S.Naidu, T.V.Sridhar, K,.Himabindu and V.Surya Teja, Narendra Publishing house.

COLLEGE OF AGRICULTURE
ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No. : **AU-ENTO-131**

Course Title : **Fundamentals of Entomology**

Credit Hours : **3(2+1)**

Year : **I**

Semester : **II**

Objectives

1. To know the history of Entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class insect and their importance for classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects
4. To study the characteristics of commonly observed insect orders and their economically important families

Course outlines

Theory

History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect body wall and moulting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouthparts, legs, Wing venation, modifications and wing coupling apparatus. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system in insects. Types of reproduction in insects. Major sensory organs. Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae,

Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophopidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Pieridae, Papiloinidae, Lycaenidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tephritidae Agromyziidae, Muscidae, Tachinidae, Culicidae.

Practical

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance.

A) Theory Lecture outlines

Lec. No. Topics

1. History of Entomology in India, Contributions of eminent Entomologists, Locations and year of establishment of Entomological institutions.
2. Arthropoda – Mention of insects in scripts. Contributions of Aristotle, J.C. Fabricius, J.G. Koenig, Carolus Linnaeus, Cramer, Dury, Dr. Kerr, Rev. Hope,Rothney, Ronald Ross, L De Niceville, H.M. Lefroy, T.B.Fletcher, E.P. Stebbing, T.V. Ramakrishna Ayyar, B.V. David, Y.Ramachandra Rao, M. S. Mani, S. Pradhan, H.S. Pruthi, M.R.G.K. Nair; M. L. Roonwal, T.Kumara Swami, K. K. Nayar, N. Ananthakrishnan and C. A. Viraktamath. Locations and year of establishment of Division of Entomology, IARI, Zoological Survey of India (ZSI), Directorate of Plant Protection, Quarantine and Storage (DPPQS), National Institute of Secondary Agriculture (NISA), National Bureau of Agricultural Insect Resources (NBAIR), National Institute of Plant Health Management (NIPHM), National Centre for Integrated Pest Management (NCIPM) and Forest Research Institute (FRI), National Institute of Biotic Stress Management (NIBSM) and Central Silk Board (CSB).
3. Contributory factors for abundance of insects - Major structural characters, developmental characters and protective characters (Morphological, physiological, behavioural and construction of protected niches) of Insecta in Animal Kingdom.
4. Classification of Phylum Arthropoda up to Classes –Different Classes of Arthropoda and comparison of characters of Class Insecta with Arachnida, Crustacea, Symphyla, Chilopoda and Diplopoda and Onychophora.
5. Structure and functions of body wall/Integument – Different layers- Basement membrane, Epidermis and Cuticle and moulting –, chemical composition, and functions of body wall and cuticular appendages. Cuticular processes and cuticular invaginations – Chaetotaxy. Moulting –

Apolysis, ecdysis and sclerotization.

6. Body segmentation of the insects- Head (Syncephalon) – Procephalon and gnathocephalon, types of head, sclerites and sutures. Thorax – Segments, sclerites and appendages (Wings and legs).
7. Abdomen – Segments, sclerites, pre and post genital appendages (Furcula, cornicles, tracheal gills and pseudo-ovipositor in Diptera - Propodeum, petiole and gaster in Hymenoptera). Male and female genital organs - Epimorphic and anamorphic development in insects.
8. Antenna – Structure of typical antenna and its modifications in different insects with examples.
9. Mouthparts – Biting and chewing, sucking (Piercing and sucking, Rasping and sucking, Chewing and lapping, Sponging and Siphoning/ Simple sucking), Mask and Degenerate types with examples.
10. Legs – Structure of a typical insect leg and modifications of insect legs with examples.
11. Wings – Areas, venation, margins and angles-Types of wings and wing coupling organs with examples.
12. Types of Metamorphosis and diapause-Metamorphosis- Ametamorphosis- Incomplete Metamorphosis or Direct or Simple Metamorphosis- Intermediate metamorphosis - Complete Metamorphosis or Complex or Indirect Metamorphosis- Hypermetamorphosis with examples. Diapause-Obligate and facultative diapauses – Stage of occurrence of diapause with examples.
13. Types of larva and pupa – Differences between nymph and larva - Larva- Protopod- Oligopod (Campodeiform and Scarabaeiform)- Polypod and Apodous with examples. Pupa- Obtect Chrysalis, Exarate and Coarctate- with examples.
14. Digestive system – Alimentary canal – Structure of foregut, midgut and hindgut – histology, functions, filter chamber and peritrophic membrane Process of digestion- Extra intestinal digestion.
15. Circulatory system – Open and closed types – Organs of circulatory system – Dorsal blood vessel (Diaphragms, sinuses and accessory pulsatile organs). Process of circulation, Types of haemocytes, Properties and functions of haemolymph.
16. Excretory system – Structure, functions and modifications of malpighian tubules. Structure and functions of other organs of excretion
17. Respiratory system – Tracheal system – Structure of spiracle and trachea Classification based on functional spiracles and other means of respiration
18. Nervous system – Neuron and its types based on structure and function. Synapse, ganglia, central nervous system, sympathetic nervous system and peripheral nervous system. Secretory (Endocrine) system – Structure and functions of neurosecretory organs (neuro secretory cells of brain, corpora cardiaca, corpora allata, prothoracic glands and ring gland).
19. Reproductive system – Structure of male and female reproductive systems – Structure and types of ovarioles and structure of follicle – Types - Special modes of reproduction in insects
20. Sense organs – Compound eyes – Structure of ommatidium, Ocelli – Dorsal ocelli and lateral ocelli -Types of images and auditory organs (Auditory hairs, tympanum, Jhonston’s organ and pilifer

organ). Chemoreceptors.

21. Taxonomy – Importance - History and Development-Binomial nomenclature - Holotype, allotype and paratype – Suffices of tribes, sub-family, family and superfamily – Law of priority – Synonyms and homonyms - Definitions of biotype - Subspecies - Species – Genus - Family and Order. Characters of Class Insecta - Economic classification of insects-Classification up to Orders – Subclasses - Apterygota and Pterygota– Orders of Apterygota and Pterygota with examples
22. Orthoptera – General characters - Acrididae, Tettigonidae,Gryllidae and Gryllotalpidae – Characters with examples
23. Dictyoptera – General characters – Blattidae and Mantidae– Characters with examples – Odonata General characters with examples
24. Isoptera – General characters –Termitidae –Characters with examples. Thysanoptera – General characters –Thripidae –Characters with examples.
25. Hemiptera – General characters - Sub order Heteroptera –Pentatomidae, Coreidae, Pyrrhocoridae, Lygaeidae, Miridae and Cimicidae - Characters with examples.
26. Hemiptera–Suborder Homoptera–Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophopidae, Aleurodidae, Pseudococcidae, - Characters with examples - Neuroptera – General characters - Chrysopidae- characters with examples.
27. Lepidoptera-General characters - Differences between moths and butterflies - Noctuidae, Sphingidae and Pyralidae- Characters with examples.
28. Lepidoptera- Gelechiidae, Lycaenidae, Arctiidae, Papilionidae, Pieridae, Bombycidae and Saturniidae - Characters with examples.
29. Coleoptera - General characters – Coccinellidae,Chrysomelidae,Scarabaeidae - Characters with examples.
30. Coleoptera - Cerambycidae, Bruchidae and Curculionidae - Characters with examples.
31. Hymenoptera-General characters – Tenthredinidae, Apidae, Ichneumonidae, Braconidae, Chalcididae and Trichogrammatidae - Characters with examples.
32. Diptera -General characters - Cecidomyiidae, Agromyzidae, Muscidae, Tephritidae, Tachinidae and Culicidae- Characters with examples.

B) Practicals

1. Methods of collection and preservation of insects including immature stages
2. External features of Grasshopper / Blister beetle
3. Study of different types of insect antennae
4. Study of different types of insect mouthparts
5. Study of different types of insect legs
6. Study of wing venation, types of wings and wing coupling mechanisms
7. Study of different types of insect larva and pupa

8. Dissection of digestive system in insects (Grasshopper).
9. Study of characters of Orders - Orthoptera, Dictyoptera and their families
10. Study of characters of Orders – Isoptera, Thysanoptera. and their families and characters of Odonata.
11. Study of characters of Order -Hemiptera and its sub order Heteroptera and its families.
12. Study of characters of Sub Order - Homoptera and its families
13. Study of characters of Order- Neuroptera and Lepidoptera and their families
14. Study of characters of Order- Coleoptera and its families.
15. Study of characters of Order- Hymenoptera and its families
16. Study of characters of Order - Diptera and its families

Text books

1. The Insects: Structure and Function (Fifth edition) by Chapman, R. F, Simpson, S. J. and Douglas, A C. Cambridge Univ. Press, UK
2. Insect Physiology and Anatomy by Pant, N.C. and Ghai, S., ICAR, New Delhi.

Suggested Readings

1. Borror and De Long's Introduction to the Study of Insects by Johnson Charles A Triplehorn and Norman F. Thomson Brooks/Cole Publishing. U.S.A.
2. Theory and Practice of Animal Taxonomy (Sixth edition) by Kapoor, V. C. Oxford and IBH Publishing, New Delhi.
3. Imm's General Text Book of Entomology (Vol. I and II). (Tenth edition) by Richards, O.W. and Davies, R.G. Chapman and Hall, London.
4. Principles of Insect Morphology by Snodgrass, R.E., CBS Publishers & Distributors, Delhi.
5. Modern Entomology by Timbhare, D.B., Himalaya Publishing House, Bengaluru.
6. Insect Physiology (Eighth edition) by Wigglesworth, V.B., Springer, New York.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- PATH-171**
Course Title	**:**	**Fundamentals of Plant Pathology**
Credits	**:**	**3 (2+1)**
Year	**:**	**I**
Semester	**:**	**II**

Objectives

1. To get acquainted with the role of different microorganisms in the development of plant disease.
2. To get general concepts and classification of plant diseases
3. To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases.
4. To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases.
5. To get acquainted with various plant disease management principles and practices.

Course Outlines

Theory

Introduction to Plant Pathology: Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India, Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis, Development of disease in plants: Disease Triangle, Disease cycle, Fungi and their morphology, reproduction and classification of fungi, Bacteria: Morphology, reproduction classification of phytopathogenic bacteria, Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants; Viruses and viroids, virus transmission, Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

Practical

Study of the microscope, Acquaintance with laboratory material and equipments, Study of different plant disease symptoms, Microscopic examination of general structure of fungi, Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria, Microscopic examination of fungal diseased specimen, Microscopic examination of bacterial diseased specimen, Preparation of culture media, Isolation of plant pathogens: Fungi, bacteria and viruses, Purification of plant pathogens, Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and

calculation on fungicides

A) Theory Lecture Outlines

Lec. No. Topics

1. **Introduction to Plant Pathology:** Definition of Plant Pathology- Objectives of Plant Pathology- Importance of Plant Pathogens- Important famines in history caused by pathogens- Irish Famine- Great Bengal Famine- Coffee Rust
2. **History of Plant Pathology with special reference to Indian work**- Contributions of P.Micheli, Anton von de Bary, M.S.Woronin, M. Ward, P.A.Millardet, T.J. Burril, E.F. Smith, Doi et al., Davis et al.,A.E. Mayer, D. Iwanowski, Beijerinck, W.M. Stanely, Diener,E. C.Stakman, E.J. Butler, B. B.Mundkur, J.F.Dastur, K.C Mehta, T.S. Sadasivan, M.K. Patel
3. **Terms used in plant Pathology** - Disease - Disorder - Pathogen -Parasite - Pathogenicity - Pathogenesis - Sign - Symptom - Syndrome - Inoculum - Inoculum Potential -Infection -Incubation Period -Latent period- Predisposition - Hypersensitivity - -Disease cycle- Disease triangle- Disease Pyramid
4. **Classification of plant diseases:** Based on occurrence (Sporadic, Endemic, Epidemic, Pandemic), Based on host plant affected (Cereals, Millets, Pulses, Oilseeds, Cash crops, Fruit crops, Vegetables, Spices with one example), Based on plant parts affected (Root, Stem, Leaves, Flower, Fruit with one example), Based on symptoms- (Necrotic, Hyperplastic, Hypoplastic etc.)
5. **Classification of plant diseases (continued):** Based on cause of plant disease with examples of important plant diseases caused by them: **Animate**- Fungi – (Brown spot, Coffee Rust) Bacteria – (Fire blight of apple, Crown gall of apple) FVB – (Pierce's disease of Grapevine, Citrus greening); Phytoplasmas – (Sesamum Phyllody, Little leaf of Brinjal), Spiroplasma – (Corn stunt, Citrus stubborn); Flagellant protozoa – (Phytomonas- Coffee Pholem necrosis); Green algae- (Red rust) and Parasitic higher plants – (Cuscuta, Loranthus, Orobanche, Striga); Viruses -(TMV, MYMV) and Viroids (Potato spindle tuber viroid, Coconut cadang cadang viroid); **Inanimate**- Khaira disease, Black heart of potato, blossom end rot of tomato, Purple leaf of cotton
6. **Fungus**– Definition – Ultra structure of fungal cell– Types of fungal thalli – (Plasmodium, Unicellular and Filamentous) – Fungi based on reproductive structures–(holocarpic, eucarpic), Types of fungi based on their physical presence on or in the host(ectophytic, endophytic and ectendophytic) – Septation in fungi (Primary, adventitious, perforated and dolipore septa)**.**
7. **Fungal tissues** – plectenchyma (prosenchyma and pseudoparenchyma); Modifications of mycelium (rhizomorphs, sclerotium, stroma, haustorium, rhizoids and appressorium) **Parasitism in fungi**- saprophytes (obligate saprophytes and facultative parasite) and parasites (obligate parasites and facultative saprophytes); Symbiosis- Mycorrhizae
8. **Reproduction in fungi**: Asexual reproduction – Fragmentation, Fission, Budding and Sporulation; Plano and Aplanospores. Planospores – types of flagella- tinsel, whiplash; Monoflagellate, Biflagellate - Anisokont and Heterokont zoospores. Conidiophore and Conidiospores (conidia). Asexual

fruiting bodies with examples

9. **Sexual reproduction –** planogametic copulation, gametangial contact, gametangial copulation, spermatization and somatogamy. Sexual spores in fungi
10. Classification of fungi (Kirk et al., 2008): Differences between three Kingdoms in which fungi are placed: Kingdom **Protozoa** - Taxonomic position and characteristics of Plasmodiophora (club root of cabbage), - Spongospora (Potato powdery scab).
11. Kingdom Chromista: Characteristics of Phylum **Oomycota**-. Taxonomic position and Distinguishing features of the genera Pythium, Phytophthora, Albugo
12. Kingdom Chromista: Characteristics of Phylum **Oomycota** (continued) Characteristics of downy mildew genera – Sclerospora, Peronospora, Peronosclerospora, Pseudoperonospora, Plasmopara and Bremia. Examples of diseases caused by each genus
13. Kingdom **Fungi** – Phylum **Chytridiomycota**, Characteristics and taxonomic position of Synchytrium endobioticum
14. Kingdom **Fungi** – Phylum **Zygomycota** and Characteristics and taxonomic position of Rhizopus
15. Kingdom **Fungi** - Characteristics of the Phylum **Ascomycota** along with types of asci and ascocarps\
16. Ascospore development in Pyronema omphaloides
17. Outline the classification of Phylum **Ascomycota** up to level of genus with the distinguishing characters citing one example of important plant diseases
18. Phylum **Ascomycota** - Key characters for the identification of powdery mildew genera
19. Phylum **Basidiomycota** - Important characteristics of the Phylum **Basidiomycota**- Outline the classification of Phylum **Basidiomycota** up to genus level (genera that causes Rust, Smut, bunt and Exobasidium, Ganoderma).
20. Phylum **Basidiomycota** (continued): Macrocyclic, microcyclic, demicyclic rusts; Autoecious and Heteroecious rusts with examples. Life cycle of Puccinia graminis f. sp.tritici Anamorphic Fungi (Mitosporic fungi = Fungi Imperfecti) Hyphomycetous anamorphic fungi: Distinguishing characters of Genera Alternaria, Botrytis, Helminthosporium, Bipolaris, Cercospora, Fusarium, Pyricularia, Mycelia Sterilia – Rhizoctonia, Sclerotium. Acervular Imperfect Fungi – Colletotrichum, Pestalotiopsis, Gloeosporium. Pycnidial Imperfect Fungi – Phoma, Phomopsis, Diplodia, Septoria
21. General morphological characteristics, reproduction and classification of **phytopathogenic bacteria** citing important Phytopathogenic bacterial genera.
22. Fastidious vascular bacteria (RLOs) – important characteristics, Example of one Genus under xylem inhabiting and Phloem inhabiting along with Gram reaction. (Leifsonia xyli (sugarcane ratoon stunt), Candidatus liberobacter asiaticus (citrus greening) and Xylella fastidiosa (Pierce's disease of grapes). Phytoplasmas and Spiroplasmas – Important characteristics of **Phytoplasma**. Examples of plant diseases caused by Phytoplasma (little leaf of brinjal, sesamum phyllody and their vectors) **Spiroplasma** – corn stunt and citrus stubborn– vectors

23. **Plant Viruses**– important characteristics of plant viruses– classification of viruses based on Nucleic acid - single stranded (ss) RNA, double stranded (ds) RNA, ssDNA and dsDNA with one or two examples of viruses causing plant diseases – Methods of transmission of plant viruses
24. Important characters of **viroids**- Examples of important viroid diseases – potato spindle tuber and coconut cadang cadang
25. Study of green algae –Brief description of Cephaleuros virescens - Red rust. Study of phanerogamic plant parasites with suitable examples – Cuscuta, Orabanche, Striga, Loranthus
26. **Development of disease in plants:** Phases in Pathogenesis- Pre-penetration stage, Penetration stage and Post Penetration.
27. **Principles of plant disease management - Exclusion** - plant quarantine, Inspection and seed certification - **Avoidance** of the pathogen (selection of pathogen free propagating material and seed, selection of field, choice of time of sowing and disease escaping varieties)
28. **Eradication- Physical methods** of eradication (hot water treatment, soil solarization and solar heat treatment;
29. **Eradication- Cultural methods** of eradication (roguing, eradication of alternate and collateral host, crop rotation, manure and fertilizer management, mixed cropping, sanitation, summer ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage.
30. **Eradication- Chemical methods** of eradication & Protection- Classification of fungicides based on different criteria like based on formulation, Method of application, movement, mechanism of action, chemical group
31. **Eradication - Biological methods** - Mechanisms of biological control with examples – Hypovirulence, cross protection
32. **Host plant resistance** - Horizontal resistance, Vertical resistance, Gene for gene hypothesis, PTI and ETI. Vertifolia effect.

B) Practicals

1. Microscopy - study of the parts of microscope
2. Acquaintance with various laboratory equipment
3. Study of different plant disease symptoms
4. Microscopic examination of Zygomycetes and Oomycetes genera
5. Microscopic examination of Powdery mildew genera
6. Microscopic examination of Basidiomycetous genera
7. Microscopic examination of Mitosporic genera
8. Preparation of culture media Potato Dextrose Agar (PDA) for fungi and Nutrient Agar (NA) for bacteria
9. Bacterial staining procedures-Simple staining - Gram’s staining
10. Isolation of plant pathogenic fungi and bacteria

11. Demonstration of mechanical transmission of plant viruses
12. Purification of plant pathogens
13. Demonstration of Koch's postulates for fungi and bacteria
14. Study of different groups of fungicides and antibiotics
15. Different methods of application of fungicides
16. Calculation of fungicide spray concentrations

Text books

1. Introduction to Principles of Plant Pathology. Singh RS. Oxford and IBH Pub. Co., New Delhi

2. A Textbook Of Fungi, Bacteria And Viruses (3rd Ed.) by H.C.Dube. Agrobios.

Suggested Readings

1. Essentials of Plant Pathology. Pathak, V. N. Prakash Pub., Jaipur
2. Introductory Plant Pathology. Kamat, M. N. Prakash Pub, Jaipur
3. Plant Pathology. Agrios, GN. Elsevier Academic Press, Amsterdam
4. Plant Diseases. Singh RS. 8th Ed. Oxford & IBH. Pub. Co., New Delhi
5. Introductory Mycology. Alexopoulos, Mims and Blackwel. John Wiley & Sons, NewYork
6. Plant Pathology. Mehrotra RS & Aggarwal A. 7 th Ed. Tata Mc Graw Hill Publ. Co. Ltd
7. Plant Virology - The Principles. Gibbs A & Harrison B. Edward Arnold, London
8. Plant Virology. Hull R. and Mathew. S., 4th Ed. Academic Press, New York
9. The Bacteria. Verma J. P., Malhotra Publ. House, New Delhi
10. Fundamentals of Plant Bacteriology. Goto M., Academic Press, New York
11. Basic Plant Pathology Methods. Dhingra OD & Sinclair J.B., CRC Press, London, Tokyo

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AEXT-193**
Course Title	**:**	**Personality Development**
Credits	**:**	**2 (1+1)**
Year	**:**	**I**
Semester	**:**	**II**

Objectives

1. To make students realize their potential strengths, cultivate their inter-personal skills and improve employability.

Course Outlines

Theory

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Practical

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behavior.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Personality - Definition, Nature of personality, Theories of personality and its types

2. The humanistic approach – Meaning, Maslow's self-actualization theory, shaping of personality, determinants of personality.
3. Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour.
4. Foundations of individual behaviour and factors influencing individual behaviour, Models of individual behaviour.
5. Perception - Meaning, types, factors and importance in Agricultural Extension and attributes and factors affecting perception.
6. Attribution theory – meaning of attribution, types of attributions, Weiner model of attribution and case studies on Perception and Attribution.
7. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behaviour, difference between learning and training, learning feedback.
8. Attitude – concept, significance, factors affecting attitude, positive and negative attitude, ways to develop positive attitude
9. Values – definition, importance of values in organization, characteristics and types of values
10. Intelligence – meaning, types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence
11. Organizational behaviour – meaning, definition, scope and importance of organizational behaviour, models of organizational behaviour
12. Emotional Intelligence – meaning, components and dimensions of emotional intelligence
13. Emotional Intelligence - state and trait, characteristics of persons with emotional intelligence and low emotional intelligence
14. Motivation - Meaning, types of motives, theories and principles of motivation and importance of motivation in Agricultural Extension
15. Teamwork - Team work - Meaning, concept, characteristic features of effective teams, types of teams, factors affecting and role of team work.
16. Group dynamics - Nature of groups, dynamics of group formation, types of groups, dynamics of formal & informal groups.

B) Practical

1. Assessing personality through MBTI personality analysis
2. Practicing Learning Styles and Strategies
3. Assessing Motivational needs
4. Administering psychological tests to assess personality types of human beings. Experiment: 1. Firo-B
5. Administering psychological tests to assess personality types of human beings. Experiment: 2. Eysenck personality inventory

6. Administering psychological tests to assess personality types of human beings. Experiment: 3. Edward's personality inventory
7. Practicing Interpersonal Communication
8. Practical exercise on Teamwork and team building
9. Practical exercise on Group Dynamics
10. Practical exercise on Win-win game
11. Measurement of Emotional Intelligence
12. Practical exercise on Leadership styles
13. Case studies on Personality and organizational behaviour
14. Practical exercise on Negotiation skills and Stress management
15. Practical exercise on Time management
16. Practical exercise on Conflict management

Text books

1. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadswor.

2. Organizational Behavior by Stephen P. Robbins and Timothy A. Judge Pearson Education.

Suggested Readings

1. How to Succeed at Interviews. 21st (rep.) by Andrews, Sudhir. Tata McGraw- Hill. Heller, New Delhi.
2. Effective Leadership by Robert. Dk Publishing.
3. Art of Public Speaking by Lucas, Stephen. Tata - Mc-Graw Hill.
4. Power of Positive Thinking by Mile, D.J. Rohan Book Company, Delhi
5. All about Self- Motivation by Pravesh Kumar. Goodwill Publishing House, New Delhi
6. Body Language by Smith, B. Rohan Book Company. Delhi
7. Organizational Behavior- Seventh Edition (International Edition) by Fred, Luthans., McGraw-Hill.

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ANNAMACHARYA UNIVERSITY

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- SEC- III**
Course Title	**:**	**Floriculture and Landscaping**
Credits	**:**	**2 (0+2)**
Year	**:**	**I**
Semester	**:**	**II**

Practical Lecture Outlines

1. Identification of various types of flower plants.
2. Identification of ornamental trees and climbers.
3. Identification of tools and implements used in landscape design.
4. Study of ground covers and indoor plants.
5. Identification and production of plug plants, seedlings and saplings.
6. Propagation of trees, shrubs and annuals, care and maintenance of plants.
7. Potting and repotting
8. Practice of propagation through specialized structures - cuttings and layering
9. Practice of propagation through specialized structures- budding and grafting
10. Making and maintenance of edge, hedge and topiary.
11. Planning of ornamental gardens (public and private gardens).
12. Planning of special type of gardens (sunken garden, terrace garden, rock garden etc.,)
13. Identification of turf grasses and turf machinery.
14. Turf establishment methods.
15. Lawn maintenance – mowing, raking, rolling, soil top dressing, weed management.
16. Physiological disorders of flowers and their remedial measures.
17. Harvesting indices of flower crops.
18. Postharvest factors affecting postharvest quality of flowers.
19. Preparations of floral preservatives.
20. Postharvest handling of commercial flowers- Rose, Chrysanthemum, Gladiolus, Lilium, Tuberose and Marigold.

21. Use of drawing equipment, graphic symbols and notations in landscaping designing.
22. Designing of different styles of gardens.
23. Practices in preparation of different type of flower arrangements including bouquets, button-holes, flower baskets.
24. Practices in preparation of different type of flower arrangements including corsages, floral wreaths, garlands with fresh flowers.
25. Identification of plants for dry flower making.
26. Practices in dry flower making, preparation of dry flower baskets, bouquets, potpourri, wall hangings, button holes, greeting cards, wreaths, etc.
27. Value addition of dry foliage.
28. Biproducts of flower crops- Rose water/ Gulkhand/ Pigments.
29. Visit to local nurseries.
30. Visit to commercial greenhouses
31. Visit to parks and botanical gardens.
32. Visit to dry flower units/ florist centers.

Text books

1. Floriculture in India by G.S. Randhawa and A. Mukhopadhyay, Allied Publishers pvt ltd.
2. Principles of landscaping by Dr. Hemla naik B, Mr. S.Y. Chandrashekar, Dr. M. Jawaharlal, Agrimoon.com

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC- IV**
Course Title	**:**	**Introduction to Python Programming**
Credits	**:**	**2 (0+2)**
Year	**:**	**I**
Semester	**:**	**II**

Practical Lecture Outlines

1. What is computer and generations of computers
2. Computer Peripheral devices
3. Computer memory management
4. Python introduction and write a simple program in python
5. Variables and Data types with examples
6. Operators in python with examples
7. Write a python program to perform arithmetic operations and comparison operators
8. Write a Python program to calculate the required amount of fertilizer for a field, based on the area and the recommended application rate per square meter?
9. Write a Python program to calculate the total cost of seeds for a farm, given the price per seed and the number of seeds needed?
10. Python Boolean values with expressions
11. Decision control statements with examples
12. Looping control statements with examples
13. Transfer control statements with examples
14. Using Python, how can you calculate the total water consumption for a farm over a month, given the daily water usage data?
15. Write a Python program that tracks the growth of a plant over a period of days
16. Write a Python program that asks the user for the current soil moisture level for multiple fields
17. Write a Python program that takes the current nitrogen level in the soil for multiple fields and calculates how much more nitrogen is needed to reach the desired level. If the nitrogen level is sufficient, the program should indicate that no fertilizer is needed.

18. Write a Python program to calculate the total amount of fertilizer used in a month, given the size of the field and the amount of fertilizer applied per hectare each day
19. Write a Python program that asks for the temperature and humidity level for multiple days. If the temperature is too high (above 35°C) or the humidity is too low (below 30%)
20. Python List data type with examples
21. Python Tuple data type with examples
22. Create a program that lists the crops grown on a farm. Display each crop one by one.
23. Write a program that asks for a crop name and checks if that crop is grown on the farm. The program should output whether the crop is found or not.
24. Create a program that allows the user to add a new crop to the list of crops grown on the farm.
25. Write a program that sorts the list of crops alphabetically and displays them.
26. What is function and explain types of functions
27. What is recursive function with examples
28. What lambda function and examples
29. Write a Python function that evaluates soil fertility using nitrogen (N), phosphorus (P), and potassium (K) levels. If all three levels are above 50, print "Soil is fertile." Otherwise, print "Soil needs improvement."
30. Write a Python function to suggest a suitable crop based on the soil pH level.
31. Write a Python function that tracks the growth stage of a crop based on the number of days after planting. (0-30 days: Germination, 31-60 days: Vegetative, 61-90 days: Flowering, 91+ days: Maturity)
32. Write a recursive function to calculate the total feed required for livestock over multiple days. Assume a daily feed rate of 25 kg per cow**.**

Text books

1. Introduction to Python Programming by Nagaraju Y and Venkatesh. Khanna Publishing House.
2. Introduction to Python Programming: A Beginner's Perspective by Ignisha Rajathi, Nagajyothi and John. Bonfring Technology Solutions

Suggested Readings

1. Python Programming using problem solving approach, Reema Thareja, Oxford-Second Edition
2. Python Programming –A modular Approach, Sheetal Taneja and Naveen Kumar, Pearson
3. Core Python Programming, Dr. R. Nageswara Rao, Dream Tech-press, Third Edition.
4. The complete reference Python, Martin C. Brown McGraw Hills, Indian edition
5. Introduction to Computer Science using Python, Charles Dierbach, Wiley

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC-VII**
Course Title	**:**	**Biofertilizers and Plant Based Biopesticides**
Credits	**:**	**2 (0+2)**
Year	**:**	**I**
Semester	**:**	**II**

Objectives

1. To understand the types and importance of bio-fertilizers, techniques for isolating microbial strains used in biofertilizers, hands-on experience in preparing specific culture media for biofertilizer organisms.
2. To impart skill on the quality and efficiency of biofertilizers, preparation of carrier materials for biofertilizer inoculants, application methods and field usage of biofertilizers.
3. To understand the types and importance of plant-based bio-pesticides and to impart knowledge and skill in preparation and usage

Practical lecture outlines

1. Introduction and importance of Biofertilizers
2. Preparation of Culture Media for isolation of biofertilizers
3. Isolation and characterization of Rhizobium from root samples
4. Isolation and characterization of Azotobacter from soil samples
5. Isolation and characterization of Azospirillum from soil samples
6. Isolation and characterization of Phosphorous Solubilizing Bacteria (PSB) from soil samples
7. Isolation and characterization of Potassium Solubilizing Bacteria (KSB) from soil
8. Isolation and characterization of Vesicular Arbuscular Mycorrhizae (VAM) from soil and root samples
9. Mass production of Azospirillum and Azotobacter
10. Mass production of Rhizobium and PSB
11. Mass production of KSB and VAM
12. Quality Control of Biofertilizers - CFU, moisture content and pH

13. Carriers used for formulating biofertilizers (Solid and liquid)
14. Application methods of biofertilizers - seed treatment, seed pelleting, soil application and foliar spray techniques.
15. Field demonstration of biofertilizer application in various crops (Legumes, cereals).
16. Biofertilizer consortia – Preparation and Compatibility testing
17. Assessment of the efficacy of biofertilizers - Nitrogen Fixation Activity Assays- Acetylene reduction assay (ARA), Nodulation efficiency
18. Azolla and Cyano bacteria production and field application methods
19. Acquaintance with botanicals used in plant disease management
20. Preparation of Neemastram and Panchapatra kashayam
21. Acquaintance of plant based biopesticides used in insect pest management, bioactive principles, mode of action, advantages and disadvantages
22. Preparation of Neem Seed Kernel Extract (NSKE) and Neem leaf extract and their uses
23. Preparation of Neem cake extract, Neem oil emulsion and their uses and study of neem based formulations available in market
24. Preparation of Tobacco decoction and its uses
25. Preparation of Annona leaf extracts and Lantana leaf extracts
26. Preparation of Pongamia kernel extract
27. Preparation of Garlic and Chilli extracts
28. Extraction of Essential oils of Lemon grass
29. Insecticidal properties of Derris, Acorus, Plumbago and Sabadilla
30. Plant based biopesticides for non-insect pest management
31. Procedure for registration and licencing of biofertilizers and plant based biopesticides.
32. Visit to biofertilizer mass production centres

Textbooks

1. Botanical Pesticides in Agriculture. Anand Prakash and Jagadiswari Rao., CRC Press Inc, New Delhi.
2. Biofertilizer. Somani, L.L, Bhandari, S.C, Saxena, S.N. and Vyas, K.K., Scientific Publisher, Jodhpur.

Suggested Readings

1. Botanical pesticides for Pest management. Dodia D. A., Rabari, P.H., Zala, M. B and Patel, G.M (Second edition). Scientific Publishers, Jodhpur.

2. Biofertilizers technology. Kannaiyan, S., Kumar, K, Govindarajan, K. Scientific Publishers, Jodhpur.
3. Botanical and Biopesticides. Parmar, B. S and Deva Kumar C., West Will Publishing House, New Delhi.
4. Agriculture Microbiology. Rangaswamy, G and Bagyaraj, D.J. 2023. PHI Learning and Private Limited.
5. Applied Entomology. Vol I &II, Srivastava, K. P. and Dhaliwal, G.S., Kalyani Publishers, New Delhi.
6. Biofertilizers in Agriculture and forestry (Third Edition). Subbarao, N.S., Oxford & IBH Publishing Co. Pvt. Limited, New Delhi.
7. Soil Microbiology (Fourth Edition). Subbarao, N.S. Oxford & IBH Publishing Co. Pvt. Limited, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC-X**
Course Title	**:**	**Beneficial Insect Farming**
Credits	**:**	**2 (0+2)**
Year	**:**	**I**
Semester	**:**	**II**

Objective

1. To study the beneficial insects with respect to their commercial use in Agriculture

Practical lecture outlines

1. Introduction and importance of beneficial insects
2. Identification of honeybee species and bee hive products and their importance
3. Biology and caste determination in honey bees
4. Beehive boxes and other equipment
5. Identification of nectar and pollen yielding plants (Bee pasturage)
6. Seasonal management of honey bee colonies
7. Inspection of bee colonies including division and uniting of honeybee colonies
8. Insect and mite pests & diseases of honey bees and their management and measures to prevent pesticide poisoning to honeybees
9. Extraction/collection and processing of honey and other beehive products
10. Bee pollination in crops (Honeybees and Bumble bees)
11. Visit to commercial apiary / honey processing unit
12. Identification and study of lac insect strains and species and their host plants
13. Brood lac inoculation on host plants, forecast of larval emergence and crop harvesting
14. Lac cultivation on bushy host *Flemingia semialata*
15. Processing of lac- raw lac, seed lac and shellac and applications of lac
16. Enemies of lac insects and their management
17. Insects as waste decomposers- Scavengers – Black soldier flies, mealworms, dung rollers, flesh flies, and carrion flies
18. Biology and identification of different stages of black soldier fly and its mass rearing techniques
19. Black soldier fly farming- Importance as waste decomposer and as poultry/fish feed

20. Composting with black soldier flies
21. Species of silkworms and their host plants
22. Preparation of planting material and raising of mulberry garden
23. Important insect pests, diseases and nutritional deficiencies of mulberry and their management
24. Silkworm rearing house and rearing equipment
25. Chawki rearing of silkworm larvae
26. Rearing of late age silkworm larvae and bed cleaning
27. Important pests and diseases of mulberry silkworm and their management
28. Mounting of late age silkworm larvae and types of mountages
29. Harvesting of silkworm cocoons, stifling, grading and identification of defective cocoons.
30. Visit to commercial sericulture unit/ Grainage /Silk cocoon market
31. Mass multiplication of *Corcyra cephalonica*, egg parasitoid - Trichogramma sp. and production of tricho cards.
32. Mass multiplication of important predators- *Cryptolaemus montrouzieri*

Text books

1. Beekeeping: A Compressive Guide to Bees and Beekeeping by Abrol, D. B. Scientific Publishers, Jodhpur
2. An Introduction to Sericulture by Ganga, G And Sulochana Chetty. 2nd Ed. Oxford & IBH Publishing, New Delhi.

Suggested Readings

1. Black Soldier Fly Biowaste Processing - A Step-by-Step Guide, 2nd Edition. Bram Dortmans, Stefan Diener, Julia Egger and Christian Zurbrugg, Eawag: Swiss Federal Institute of Aquatic Science and Technology, Dubendorf, Switzerland.
2. A Practical Manual of Beekeeping: How to Keep Bees and Develop Your Full Potential as an Apiarist. David Cramp, Spring Hill Publishers, Taiwan.
3. Beekeeping – Theory and Practical. Koteswara Rao, S. R. Mayank Kumar Rai, Singh, R.P. and Nagaraja, N., National Institute of Open Schooling, Noida, U.P.
4. Recent Advances in Lac culture. Kumar, K.K, Ramani, R. and Sharma, K. K., Indian lac Research Institute, Ranchi.
5. Beneficial Insect Farming Benefits and Livelihood Generation. Sharma K.K, Monobrullah Md, Mohanasundaram A and Ramani R., ICAR- Indian Institute of Natural Resins & Gums, Ranchi (Jharkhand), India.
6. Elements of Economic Entomology. Vasantharaj David, B. and Rama Murthy V.V., Brillion Publishing, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC-XIII**
Course Title	**:**	**Plantation Crop Production and Processing**
Credits	**:**	**2 (0+2)**
Year	**:**	**I**
Semester	**:**	**II**

Practical lecture outlines

1. Identification of plantation crops
2. Description and identification of coconut and arecanut varieties.
3. Description and identification of species and varieties in coffee
4. Description and identification of cashewnut and cacao varieties
5. Selection of mother palm, seed nuts and planting of seed nuts in the nursery of coconut and arecanut.
6. Seed treatment and nursery raising of oil palm
7. Layout and planting of palms
8. Propagation and nursery raising of cashewnut and cocoa
9. Layout and planting of cashewnut and cocoa
10. Epicotyl and softwood grafting in cashewnut.
11. Rejuvenation techniques in cashew nut
12. Training and pruning in cashewnut and cocoa
13. Shade management in coffee
14. Propagation of tea and coffee
15. Training and pruning in tea and coffee
16. Pests and diseases of coconut and arecanut
17. Pests and diseases of cocoa, cashewnut and rubber
18. Pests and diseases of ccoffee and tea
19. Study of different by-products of plantation crops
20. Physiological disorders of plantation crops
21. Harvesting and processing of cacao

22. Harvesting and processing of cashewnut
23. Harvesting and processing of oil palm
24. Harvesting and processing of tea
25. Harvesting and processing of coffee
26. Different methods of tapping in rubber
27. Working out of economics and project preparation for coconut and arecanut
28. Working out of economics and project preparation for cacao and oil palm
29. Working out of economics and project preparation for cashewnut
30. Working out of economics and project preparation for tea and coffee.
31. Visit to plantation nursery/ estate/ research station
32. Visit to commercial plantations and processing units

Textbooks

1. A text book on fruits and plantation crops by V. Ponuswami, M. Kumar, V. Arumugam, R. Ramesh kumar, C. Krishna murthy, Jaya hub house.
2. Post-harvest handling and processing of plantation crops by Palli Venkata santhosh kumar and V. sudha vani, Notion press.

Suggested Readings

1. Introduction to spices, Plantation crops and Aromatic plants by Kumar, N.J.B. M. Md. Abdul Khaddar, Ranga Swamy, P. and Irrulappan, I., Oxford & IBH, New Delhi.
2. Hand Book of Coconut Palm by Thampan, P.K., Oxford IBH, New Delhi.
3. Hand Book of Tea Cultivation by Ranganadhan, V., UPASI Tea Research Station, Cinchona.
4. Coconut by Thompson, P.K., Oxford & IBH Publishing Co. Ltd., New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-NCC-II/ AU-NSS-II**
Course Title	**:**	**National Cadet Crops & National Service Scheme**
Credits	**:**	**1 (0+1)**
Year	**:**	**I**
Semester	**:**	**II**

NCC II

Objectives

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Practical/ Awareness activities

1. Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out.
2. Ground/take up arms, examine arms. Shoulder from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice- versa.
3. Guard mounting, guard of honor, Platoon/Coy Drill.
4. Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning and sight setting.
5. Rifle Loading, cocking, and unloading. The lying position and holding.
6. Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of ight.
7. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.
8. Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
9. The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use.
10. Setting a map, finding north and own position. Map to ground and ground to map.
11. Knots and lashings and Explosives and IEDs.

12. Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction.
13. Judging distance -Description of ground and indication of landmarks- Recognition and description of target- Observation, Camouflage and concealment.
14. Field signals and Section formations.
15. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill.
16. Types of communication, media, latest trends and developments.

NSS II

Objective

To evoke social consciousness among students through various activities viz., working together, constructive and creative social work, to be skilled in executing democratic leadership, developing skill in program to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Practical/ Awareness activities

• Importance and role of youth leadership

• Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies

• Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programs

• Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations

• Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

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Course Structure for B.Sc. (Hons.) Agriculture
Semester-III (Second Year I Semester)

S. No.	Category	Course Number	Course Title	Hours per Week			Credits
				L	T	P	
1.	Core Course	AU-AGRO-201	Crop Production Technology-I (Kharif crops)	1	0	4	3(1+2)
2.	Core Course	AU-AGRO-202	Principles and Practices of Natural Farming	1	0	2	2(1+1)
3.	Core Course	AU-GPBR-211	Principles of Genetics	2	0	2	3(2+1)
4.	Core Course	AU-SSAC-221	Problematic Soils and their management	1	0	2	2(1+1)
5.	Core Course	AU-ENTO-231	Insect Ecology & Concepts of Integrated pest Management	1	0	2	2(1+1)
6.	Core Course	AU-HORT-281	Production Technology of Fruit and Plantation crops	1	0	2	2(1+1)
7.	Common Course	AU-AEXT-291	Entrepreneurship Development and Business communication	2	0	2	3(2+1)
8.	Core Course	AU-AEXT-292	Fundamentals of Extension Education	1	0	2	2(1+1)
9.	Common Course	AU-COCA-201	Physical Education, First Aid, Yoga Practices and Meditation	0	0	4	2(0+2)
10.	Skill Enhancement course	AU-SEC-V	Commercial Sericulture	0	0	4	2(0+2)
		AU-SEC-VIII	Production Technology of Bioagents				
			Total Credits				**23**

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Course No.	**:**	**AU-AGRO-201**
Course Title	**:**	**Crop production technology -1 (*Kharif* Crops)**
Credit Hours	**:**	**3 (1+2)**
Year	**:**	**II**
Semester	**:**	**I**

Objectives

1. To impart basic and fundamental knowledge on principles and practices of kharif crop production.
2. To impart knowledge and skill on scientific crop production and management.

Course Outlines

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops. Cereals- rice, maize, sorghum, pearl millet and finger millet, pulses- Pigeonpea, Mungbean and urdbean; oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops- sorghum, cowpea, cluster bean and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeonpea and mungbean, maize, groundnut and cotton ,effect of seed size on germination and seedling vigour of Kharif season crops, effect of sowing depth on germination of Kharif crops, identification of weeds in Kharif season crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of Kharif season crops, study of crop varieties and important agronomic experiments at experiential farm. Study of forage experiments, morphological description of Kharif season crops, visit to research centers of related crops.

A) Theory Lecture Outlines

Lec. No. Topics

1. Cereals – Importance – Rice – Origin – Geographical distribution – Nutritional Value – Area, Production and productivity in India and Andhra Pradesh. Economic importance – Classification of rice plant types.
2. Soil and climatic requirements –-different types of rice ecosystems – Field preparation- crop establishment techniques in rice
3. Nutrient Management – Water management.

4. Weed management –harvesting- Yield attributes- yield- post harvest operations – cropping systems in rice- values added products.
5. Maize – Origin – geographical distribution – economic importance – area production and productivity in India and A.P – soil and climatic requirement- Classification of maize.
6. Maize - Field preparation - seeds and sowing - Nutrient management - water management - weed management – Harvesting – yield attributes-yield- value addition Zero tillage maize - cropping systems.
7. Sorghum, Pearl millet – Origin – geographical distribution – economic importance – area production and productivity in India and AP – soil and climatic requirement- Field preparation -seeds and sowing- Nutrient management- water management- weed management – Harvesting – yield attributes-yield- value addition- cropping systems.
8. Finger millet and other minor millets (Foxtail millet, Kodomillet, Proso millet, Little millet)– Origin – geographical distribution – economic importance – adaptations–soil and climatic requirement- Field preparation-seeds and sowing- Nutrient management- water management-weed management – Harvesting – yield attributes- yield- value addition- cropping systems.
9. Pulses – Economic importance – constraints for achieving higher productivity of pulses – strategies for improving the pulse production in India – Rice fallow pulses Greengram, Blackgram– Origin – geographical distribution – economic importance – area production and productivity in India and AP – soil and climatic requirement, Field preparation -seeds and sowing- Nutrient management-water management-weed management – Harvesting – yield attributes- yield - cropping systems.
10. Pigeonpea – Origin – geographical distribution – economic importance – area production and productivity in India and AP – soil and climatic requirement, Field preparation - seeds and sowing - Nutrient management - water management - weed management – Harvesting – yield attributes - yield - cropping systems.
11. Groundnut, Soyabean – Origin – geographical distribution – economic importance – area production and productivity in India and AP – soil and climatic requirement - Field preparation - seeds and sowing - Nutrient management - water management - weed management – Harvesting – yield attributes – yield - quality parameters - cropping systems.
12. Sesame, Castor – Origin – geographical distribution – economic importance – area, production and productivity in India and AP – soil and climatic requirement, Field preparation - seeds and sowing - Nutrient management - water management - weed management – Harvesting – yield attributes - yield - quality parameters - cropping systems.
13. Cotton – Origin – geographical distribution – economic importance – area production and productivity in India and AP – Classification- soil and climatic requirement - Field preparation - seeds and sowing - Varieties/Bt. Cotton - branching - Nutrient management- water management-weed management – Topping - bud and boll shedding- Harvesting – defoliants - mechanized harvesting - yield attributes – yield - quality parameters - cropping systems.

14. Jute, Mesta, Sunhemp - Origin – geographical distribution – economic importance – area production and productivity in India and AP – Classification - soil and climatic requirement - land preparation - seeds and sowing - Nutrient management- water management - weed management – yield attributes - yield – Harvesting - Retting - quality parameters - cropping systems.
15. Forage Crops – Importance – terminology in forage production – classification of fodders – quality parameters – Sorghum – Maize – importance - seeds and sowing – Nutrient management - irrigation – weed management – harvesting – yield – quality of fodder.
16. Cowpea – Cluster bean - Guinea grass and Napier grass – importance, seeds and sowing – Nutrient management, irrigation – weed management – harvesting – yield – quality of fodder.

B) Practicals

1. Identification of seeds/Crops.
2. Land preparation, layout of plots and calculation of seed rate.
3. Sowing of crops in student plots.
4. Raising of rice nursery including SRI nursery
5. Study of the effect of seed size on germination and seedling vigor
6. Effect of sowing depth on germination of *Kharif* crops
7. Identification of major weeds in different crops.
8. Practicing of Puddling -Transplanting of rice to main field.
9. Calculation of fertilizer dose - Fertilizer application -Top dressing and foliar feeding of nutrients.
10. Scheduling of irrigation to the crops.
11. Visit to the research station of related crops
12. Agronomic characters of Cereal crop varieties.
13. Agronomic characters of Millet crop varieties.
14. Agronomic characters of Pulse crop varieties.
15. Agronomic characters of Oil seed crop varieties.
16. Agronomic characters of Fibre crop varieties
17. Agronomic characters of Forage crop varieties
18. Recording of Biometric observations in student plots.
19. Morphological description and growth stages of cereal crops
20. Morphological description and growth stages of millet crops
21. Morphological description and growth stages of pulse crops
22. Morphological description and growth stages of oilseed crops
23. Morphological description and growth stages of fibre crops
24. Morphological description and growth stages of forage crops
25. Recording of yield attributes and estimation of yield in different crops
26. Harvesting and recording of yield
27. Post-harvest operations and mechanization in different crops

28. Harvesting of forage crops and recording of yield
29. Hay and silage making
30. Visit to agronomic experiments at experimental farms.
31. Visit to farmer's fields.
32. Visit to post harvest processing units.

Textbooks

1. Textbook of Field Crops Production - Commercial Crops. Volume II Rajendra Prasad. ICAR Publication.
2. Modern techniques of raising field crops by Chidda Singh. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Suggested Readings

1. Recent Strategies on Crop Production by B. Gurarajan, R. Balasubramanian and V. Swaminathan. Kalyani Publishers, New Delhi.
2. Agronomy of Field Crops by S.R. Reddy. Kalyani Publishers, New Delhi.
3. Crop Management by S.S. Singh. Kalyani Publishers, New Delhi.
4. Forage Production by Subhash Chandra Bose, M. and Balakrishnan, V. South Asian Publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No. : **AU-AGRO-202**

Course Title : **Principles and Practices of Natural Farming**

Credit Hours : **2 (1+1)**

Year : **II**

Semester : **I**

Objectives

1. To provide comprehensive understanding and knowledge to students about natural farming
2. To teach students the concept, need and principles of native ecology-based production natural farming
3. To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives

Course Outlines

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, Processing, labelling, economic considerations and viability, 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, Case studies and success stories in natural farming and chemical free traditional farming, 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 (ITK) 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).

A) Theory Lecture Outlines

Lec. No. Topics

1. Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in the present context, Natural farming: Definition- Concept- Objective and Principles of Natural farming. Status of Natural farming in World and India.
2. Scope and importance of natural farming -main pillars of natural farming- Methods/ types/schools of natural farming. Characteristics of a natural farm. Merits and limitations of Natural farming. Types of natural farming systems and practices (Bio- dynamic, Homa farming, Natural farming, Rishi Krishi, Panchagavya Krishi, Yogic farming.
3. Soil health, water use, biodiversity conservation, food and nutritional security - Sustainable Development Goals (SDGs). Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems.
4. Introduction to concept of ecological water, carbon and nitrogen foot prints, carbon sequestration. Concept and evaluation of ecosystem services. Integration of crops with trees and animals, cropping system approaches -rearing of animals (Dairy, sheep and goat) under natural farming.
5. Indigenous seed production, farm waste recycling - use of renewable energy approaches in a natural farm and water conservation, Nutrient management in natural farming
6. Weed management under natural farming and mechanization in natural farming
7. Important natural farming practices for field crops Natural farming in India - key policies, Programmes - Challenges in growth of natural farming in India
8. General practices in natural farming to contain insect pests on various field crops- pest definition- categories of different pests – Farmers Field School- Ecological engineering concepts, principles and approaches - Biodiversity in ecofriendly agriculture.
9. Study of Indigenous technical Knowledge for insect pests and disease management in natural farming- Preparation and use of panchagavya, vermi wash, sour butter milk, Ghana jeevamrutham, beejamrutham, drava jeevamrutam and application to combat insect pests and

diseases on various crops.

10. Study of IPM – Concepts, Principles and different principles in pest management in natural farming – Pest surveillance and pest forecasting – Seed treatment - host plant varietal selection- Agronomic management practices – Crop rotation- Intercrops-Trap crops-Cover crops- Physical and mechanical measures- role of Pheromone traps and different types pheromones traps used in pest monitoring- ITKs related to management of plant diseases - Suppressive soils, concept and potentialities for managing soil borne pathogens
11. Study of Insecticidal properties of botanical insecticides - Neem, Pongamia, custard apple, *Vitex nigundo*, sweet flag- Preparation of different plant-based oils and extracts- Neem oil, eucalyptus, NSKE, PSKE, Custard leaf extract –Tobacco decoction- chilli and garlic paste- Role of soil microbiome in disease management
12. Study and preparation of Neemastra, Agniastra, Brahmastra, valilaku, Ipomia, datura kashayam and Dasapatra kashayam- Usage and Precautions-Field application against insect pests and diseases.
13. Role of cultural/physical /mechanical/Indigenous techniques in management of different stored grain insect pests- Different traditional storage structures used to minimize insect damage on different stored grains and products
14. Processing, labelling -certification and standards in natural farming,
15. Marketing and export potential of natural farming produce and products-Economic viability (Yield, Cost of production, Net Income) of natural farming products.
16. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture. Case studies and success stories in natural farming and chemical free traditional farming and entrepreneurship opportunities in natural farming.

B) Practicals

1. Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming.
2. Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management.
3. On-farm inputs - Preparation methods and protocols. (Botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient)
4. Weed management practices in natural farming (cultural practices – stale seed bed- mulching, smothering crops).
5. Study of Agro ecosystem analysis (AESA)- Principles and methodology for Assessment of insect pests and diseases under natural farming
6. Study of methods and Preparation of Panchagavya, sour butter milk, Ghana jeevamrutham, beejamrutham, drava jeevamrutam for insect pests and disease management.
7. Study of preparation of different cow products-based plant extracts Neemastra, Agniastra,

brahmastra *etc*. for insect pests and disease management

8. Mass production and field release of important insect predators, parasitoids and Entomopathogenic fungi
9. Techniques of indigenous seed production - storage and marketing.
10. Partial and complete nutrient and financial budgeting in natural farming.
11. Evaluation of ecosystem services in natural farming (Crop and System).
12. Economic analysis of natural farming systems.
13. Visit to bio control laboratory and study of preparation of biofertilizers/bio-inoculants.
14. Studies on post-harvest handling of natural farming products.
15. Study of quality parameters of natural farming produce (shelf-life, colour, flavour, aroma, taste).
16. Visit to natural farming fields and documentation of the natural farming practices

Textbooks

1. Principles and Practices of Natural Farming by S.S. Walia. Scientific Publishers.

Suggested Readings

1. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa) by Ayachit, S.M. Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Alternative Methods of Agriculture by Boeringa, R. Elsevier, Amsterdam.
3. Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge Document 1 To 7 by Das, P, Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others, Indian Council of Agricultural Research, New Delhi.
4. Ecological Farming -The seven principles of a food system that has people at its heart. 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
6. The One-Straw Revolution: An Introduction to Natural Farming by Fukuoka, M. Rodale Press, Emmaus, PA. 181 pp
7. The Natural Way of Farming: The Theory and Practice of Green Philosophy by Fukuoka, M. Japan Publications, Tokyo, 280 pp.
8. 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.
9. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
10. State of Organic and Natural Farming: Challenges and Possibilities by Khurana, A. and Kumar, V. Centre for Science and Environment, New Delhi.

11. Sanskrit Non-Translatable - The importance of Sanskritizing English by Malhotra R. and S.D. Babaji. Amaryllis, New Delhi India.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-GPBR-211**
Course title	**:**	**Principles of Genetics**
Credit hours	**:**	**3 (2+1)**
Year	**:**	**II**
Semester	**:**	**I**

Objective

To make the students acquainted with both principles and practices in the areas of classical genetics, modern genetics, quantitative genetics and cytogenetics.

Course Outlines

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 example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation. Multiple alleles, pleiotropism and pseudo alleles, 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 division, Experiments on monohybrid, dihybrid, trihybrid, 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 on models on DNA and RNA

structures.

A) Theory Lecture outlines

Lec. No. Topics

1. Introduction and definition of cytology, genetics and cytogenetics and their interrelation. Pre and post Mendelian concepts of heredity-Early history of heredity, inheritance of acquired traits, preformation theory, pangenesis and germplasm theory.
2. Study of model organisms (Drosophila, Arabidopsis, Garden pea, E.coli, and mice).
3. Chromosome - Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, types of chromosomes based on position of centromere.
4. Special types of chromosomes – Polytene chromosomes, Lamp brush chromosomes, B or Accessory chromosomes and Isochromosomes.
5. Cell division – Cell cycle – Mitosis - Process of mitosis - Significance.
6. Meiosis - Process - Differences between mitosis and meiosis - Significance.
7. Mendelian principles of heredity – Terminology, Mendel's experiments – Reasons for selection of pea as experimental material- characters studied - Reasons for Mendel's success.
8. Mendel's laws – Law of segregation – Law of independent assortment – Principle of dominance – Principle of unit characters – Exceptions to mendel's laws – Rediscovery of mendelian principles.
9. Chromosomal theory of inheritance- Chromosomal basis for Law of segregation and Law of independent assortment.
10. Probability (Addition and Multiplication rule) and Chi-square test.
11. Dominance relationships – Complete dominance, incomplete dominance, codominance, over dominance, pseudo dominance, lethal factors.
12. Gene interaction – Non epistatic interaction – Interaction of factors; epistatic interactions – Complementary epistasis, dominant epistasis.
13. Recessive epistasis, duplicate dominant gene action, dominant suppression or inhibitory gene action, duplicate genes with cumulative effect.
14. Multiple alleles – Characteristics of multiple alleles - Blood groups in humans, coat colour in rabbits, self-incompatibility alleles in plants – Test of allelism - pseudoalleles – pleiotropism, penetrance and expressivity.
15. Qualitative and Quantitative traits, Polygenes and continuous variations – Definition - Inheritance and their differences, multiple factor hypothesis.
16. Linkage –Types of linkage – Characteristic features of linkage – Detection of linkage - Linkage groups.
17. Crossing over - Mechanism of crossing over – Types of crossing over – Cytological proof of crossing over in Drosophila – Chromosome mapping- two point test cross.

18. Sex determination – Mechanisms of sex determination – Chromosomal sex determination, genic balance theory in Drosophila melanogaster, male haploidy, single gene effects.
19. Sex linkage – White eye colour in Drosophila, colour blindness and haemophilia in humans - sex influenced traits – Horns in sheep, baldness in humans, sex limited traits - Milk production in cattle, beard in man – Pseudo hermaphrodites – Gynandromorphs.
20. Nature and structure of genetic material - DNA and its structure -Watson and Crick's model - Function – Types of DNA- Experiments to prove DNA as genetic material.
21. Replication of DNA - Modes of DNA replication - Semi-conservative DNA replication - Experimental proof.
22. Types of RNA - Messenger RNA, ribosomal RNA and transfer RNA - structure of tRNA, differences between DNA and RNA.
23. Protein synthesis – Central dogma - Genetic code – Properties of genetic code – Wobble hypothesis.
24. Steps in protein synthesis – Transcription, Post transcriptional modifications and translation.
25. Gene regulation - Lac operon concept – Gene concept – Cistron – Recon – Muton.
26. Mutation – Definition – Classification of mutations - Characteristics of mutations - Xenia and Metaxenia – Chimeras Types and their significance.
27. Molecular Basis of Mutations - Methods of inducing mutations - Physical and chemical mutagens.
28. Structural changes in chromosome – Classification - Deletions (deficiency) - Duplications and their significance.
29. Inversions - pericentric inversions and paracentric inversions - inversions as cross over suppressors. Translocations - simple and reciprocal - their significance.
30. Numerical variations in chromosomes and their implications –Euploids (Haploids, diploids, dihaploids, doubled haploids, Autopolyploids and Allopolyploids).
31. Numerical variations in chromosomes and their implications – Anueploids – Hypoploids and Hyperploids (Nullisomics, Monosomics, Trisomics and Tetrasomics).
32. Cytoplasmic inheritance – Definition – Chloroplast inheritance (leaf variegation in *Mirabilis jalapa*) - mitochondrial inheritance (cytoplasmic male sterility in maize) -Characteristic features of cytoplasmic inheritance - Differences between chromosomal and extra chromosomal inheritance.

B) Practicals

1. Study of microscope.
2. Study of cell structure.
3. Mitosis cell division.
4. Meiosis cell division.
5. Practice on mitotic and meiotic cell division.
6. Problems on monohybrid, testcross and backcross.

7. Problems on dihybrid, testcross and backcross.
8. Problems on trihybrid, testcross and backcross.
9. Problems on probability.
10. Problems on chi-square test.
11. Problems on epistatic interactions including test cross and back cross.
12. Problems on epistatic interactions including test cross and back cross.
13. Problems on epistatic interactions including test cross and back cross.
14. Determination of linkage and cross over analysis (through two-point testcross data).
15. Study on sex linked inheritance in Drosophila.
16. Study on models on DNA and RNA structures.

Textbooks

1. Fundamentals of Genetics. B.D.Singh. Kalyani Publishers, New Delhi.
2. Fundamentals of Genetics. Phundhan Singh. Kalyani Publishers, New Delhi.

Suggested Readings

1. Genetics: M.W. Strickberger. Collier Macmillan Ltd.
2. Principles of Genetics: Gardner, Simmons and Snustad. Wiley Publishers.
3. Principles of Genetics: Sinnott, Dunn and Dobzhansky. Tata McGraw-Hill Ltd., New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SSAC-221**
Course title	**:**	**Problematic Soils and their management**
Credit hours	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**I**

Objectives

1. To acquaint the students about various problem soils like degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils. Also to impart knowledge about remote sensing and GIS, Multipurpose tree and land capability classification
2. To give hands on training about estimation of various soil and water quality parameters associated with problem soils

Course Outlines

Theory

Soil quality and health, Distribution of Waste land and problem soils in India with special reference to Assam and North Eastern Region. Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Management of Riverine soils, Waterlogged soils, Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Irrigation water – quality and standards, utilization of saline water in agriculture. Use of Remote sensing and GIS in diagnosis and management of problem soils. Irrigation and water quality. Multipurpose tree (MPT) species, bio MPTs of soils, land capability and classification, land suitability classification.

Practical

Remediation through Determination of p^H and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO3, HCO3, Cl, SAR and RSC), Determination of nitrate (NO3-) from irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

A) Theory Lecture Outlines

Lec. No. Topics

1. Soil quality and Health- Definition - Concepts – Soil resilience – Factors affecting soil quality (Physical, chemical and biological) – Assessment of soil quality - Management and improvement of soil quality.
2. Problem soils –Definition – Different types of problematic soils – Extent and distribution of problematic and wastelands soils in different agro-eco systems in Andhra Pradesh. Categorization of problematic soils based on physical, chemical and biological properties.
3. Salt affected soils – Origin and formation - Distribution of salt affected soils in India and Andhra Pradesh. Characteristic features of saline, sodic and saline – sodic soils – Diagnostic criteria based on properties.
4. Saline soils – Visual symptoms for identification of saline soils – Buildup of salinity - Effect of salinity on plant growth and nutrient availability - Reclamation and management.
5. Sodic soils - Visual symptoms for identification of sodic soils - Effect of sodicity on plant growth and nutrient availability - Reclamation and management.
6. Saline - sodic soils – Visual symptoms for identification of saline - sodic soils – Effect of salinity on plant growth and nutrient availability - Reclamation and management.
7. Acid soils – Extent of area in India and Andhra Pradesh – Formation - Characteristics of acid soils – Sources of soil acidity – nutrient limitations and toxicity - Reclamation of acid soils - Different liming materials used for reclamation – Benefits of liming – Harmful effects of over liming.
8. Acid sulphate soils – Origin – Types – Characterization - Constraints and management.
9. Land degradation - Eroded, compacted, flooded and waterlogged soils – Biologically sick soils – Effects on plant growth – Management.
10. Polluted soils – Definition – Sources of pollution – Bio solid wastes –Industrial effluents (distillery, paper mill, tannery, textiles industrial effluents) –Mechanism of interaction of wastes with soil.
11. Soil pollution - Potentially toxic elements - excessive use of fertilizers, pesticides and weedicides – Heavy metal contamination – Management.
12. Mined soils (Coal mined & Oil mined) –Riverine soils- Waterlogged soil- formation- properties and their management
13. Irrigation water – Quality and standard parameters - classification based on ICAR, CSSRI and USDA criteria- Guidelines for judging quality of water - Utilization of saline water in agriculture.
14. Remote Sensing and GIS techniques in diagnosis, mapping and management of degraded and problematic soils.
15. Bio-remediation of problem soils through Multi-Purpose Tree Species (MPT'S)
16. Land suitability classification - Land Capability Classification

B) Practicals

1. Field identification of problematic soils and visit to degrade lands.
2. Determination of p^H and EC of salt affected soils (acid, saline and alkali) in saturated extract paste
3. Determination of redox potential in soil
4. Estimation of water soluble and exchangeable cations and computation of SAR and RS in soil
5. Determination of p^H and EC of saline, sodic and good quality irrigation water.
6. Determination of CO_3, and HCO_3 in irrigation water.
7. Determination of chlorides in irrigation water.
8. Determination of Ca and Mg content in irrigation water.
9. Determination of Na and K content in irrigation water.
10. Computation of quality class, RSC and SAR of irrigation water.
11. Determination of Gypsum requirement (GR) of sodic soils
12. Determination of Lime Requirement of acid soils
13. Determination of ESP of sodic soils.
14. Determination of aggregate stability of sodic soils
15. Determination of nitrates in irrigation water
16. Determination of dissolved oxygen and free carbon dioxide levels in water samples

Textbooks

1. Management of soil problems- Osman, Khan Towhid – Springer publications
2. Saline alkali soils of India- Agarwal R R, Yadav.J S P and Gupta R N - ICAR AGRBIOS (India)

Suggested Readings

1. Nature and properties of soils- Brady Nyle C and Ray R Well- Pearson education INC. New Delhi
2. Principle of Remote sensing –Cirsan J. Paul., - Longman New York, Indian Society of Soil Science.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No. : **AU-ENTO-231**

Course title : **Insect Ecology and Concepts of Integrated Pest Management**

Credit hours : **2 (1 +1)**

Year : **II**

Semester : **I**

Objectives

1. To know the influence of ecological factors on insect development and distribution
2. To understand the tools and concepts of Integrated Pest Management
3. To know about different biocontrol agents and their mass multiplication *viz.,* predators, parasitoids, EPF and NPV
4. To know the classification, formulations of insecticides and their use in pest management

Course Outlines

Theory

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance. Concepts of Balance of Life in nature, Biotic Potential and Environmental Resistance and causes for outbreak of pests in agro-ecosystem. Pest surveillance and pest forecasting. Categories of pests. IPM: Concepts, Host plant resistance, components/tools of IPM: Cultural, Mechanical, Physical, Legislative, Biological (Important parasitoids, predators, transgenic plants, pathogens such as bacteria, fungi, EPNs and viruses). Chemical control - importance, hazards and limitations. Classification of insecticides, toxicity of insecticides, brief mode of action of different groups of insecticides used in crop pest management - label claim of insecticides. Biorational insecticides, repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes, Insecticides Act 1968.

Practical

Study of distribution patterns of insects in crop ecosystems - Sampling techniques for the estimation of insect population and damage - Pest surveillance through light traps, pheromone traps and forecasting of pest incidence - Calculation of doses/ concentrations of different insecticidal

formulations - Acquaintance of insecticide formulations – Compatibility of pesticides with other agrochemicals and phytotoxicity of insecticides – Pesticide appliances and their maintenance - Acquaintance of mass multiplication techniques of important predators : *Cryptolaemus*. Important parasitoids: Egg, larval and pupal parasitoids *viz*., *Trichogramma*, *Apanteles* and *Tetrastichus*. Important Entomopathogenic Fungi: *Beauveria bassiana* and Nuclear Polyhedrosis Virus (NPV) on *Helicoverpa* and *Spodoptera*. Study of insect pollinators, weed killers and scavengers - Identification of major non-insect pests *viz.*, birds, rodents, crabs, snails, slugs and mammalian pests. Household and veterinary insect pests.

A) Theory Lecture Outlines

Lec. No. Topics

1. Insect Ecology- Introduction, Autecology and Synecology-Population-Community Ecosystem Agro - ecosystem - Environment and its components. Abiotic factors – Temperature - Its effect on the development, fecundity, distribution, dispersal and movement of insects - Adaptations of insects to temperature - Thermal constant-Day Degrees. Moisture - Adaptation of insects to conserve moisture.
2. Humidity- Its effect on development, fecundity and colour of body Rainfall - Its effect on emergence, movement and oviposition of insects. Light – Phototaxis - photoperiodism - Its effect on growth, moulting activity or behaviour, oviposition and pigmentation - Use of light as a factor of insect control; Atmospheric pressure and its effect on behaviour. Air currents - Effect on dispersal of insects – Edaphic factors
3. Biotic factors–Food-Classification of insects according to nutritional requirements - Other organisms Inter and Intra specific associations - Beneficial and harmful associations of parasitoids based on site of attack, degree of parasitism and food habits. Effect of biotic factors - Competition, natural and environmental resistance
4. Concepts of Balance of life in nature - Biotic potential and environmental resistance- Factors contributing to increase or decrease of population -Causes for outbreak of pests in agroecosystem.
5. Practices, Scope and Limitations of IPM – IPM Definitions, Concepts– Economic Threshold Level (ETL) – Economic Injury Level (EIL) and General Equilibrium Position (GEP)–Modified Equilibrium Position (MEP) -Components/tools of IPM.
6. Pest surveillance and pest forecasting – Definition-Importance in IPM –Advantages - Components of pest surveillance, types of forecasting (Short term and long-term forecasting and their advantages) – Insect pests – Definitions of negligible, minor and major pests; Different categories of pests – Regular, occasional, seasonal, persistent, sporadic, epidemic and endemic pests with examples.
7. Host-plant resistance - Principles of host plant resistance – Ecological resistance – Phenological asynchrony, induced resistance and escape – Genetic resistance – Mono, oligo and polygenic resistance – Major gene resistance (vertical/ specific/ qualitative) and minor gene resistance

(horizontal/ nonspecific/ quantitative) – Host - plant selection process-host habitat finding, host finding, host recognition, host acceptance and host suitability- Mechanisms of Genetic resistance-Non-preference (antixenosis), antibiosis and tolerance –Transgenic plants.

8. Components/ tools of IPM: Cultural control -Normal and special cultural practices which incidentally control the pests and agronomic practices recommended specifically against the insect pests with examples.
9. Mechanical control –Different mechanical methods of pest control with examples. Physical control – Use of inert carriers against stored product insects - steam sterilization – Solarization - Solar radiation Light traps - Flame throwers *etc*.; Legislative measures -Importance of quarantine-Examples of exotic pests -Different legislative measures enforced in different countries including India.
10. Biological control - Types of biological control – Introduction, augmentation and conservation – Advantages and disadvantages of biological control. Parasite – Parasitoid - Parasitism - Grouping of parasites based on nature of host, stage of host, site of parasitisation, duration of attack, degree of parasitisation and food habits– Kinds of parasitism–qualities/attributes of an effective parasitoid. Predators – Predatism – qualities of insect predator – Differences between predator and parasite.
11. Microbial control - Important groups of microorganisms - Bacteria, viruses and fungi used in pest control and multiplication technique of Bacteria- Transgenic plant pathogens–Entomopathogenic nematodes (EPNs)–Important species- Mode of infectivity and examples
12. Chemical control - Importance and ideal properties of insecticide - Classification of insecticides based on origin, mode of entry, mode of action and toxicity with list of insecticides - Toxicity evaluation of insecticides - Acute or chronic toxicities, oral and dermal toxicities- LC50 (Median Lethal Concentration), LD50 (Median Lethal Dose), ED50 (Median Effective Dose), LT50 (Median Lethal time), KD50 (Median Knock down Dose) and KT50 (Median Knock Down Time) – Bioassay methods – Advantages and disadvantages of chemical control
13. Insecticides- Brief mode of action of different groups of insecticides with examples – Organochlorines – DDT and BHC – Cyclodienes – Endosulfan; Organophosphates – Malathion, Monocrotophos, Chlorpyriphos, Phorate, Acephate and Profenophos; Carbamates – Carbaryl and Carbofuran; Synthetic pyrethroids – Deltamethrin, Lambda cyhalothrin, Neonicotinoids-Imidacloprid, Acetamiprid and Thiamethoxam.
14. Novel Insecticides used in crop pest management with brief mode of action - Spinosyns-Spinetoram, Spinosad; Avermectins - Emamectin benzoate, Abamectin; Pyridine Azomethines - Pymetrozine, Thiourea – Diafenthiuron; Pyrroles – Chlorfenapyr; Nereistoxin analogues - Cartap hydrochloride; Benzoylphenyl Ureas- Novaluron, Pyrazole - Tolfenpyrad; Oxadiazines - Indoxacarb; Diamides - Chlorantraniliprole, Cyantraniliprole, Flubendiamide; Phenyl pyrazole – Fipronil; Ketoenols – Spirotetramat, spiromesifer; Pyridine Carboxamide –Flonicamid;

Hydroxy- 4- coumarin – Bromodialone - Label Claim of Insecticides.

15. Biorational Insecticides - repellents (Physical and Chemical) and antifeedants - Importance of antifeedants and limitations of their use – Attractants - Sex pheromones - Synthetic sex pheromones use in IPM - Insect hormones – Gamma irradiation –Genetic control – Sterile male technique.
16. Application techniques of spray fluids - High volume, low and ultralow volume sprays - Phytotoxic effects of insecticides - Safe use of pesticides. Symptoms of poisoning - First aid and antidotes for important groups of insecticides. Insecticides Act 1968 – Important provisions - Insecticide resistance – resurgence - insecticide residues – importance - Maximum Residue Limits (MRL) – Acceptable Daily Intake (ADI) – Safe waiting periods.

B) Practicals

1. Sampling techniques for the estimation of insect population in different crops and distribution patterns of insects in crop ecosystems
2. Techniques for the estimation of insect damage in different crops
3. Pest surveillance through light traps, pheromone traps and forecasting of pest incidence
4. Acquaintance of insecticide formulations
5. Calculation of doses/ concentrations of different insecticidal formulations
6. Compatibility of pesticides with other agrochemicals and phytotoxicity of insecticides; insecticides banned, withdrawn and restricted use
7. Pesticide appliances and their maintenance
8. Acquaintance of mass multiplication techniques of important predators – *Cryptolaemus*
9. Acquaintance of mass multiplication techniques of the egg parasitoid, *Trichogramma*
10. Acquaintance of mass multiplication techniques of *Apanteles* sp. (Larval) and *Tetrastichus* sp (Pupal) parasitoids
11. Acquaintance of mass multiplication techniques of important entamopathogenic fungus, *Beauveria bassiana*
12. Acquaintance of mass multiplication techniques of Ha NPV and Sl NPV.
13. Study of insect pollinators, weed killers and scavengers
14. Identification of different rodent pests
15. Identification of different non-insect pests *viz*., birds, crabs, snails and slugs.
16. Identification of different household and veterinary insect pests

Textbooks

1. Principles of Applied Entomology. K.N. Ragumoorthi, M.R. Srinivasan, V. Balasubramani, N. Natarajan. A.E. Publications
2. Insect Ecology and Pest Management. Dr. Satyendra Kumar Singh, Dr. Ravi Shanker Verma, Mr. Rajeev Kumar and Dr. Nagesh Kumar Shah S. R. Scientific Publication Agra

Suggested Readings

1. Applied Animal Ecology Atwal by A.S. and Bains, S.S. Kalyani Publishers, New Delhi
2. Integrated Pest Management: Concepts and Approaches by Dhaliwal, G.S. and Ramesh Arora. Third Edition, Kalyani Publishers, Ludhiana
3. Fundamentals of Ecology by Eugene P. Odum and Gray W Barrett. Fifth Edition. Cengage India Private Limited. New Delhi.
4. Biological Pest Suppression by Gautam, R.D. Westville Publishing House, New Delhi
5. Insecticides with Novel Modes of Action, Mechanisms and Application by Ishaaya, I. and Degheele, D. Springer.
6. Entomology and Pest Management by Larry P Pedigo and Marlin E Rice. Prentice Hall of India Private Ltd., New Delhi
7. Introduction to Insect Pest Management by Metcalf, R. L. and Luckman, W. H. Third Edition, Wiley India Pvt. Ltd. Noida
8. General and Applied Entomology by Vasantharaj David, B. And Aanathakrishnan, T. N. Tata McGraw-Hill Publishing House, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-HORT-281**
Course title	**:**	**Production Technology of Fruit and Plantation Crops**
Credit hours	**:**	**2(1+1)**
Year	**:**	**II**
Semester	**:**	**I**

Objectives

1. To educate about the different forms of classification of fruit crops
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of fruit and plantation crops
3. To educate about the physiological disorders of fruit crops, palms and plantation crops

Course Outlines

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 growth regulation, important disorders, maturity indices and harvest, value addition. Fruit crops: mango, banana, papaya, guava, citrus, grape, litchi, pineapple, pomegranate, apple, strawberry, jackfruit and ber. Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management planting and planting systems, cropping systems, aftercare, 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, processing - value addition. Palms: coconut, arecanut and oilpalm, Plantation crops: cashew, tea, coffee, cocoa and rubber.

Practical

Propagation techniques, selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, grapes, citrus (mandarin and acid lime), pomegranate, jackfruit, preparation and application of PGR's for propagation, Micro propagation, 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, Visit to commercial orchard and plantation industries.

A) Theory Lecture outlines

Lec. No. Topics

1. Scope and Importance of fruit and plantation crops – Nutritional, industrial and medicinal importance – Classification of fruit crops - Area, production and export import trade of fruit and plantation crops
2. Mango – Importance - Climate – Soil – Varieties – Propagation and use of root stocks – Planting density and systems of planting – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Value addition - Physiological disorders
3. Banana – Importance - Climate – Soil – Varieties – Propagation – Planting density and systems of planting – Water, nutrient and weed management - Inter cultivation – Special intercultural operations – Maturity indices and harvest– Value addition - Physiological disorders
4. Citrus - Importance - Climate – Soil – Varieties – Propagation and use of root stocks – Planting density and systems of planting – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Value addition - Physiological disorders
5. Guava and Litchi - Importance - Climate – Soil – Varieties – Propagation and use of root stocks – Planting density and systems of planting – Training and pruning – Water, nutrient and weed management – Inter cultivation – Maturity indices and harvest– Value addition - Physiological disorders
6. Papaya and Pomegranate - Importance - Climate – Soil – Varieties – Propagation and use of rootstocks. Planting density and systems of planting – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Value addition- Physiological disorders
7. Grape - Importance - Climate – Soil – Varieties – Propagation and use of root stocks – Planting density and systems of planting – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Value addition - Physiological disorders
8. Pineapple, Jack fruit and Ber - Importance - Climate – Soil – Varieties – Propagation and use of root stocks – Planting density and systems of planting – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest– Value addition
9. Apple and Strawberry- Importance - Climate – Soil – Varieties – Propagation and use of root stocks –Planting density and systems of planting – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Value addition - Physiological disorders
10. Coconut and Arecanut - Importance - Climate – Soil – Varieties – Propagation – Nursery management Planting density and Cropping systems – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Processing - Value addition
11. Cashewnut - Importance - Climate – Soil – Varieties – Propagation – Nursery management - Planting density and Cropping systems – Training and pruning – Water, nutrient and weed

management - Inter cultivation – Maturity indices and harvest– Processing - Value addition

12. Oil palm - Importance - Climate – Soil – Varieties – Propagation – Nursery management – Planting density and Cropping systems – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Processing - Value addition
13. Tea - Importance - Climate – Soil – Varieties – Propagation – Nursery management - Planting density and Cropping systems – Shade management - Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest– Processing - Value addition
14. Coffee - Importance - Climate – Soil – Varieties – Propagation – Nursery management - Planting density and Cropping systems – Shade management- Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest– Processing - Value addition
15. Cocoa - Importance - Climate – Soil – Varieties – Nursery management - Planting density and Cropping systems – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Processing - Value addition
16. Rubber - Importance - Climate – Soil – Varieties – Nursery management - Planting density and Cropping systems – Training and pruning – Water, nutrient and weed management - Inter cultivation – Maturity indices and harvest – Processing – Value addition

B) Practicals

1. Identification of fruit and plantation crops
2. Propagation methods for fruit crops
3. Propagation methods for plantation crops
4. Micro-propagation
5. Preparation of plant bio regulators and their uses
6. Coconut propagation - Mother palm selection, seed nut selection and raising of coconut seedlings
7. Pre-treatment of banana suckers and de-suckering in banana
8. Sex forms and latex extraction in papaya
9. Canopy management in fruit crops
10. Fertilizer scheduling in mango, banana, citrus and grape
11. Fertilizer scheduling in guava, papaya, strawberry and pomegranate
12. Fertilizer scheduling in coconut, cashewnut and oil palm
13. Physiological disorders of fruit crops – Mango, Citrus, Grape
14. Physiological disorders of plantation crops
15. Visit to processing unit
16. Visit to commercial plantations/ fruit orchards

Textbooks

1. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.

2. Plantation Crops. Vol I and II. Parthasarathy, V. A., P.K. Chattopadhyay and Bose, T.K. Bio green books Publishers.

Suggested Readings

1. Handbook of Horticulture by Chadha, K.L. ICAR, Delhi
2. Textbook of temperate fruits by Chadha, T.R. ICAR, New Delhi
3. A Text Book on Pomology (4 volumes) by Chattopadhyay, T.K. Kalyani Publishers, Ludhiana.
4. Cultivation of minor fruits by Das, B.C and Das, S.N. Kalyani Publishers, Ludhiana.
5. Production Technology of Fruits and Plantation Crops by Kavino, M, V. Jegadeeswari, R. M. Vijayakumar and S. Balkrishnan. Narendra Publishing House.
6. Introduction to spices, Plantation crops and Aromatic plants by Kumar, N.J. B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. Oxford & IBH, New Delhi.
7. Production Technology of Fruits and Plantation Crops by Sharma, A., Kumar, P., Tripathi, V.K. Elite Publishing House

Course No. : **AU-AEXT-291**

Course title : **Entrepreneurship Development and Business communication**

Credits : **3 (2+1)**

Year : **II**

Semester : **I**

Objective

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit
3. To enable the student to develop financially viable agribusiness proposal

Course Outlines

Theory

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning–spotting of opportunity scanning of environment–identification of product / service – starting a project; factors influencing sensing the opportunities. Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management – product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management /accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management-market, types, marketing assistance, market strategies. Crisis management- raw material, production,

leadership, market, finance, natural etc.

Practical

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

A) Theory Lecture Outlines

Lec. No. Topics

1. Concept of Entrepreneur, Entrepreneurship, need for and importance of entrepreneurial development
2. Development of entrepreneurship, motivational factors, social factors, environmental factors.
3. Characteristics of entrepreneurs, entrepreneurial attributes/competencies:
4. Evolution of entrepreneurship: Approaches of entrepreneurship and theories of entrepreneurship
5. Types of entrepreneurs, functions of entrepreneurs and importance of entrepreneurial development and process of entrepreneurship development
6. Phases of Entrepreneurship Development
7. Agri-entrepreneurship–Concept, need and scope. Characteristics of entrepreneurship useful for agripreneurship.
8. Idea generation scanning and opportunity identification need for scanning
9. Spotting of opportunity, scanning of environment identification of product/service and preliminary screening of ideas
10. Incubation and commercialization of business ideas- Researching/ managing competition
11. Starting a project: Identification of sound enterprise, steps to be considered in setting up enterprise, factors influencing sensing the opportunities.
12. SWOT Analysis- concept, meaning and advantages
13. Infrastructure and support schemes for entrepreneurship development
14. Export and import policies relevant to Indian agriculture sector
15. Role of financial institutions and other agencies in entrepreneurship development
16. Venture Capital (VC), Contract Farming (CF), Joint Venture, Public Private Partnership (PPP)
17. Steps involved in functioning of an enterprise
18. Selection of the product/services, selection of form of ownership, Registration, selection of site, capital sources, acquisition of, manufacturing know- how, packaging and distribution.
19. Planning of an enterprise, project identification, selection and formulation of project
20. Project report preparation, Enterprise management
21. Production management: Product, levels of products, product mix and quality control
22. Cost of production, production controls, material management, raw material costing and inventory control
23. Personal management: Man power planning, labour turn over, wages/salaries

24. Financial management/accounting: Funds, fixed capital and working capital
25. Costing and pricing, long term planning and short-term planning
26. Book keeping, journal, ledger, subsidiary books
27. Annual financial statements and taxation
28. Marketing management: Market, types, marketing assistance, market strategies, business stake holders- Importance of agri-business in Indian economy
29. Supply Chain Management- Meaning, Advantages, Stages, Process, Drivers and Scope of Agri-Supply Chain Management
30. Crisis management: Raw material, production, leadership, market, finance, naturals etc.
31. Assessment of entrepreneurship skills - Business leadership skills- Communication skills for entrepreneurship development
32. Organizational skills, managerial skills, problem solving skills, and time management skills for entrepreneurship development

B) Practicals

1. SWOT analysis of a selected agro-based enterprise
2. Visit to study the characteristics of successful entrepreneurs/agripreneurs
3. Visit to Entrepreneurial Development Institute to study the process of Entrepreneurship Development
4. Visit to study the constraints in setting up of Agro-industries/Micro Medium and Small Enterprises (MSMEs)
5. Visit to Agro-industry to study the formulation of Project feasibility Report
6. Visit to local financial institutions to study the MSME policies
7. Visit to Institutions/agencies supporting entrepreneurship
8. Visit to local public-private enterprise to study the enterprise management
9. Visit to Agri-clinic and Agribusiness center
10. Visit to Agri-export agency
11. Practicing exercise on creativity and time audit
12. Practicing exercise on project report preparation and proposal writing
13. Power point presentation of Assignments-Session I
14. Power point presentation of Assignments-Session II
15. Power point presentation of Assignments-Session III
16. Power point presentation of Assignments-Session IV

Textbooks

1. Entrepreneurship: Development and Management, Desai, V. Himalaya Publishing House.
2. The Agribusiness Book. Pandey, M. and Tewari, D. IBDC Publishers, Lucknow.

Suggested Readings

1. Entrepreneurship Development and Small Business Enterprises – P.M. Charantimath. Pearson Publications, New Delhi.
2. Management Theory and Practice – C.B. Gupta. Sultan Chand & Sons.
3. Handbook on Empowerment and Entrepreneurship – Indu Grover. Agrotech Public Academy.
4. Entrepreneurial Development – S.S. Khanka. S. Chand & Co.
5. Business Communication for Managers – P. Mehra. Pearson India, New Delhi.
6. Projects – Prasanna Chandra. Tata McGraw Hill, New Delhi.
7. Effective Managerial Leadership – D. Singh. Deep & Deep Publications.
8. Entrepreneurship Development & Management – R.K. Singhal. Katson Books.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-AEXT-292**
Course title	**:**	**Fundamentals of Extension Education**
Credit hours	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**I**

Objectives

1. State the importance of extension education in agriculture.
2. Familiarize with the different types of agriculture and rural development programmes launched by govt. of India.
3. Classify the types of extension teaching methods.
4. Elaborate the importance and different models of communication.
5. Explain the process and stages of adoption along with adopters' categories.

Course Outlines

Theory

Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning- Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: extension efforts in pre independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Reorganised Extension System (T&V system) various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme- ITDA, IRDP/SGSY/NRLM. Women Development Programme-RMK, MSY etc. New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader. Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; communication: meaning

and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To get acquainted with university extension system. Group discussion- exercise; Identification of rural leaders in village situation; preparation and use of AV aids, preparation of extension literature – (leaflet, booklet, folder, pamphlet news stories and success stories); Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA/PRI and other development departments at district level; visit to NGO/FO/FPO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television.

A) Theory Lecture Outlines

Lec. No. Topics

1. Education: meaning, definition & types; Extension education- meaning, definition, concepts, characteristics, scope and process, Objectives and principles of extension education
2. Extension programme planning – meaning, process, principles; Extension programme planning – steps in programme development.
3. Extension systems in India: Extension efforts in pre-independence era – Srinikethan, Marthandam, Sevagram, Firka development scheme, Gurgaon experiment, etc., Extension efforts in post- independence era – Etawah pilot project, Nilokheri experiment etc.,
4. Reorganized Extension System (T&V system) various extension/ agricultural development programmes launched by ICAR / Govt. of India-IADP, IAAP, HYVP, KVK, IVLP.
5. Rural development- meaning, definitions, concept, various rural Development programs launched by Govt. of India
6. Community development- meaning, definition, concept principles, philosophy of C.D.
7. New trends in agricultural extension- privatization extension and cyber extension/ e- extension, market-led extension, farmer –led extension, expert systems, etc.,
8. DWCRA, Commodity Interest Groups (CIGs), Farmer Producer Groups (FPG).
9. Transfer of technology: concept and models and capacity building of extension, extension personnel
10. Rural leadership: meaning, definition and concept, types of leaders in rural context, roles of leaders and methods of identification of a Rural leader
11. Extension administration: meaning, definition and concept, principles and functions. Monitoring evaluation – definition and concept, principles. monitoring and evaluation of extension

programmes

12. Extension Teaching Methods- meaning, classification, individual, group and mass contact methods.
13. ICT Applications in TOT (New and social media), media mix strategies.
14. Communication: meaning and definition; Principles and functions of Communication, Models and barriers in Communication.
15. Diffusion of Innovation: Concept and meaning process, attributes of innovation and stages of adoption, adopter categories.
16. Agriculture Journalism

B) Practicals

1. To study and familiarize university extension system
2. Group discussion – Simulated exercise
3. Identification of rural leaders in village situation
4. Preparation and use of Audio-visual Aids
5. Preparation of extension literature – Leaflet, folder, pamphlet, booklet, news stories and success stories
6. Presentation skills exercise
7. Visit to village to understand the problems being encountered by villagers/ farmers
8. Visit to study organization and functioning of DRDA/PRI other development departments at district level
9. Visit to NGO/FO/FPO and learning from their experience in rural development
10. Understanding PRA techniques and their application in village development planning
11. Visit to community radio
12. Visit to television studio
13. Developing script for print media
14. Developing script for electronic media
15. Developing script for radio
16. Developing script for Television

Textbooks

1. Introductory Rural Sociology by J.B. Chitambar. New Age International Private Limited.
2. Extension Communication and Management by Ray, G. L. Kalyani Publications, New Delhi.

Suggested Readings

1. Extension Education by Adivi Reddy, A. Sree Lakshmi press, Bapatla.
2. Education and Communication for Development by Dahama, O. P. and Bhatnagar, O.P. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
3. Fundamentals of Extension Education and Management in Extension by Jalihal, K. A. and Veerabhadraiah, V. Concept publishing company, New Delhi.
4. Agricultural Extension by Muthaiah Manoraharan, P. and Arunachalam, R. Himalaya Publishing

House (Mumbai).

5. Textbook on Rural Development, Entrepreneurship and Communication Skills by Sagar Mondal and Ray, G. L. Kalyani Publications.
6. Handbook of Extension Education by Rathore, O. S. et al. Agrotech Publishing Academy, Udaipur.
7. Extension Teaching Methods and Communication Technology by Dudhani, C.M.; Hirevenkat goudar, L.V., Manjunath, L.; Hanchinal, S.N. and Patil, S.L. UAS, Dharwad.
8. Textbook on Agricultural Communication: Process and Methods by Sandhu, A.S. Oxford and IBH Publishing Pvt. Ltd., New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-COCA-201**
Course title	**:**	**Physical Education, First Aid and Yoga Practices**
Credit hours	**:**	**2 (0+2)**
Year	**:**	**II**
Semester	**:**	**I**

Objectives

1. To make the students aware about Physical Education, First Aid and Yoga Practices
2. 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 & Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory &Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular 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 & its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; History of Yog, Types of Yog, Introduction to Yog,

- Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhas tasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan , Halasan , Sarpasan, Ardhdhanurasan, Sawasan
- Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
- Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, 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 national

sporting events; Awards in Sports; History, latest rules, measurements 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 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 Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

COLLEGE OF AGRICULTURE
ANNAMACHARYA UNIVERSITY

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC-V**
Course title	**:**	**Commercial Sericulture**
Credit hours	**:**	**2 (0+2)**
Year	**:**	**II**
Semester	**:**	**I**

Objective: To develop skill in Rearing of Silkworms commercially

Practical Lecture Outlines

1. Acquaintance with silk producing insects and sericulture
2. Silkworm species and bioecology
3. & 4 Mulberry silkworm - systematic position, distribution, detailed morphology and biology
5. Voltinism and Development of new hybrid silkworm races
6. Moriculture: Maintenance of mulberry garden- Agronomical practices
7. Mulberry varieties and their characteristics
8. Preparation and plating of mulberry garden
9. Planting systems of mulberry garden
10. Pruning of mulberry garden and leaf harvest
11. Management of important pests of mulberry
12. Management of important diseases of mulberry
13. Visit to government and private managed mulberry garden within the district
14. Acquaintance with different appliances of silkworm rearing
15. Model rearing house and methods of disinfection of sericulture unit
16. Visit to nearby Grainages
17. Chawki rearing of mulberry silkworm
18. Handling of silkworm during moult and other methods of chawki rearing
19. Visit to nearby chawki centres
20. Rearing of late age / old age silkworm larvae
21. Dissection of silkworm larval salivary glands
22. Different methods of rearing late age silkworms
23. Different types of mountages

24. Visit to silkworm rearing centre of farmers
25. Harvesting of cocoons and cocoon characters Types of defective cocoons and their management
26. Reeling of Silk from the cocoons- visit to silk reeling units
27. Pests of mulberry silkworm and their management
28. Diseases of mulberry silkworm and their management
29. & 30 Visit to nearby cocoon selling units (Govt. and Private) and Interaction of silkworm rearing farmers with students and their feedback
31. Acquaintance with rearing of eri silkworm on castor
32. Economic analysis of silkworm rearing

Textbooks

1. An Introduction to Sericulture by G. Ganga J. Sulochana Chetty. CBS publishers and distributors Pvt. Ltd
2. Fundamentals of Sericulture: A Complete Guide from Mulberry Cultivation to Silk Production by Katta Subramanya Sai Teja, Sujatha G S, D Lalithambica Devi and G Anil Kumar. Notion Press.

Suggested Readings

1. Introduction to Sericulture by Ganga, G and Sulochana Chetty. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi
2. Principles of Sericulture by Hisao Aragu. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-SEC-VIII**
Course Title	**:**	**Production Technology of Bio-Agents**
Credit Hours	**:**	**2 (0+2)**
Year	**:**	**II**
Semester	**:**	**I**

Practical Lecture Outlines

1. Acquaintance with Biocontrol Laboratory (Research & Commercial), Rearing rooms, Laboratory Instruments & Equipment used for the production of Bio agents
2. Importance, scope and potential of bioagents
3. Terms and Concepts- definition of Biocontrol (baker and Cook), Mechanisms Biological Control – Competition, Antibiosis and Hyperparasitism; PGPR, Endophytes, Phylloplane, Phyllosphere, Rhizoplane, Rhizosphere, Resistance, SAR, ISR and microbial consortia
4. Preparation of culture media for isolation of fungal and bacterial bioagents
5. Isolation & Characterization of *Trichoderma* spp.
6. Isolation & Characterization of *Pseudomonas fluorescence*
7. Isolation & Characterization of *Bacillus subtilis* and *Bacillus thuringiensis*
8. Isolation & Characterization of Actinobacteria (*Streptomyces* spp. etc.)
9. Field visit to explore naturally infected cadavers of *Bt* and Entomopathogenic fungi
10. Isolation & Characterization of *Beauveria bassiana*
11. Isolation & Characterization of *Metarhizium anisopliae* and *Metarhizium rileyi*
12. Isolation & Characterization of Entomopathogenic nematodes (EPNs)
13. Isolation & Characterization of Entomopathogenic viruses from infected cadavers
14. Evaluating the efficacy of bioagents by different methods
15. Mass production of Fungal bioagents
16. Mass production of Bacterial bioagents
17. Identification of Natural Enemies (Parasitoids and Predators); Types of parasitism & Predation
18. Mass Production Technology of predators like Coccinellids viz., *Cryptolaemus montrouzieri* & *Coccinella* spp.
19. Mass Production Technology of *Corcyra cephalonica*, a factitious host for rearing of parasitoids and predators.

20. Mass Production Technology of egg parasitoid, viz., *Trichogramma* spp.
21. Mass multiplication of insect hosts like *Spodoptera litura* and *Helicoverpa armigera* on specific semisynthetic diet
22. Mass production technologies of *Sl*NPV & *Ha*NPV
23. Mass Production Greater wax moth, *Galleria mellonella*, a factitious host for rearing of EPNs.
24. *In-vivo* mass production of Entomopathogenic Nematodes (EPNs)
25. Laboratory bio-assay of EPBs, EPFs, NPVs & EPNs on their respective or selected host insects
26. Field evaluation for the efficacy of fungal and bacterial bio-agents against plant pathogens
27. Field evaluation for the efficacy of Entomopathogenic fungal and bacterial bio-agents against insect pests.
28. Various Carriers used in bioagent commercial formulations
29. Quality control of bioagent formulations (both solid and liquid based); acquaintance with commercial formulations of bioagents
30. Application methods – Seed treatment, Seed pelleting, Seedling dip, sett treatment, Soil application (multiplication in FYM) and Foliar application
31. Impediments or limitations in mass production and use of bioagents
32. Visit to Biocontrol Laboratory

Textbooks

1. Manual of Biocontrol Agents by Dwarka, Babli. Satish Serial Publishing House.
2. Bio-Fertilizers, Bio-Control Agents and Bio-Pesticides: Concepts and applications by Mr. Aniket Ambadasrao Patil, Dr. Sandeep Lotan Badgujar, Dr. Sandeep Sudhakar Wagh. Redshine Publishers.

Suggested Readings

1. Botanical and Bio pesticides by BS Parmar and C. Deva Kumar. West Will Publishing House, New Delhi.
2. Applied Entomology by Srivastava, K. P. and Dhaliwal, G.S. Vol I &II, Kalyani Publishers, New Delhi
3. Biological Control of Plant Diseases and Weeds by Sharma, P. Indian Council of Agricultural Research, New Delhi
4. Biological Control of Plant Diseases by Chincholkar, S.B. and Mukerji. CRC Press, London

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course Structure for B.Sc. (Hons.) Agriculture
Semester-IV (Second Year II Semester)

S.No.	Category	Course Number	Course Title	Hours per Week			Credits
				L	T	P	
1.	Common Course	AU-STAM-202	Agricultural Informatics and Artificial Intelligence	2	0	2	3(2+1)
2.	Core Course	AU-AGRO-203	Crop Production Technology-II (Rabi Crops)	1	0	2	2(1+1)
3.	Core Course	AU-AGRO-204	Water Management	1	0	2	2(1+1)
4.	Core Course	AU-GPBR-212	Basics of Plant Breeding	2	0	2	3(2+1)
5.	Core Course	AU-ENTO-232	Fundamentals of Nematology	1	0	2	2(1+1)
6.	Core Course	AU-AECO-241	Principles of Agricultural Economics and Farm Management	2	0	2	3(2+1)
7.	Core Course	AU-AENG-251	Farm Machinery and power	1	0	2	2(1+1)
8.	Core Course	AU-HORT-282	Production Technology of Vegetables and Spices	1	0	2	2(1+1)
9.	Skill Enhancement course	AU-SEC-VI	Mushroom Production Technology	0	0	4	2(0+2)
		AU-SEC-IX	Soil, Plant and Water Testing				
		AU-SEC-XII	Organic Production Technology				
Total Credits							**21**

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Course No.	**:**	**AU-STAM-202**
Course Title	**:**	**Agricultural Informatics and Artificial Intelligence**
Credits	**:**	**3 (2+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

1. To acquaint student with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
2. To provide basic knowledge of computer with applications in Agriculture
3. To make students familiar with Agricultural-Informatics, its components and applications in agriculture.

Course Outlines

Theory

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, creating database, Uses of DBM Sin Agriculture, Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/ output operations. e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smart phone mobile apps in agriculture for farm advice: Market price, post-harvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System ,Soil Information Systems etc .for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

Practical

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files & folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting as scientific documents, MS-EXCEL Creating as spread sheet, use of statistical tools, writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/ Crop-Info / Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA)

A) Theory-Lecture outlines

Lec. No. **Topics**

1. Introduction to Computers- Definition, Evolution of computers, Advantages and limitations.
2. Anatomy of Computers (with block diagram)-Components of computer and it's functions.
3. Overview of Input and output devices of Computer.
4. Computer memory concepts- Units of Memory- Primary memory and Secondary memory- RAM-ROM-PROM-EPROM-EAPROM-Cache memory.
5. Processors and Speed, Classifications of Computers, Hardware and Software.
6. Computer Languages- Machine, Assembly and High-level languages- Algorithm and flow charts.
7. Types of Software- Operating system- Translators-interpreters- utility program - Application program, General Purpose program- Viruses and Vaccines.
8. Operating System (OS)- Functions of OS - Types of OS- DOS and Windows-Booting process
9. WINDOWS: Features of Windows OS, Desktop and its elements, Anatomy of a WINDOW – Title Bar, Minimize, Maximize, Restore and Close Buttons, Scroll Bars, Menus and Tool- Starting and shutting down of WINDOWS. WINDOWS Explorer, working with organization of files and folders, Copy, Move and Print files – setting time and date.
10. Introduction to MS-Office and Applications. MS-Word: Features of good word processor. Creating, Editing and Formatting a document.
11. MS-Word: Toolbar options – converting to .pdf files.
12. MS-Word: Equation editor, Drop cap, Format Painter, Auto text etc.
13. MS-Excel: Features, Data presentation, Tabulation, Sorting, Filtering, Merging of cells, etc.
14. MS-Excel: Creation of Diagrams and Graphs- pivot Table
15. MS-Excel: Solving of formula expressions through formula toolbar- In-built functions (Sum, Average, Standard deviation, Correlation. etc.) - Applications of Data Analysis tools- Introduction to Statistical

analysis -Descriptive Statistics, Correlation and Regression.

16. MS-Excel: Data Analysis tools - t-test, z-test and ANOVA
17. Introduction of Database Management System. Applications of DBMS in Agriculture and other fields.
18. Introduction of MS-Access, Objects of MS-Access and types of fields.
19. MS-Access: Concepts and creating data base.
20. MS-PowerPoint: Creating slides, Layout, Action buttons, Transitions, Animations etc.
21. Networking – Types of networks (LAN, WAN, MAN, EAN etc.,)- networking equipment and Internet-World Wide Web (WWW)- Concepts
22. Introduction on e-Agriculture- concepts of smart agriculture.
23. Application of innovative ways to use information and communication technologies (IT) in Agriculture.
24. Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, advantages and limitations.
25. Smartphone mobile apps in agriculture for farm advice: Market price, post-harvest management etc.
26. Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information.
27. Decision support systems: Concepts, components and applications in Agriculture. Agriculture Expert System, Soil Information Systems etc., for supporting farm decisions.
28. Preparation of contingent crop planning and crop calendars using IT tools.
29. Digital India and schemes to promote digitalization of agriculture in India.
30. Introduction to Artificial Intelligence (AI)- Definition, background and its applications and limitations.
31. Use of AI in agriculture for autonomous crop management - Livestock health monitoring-Food and nutrition sciences. etc.
32. Introduction and applications of the Internet of Things (IoT) in agriculture and other sectors with examples- Role of Big Data analytics in Agriculture sector.

B) Practicals

1. Study of computer components, accessories –Booting of computer and its shut down - Practicing Windows operating system –Title bar – Minimum, maximum and close buttons - Scroll bars Menus and tool bars.
2. DOS Commands – DATE, TIME, DIR, COPY, PATH, LABEL, VOL, MD, CD, DEL and TREE etc.,
3. Windows explorer-creating files and folders, File Management, Control Panel- Taskbar and desktop management- Paint, notepad, WordPad, calculator etc.,
4. MS-Word: Menu bar, creating a document, saving and editing etc.
5. MS-Word: Creation of tables, Equation editor, Drop cap, Format Painter, mail merge
6. MS-PowerPoint: Creating slides, editing (Layout, action buttons...etc.) and power point presentation.

7. MS- Excel: Creating a spread sheet and data entry- Basic Functions (Mathematical and Statistical) through formula bar and use of in-built functions. Sorting-Filtering and Text to column.
8. MS- Excel- RBD Analysis using cell reference
9. MS- Excel: Pivot table, Creating diagrams and graphs, What if analysis etc.,
10. MS- Excel: Analysis of scientific data- Data Analysis tools- Descriptive Statistics (Mean, Median, Mode. Etc.), Histogram, Correlation and Regression
11. MS- Excel: Data Analysis tools- Testing of hypothesis (t-test, z-test, F-test), ANOVA one way and ANOVA two-way classification.
12. MS-Access: Creating Database by structuring with different types of fields and Creating relationships.
13. MS-Access: Preparing queries and report.
14. Introduction to World Wide Web (WWW)- Internet concepts - Creating Email – use of Search Engines.
15. Use of smart phones and other devices in Agro-advisory and dissemination of market information.
16. GIS Applications in Agriculture

Textbooks

1. Introductory Agri Informatics by Subrat K. Mahapatra et al., Jain Brothers Publication
2. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, Pearson, Pearson College Div Publishers

Suggested Readings

1. Fundamentals of Computers by V. Rajaraman, Prentice Hall of India, New Delhi
2. Introduction to Information Technology by Pearson, Pearson Education, India
3. An Introduction to Database Systems by C. J. Date, Addison – Wesley Publication Company
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan Satpathy, Wiley India
5. Introductory Agri Informatics by Subrat K. Mahapatra et al., Jain Brothers Publication
6. Principles of Artificial Intelligence by Nils J. Nilsson, Narosa Publishing House

Course No.	**:**	**AU-AGRO-203**
Course Title	**:**	**Crop Production Technology-II (Rabi Crops)**
Credits	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

i) To impart basic and fundamental knowledge on principles and practices of rabi crop production.

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

Course Outlines

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rabi crops; cereals- wheat and barley, pulses- chickpea, lentil, peas, oilseed rapeseed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops- mentha, lemon grass and citronella, Forage crops – berseem, lucerne and oat.

Practical

Sowing methods of wheat and sugarcane, identification of weeds in rabi season crops, study of morphological characteristics of rabi crops, study of yield contributing characters of rabi season crops, yield and juice quality analysis of sugarcane, study of important agronomic experiments of rabi crops at experimental farms. Study of rabi forage experiments, oil extraction of medicinal crops, visit to research stations of related crops.

A) Theory Lecture Outlines

Lec. No. **Topics**

A) *Rabi* Cereals

1. **Wheat-** Origin - geographical distribution - area, production and productivity in major wheat growing states in India - economic importance - soil and climatic requirements - growth stages – Classification.
2. Field Preparation - seeds and sowing - nutrient management - water management - weed management - Harvesting -yield attributes – yield - wheat based cropping systems.
3. **Barley and Quinoa –** Origin- geographical distribution - economic importance- classification - area, production and productivity in major barley growing states in India- soil and climatic requirements - varieties - cultural practices - Harvesting -Yield attributes – yield.

B) *Rabi* Pulses

4. **Chickpea -** Origin - geographical distribution- economic importance- area, production and productivity in India and Andhra Pradesh - types of chick pea- soil and climatic requirements- growth stages - Field preparation - seeds and sowing- varieties- nutrient management- water management- weed management- harvesting- yield attributes – yield.
5. ***Rabi* Redgram and Rajma -** Origin - geographical distribution - economic importance- area, production and productivity in India and Andhra Pradesh - soil and climatic requirements - growth stages - Field Preparation - seeds and sowing – varieties - nutrient management - water management – weed management – harvesting- yield attributes – yield.

C) *Oilseeds*

6. **Rapeseed and mustard –** Origin –classification- geographical distribution - area, production and productivity in major rapeseed and mustard growing states in India - economic importance- soil and climatic requirements- Field preparation - seeds and sowing- varieties- nutrient management- water management- weed management- Harvesting – yield attributes – yield - quality considerations.
7. **Sunflower and Safflower –** Origin - geographical distribution - area, production and productivity in India and Andhra Pradesh – economic importance- soil and climatic requirements- Field preparation - varieties - seeds and sowing-nutrient management- water management-weed management - seed setting problems and measures in sunflower -harvesting-yield attributes –yield.
8. **Linseed and Niger –** Origin - geographical distribution - area, production and productivity in India and Andhra Pradesh - economic importance- soil and climatic requirements- Field preparation - seeds and sowing-season- pyra/utera (Linseed)- varieties – nutrient management- water management- weed management –harvesting- yield attributes –yield quality considerations.

D) *Sugar Crops*

9. **Sugarcane –** Origin - geographical distribution - area, production and productivity in India and Andhra Pradesh - economic importance - soil - climatic requirements– Influence of rainfall, temperature, light - growth stages- Field preparation –planting time in Coastal and Rayalaseema regions of AP, Planting material – setts – short crop – nursery crop – different methods of planting.
10. Nutrient Management - trash mulching – wrapping and propping- water management- weed management- criteria for judging maturity- Ratoon cane management – factors affecting quality of sugarcane – arrowing – crop logging.
11. **Sugarbeet –** Origin - geographical distribution - area, production and productivity in India - economic importance- soil - climatic requirements -Field preparation - seeds and sowing-nutrient management - water management- weed management-harvesting- yield attributes –yield.

E) *Forage Crops*

12. **Berseem, Lucerne, Oat –** importance- seeds and sowing -nutrient requirement- irrigation- weed management- harvesting –yield quality of fodder.

F) Medicinal and aromatic Crops

13. **Mentha, Lemon grass, Citronella-** Origin - geographical distribution - area, production and productivity in major Mentha, Lemon grass, Citronella growing states in India - economic importance- soil - climatic requirements Field preparation - seeds and sowing- nutrient management - water management- weed management-harvesting- yield attributes –yield.

G) ***Other Crops***

14. **Potato -** Origin - geographical distribution - area, production and productivity in India - economic importance- soil - climatic requirements – varieties - Field preparation - seeds and sowing- nutrient management - water management-weed management-harvesting- yield attributes-yield - quality considerations.
15. **Tobacco -** Origin - geographical distribution - area, production and productivity in India and Andhra Pradesh - economic importance - soil - climatic requirements– types of tobacco- Field preparation, Nursery management-seeds and sowing for different types- seed treatment-seed rate- spacing-season-time and method of sowing.
16. **Tobacco** -nutrient management – topping and desuckering- water management- weed management-harvesting-yield attributes –yield –priming- curing, Quality characters nicotine content, burning quality, aroma and sugar content - methods of curing -flue curing of Virginia tobacco.

B) Practicals

1. Land preparation and layout of plots
2. Sowing methods of wheat
3. Planting methods of sugarcane
4. Sowing and raising of *rabi* oil seeds and fodder crops
5. Sowing and raising of *rabi* pulse crops
6. Identification of weeds in *rabi* season crops
7. Study of growth parameters and yield attributes (biometric observations) of *rabi* oil seed crops
8. Study of growth parameters and yield attributes (biometric observations) of *rabi* pulse crops
9. Visit to nearby Agro-based industry
10. Study of important agronomic experiments of *rabi* crops at research farms
11. Visit to Forage crops
12. Visit to Jaggery making units
13. Hay and silage making
14. Raising of tobacco nursery
15. Study of quality parameters of tobacco
16. Visit to nearby pulse and oil processing units related to *rabi* crops

Textbooks

1. Textbook of Field Crops Production - Foodgrain Crops. Volume I Rajendra Prasad ICAR Publication.
2. Textbook of Field Crops Production - Commercial Crops. Volume II Rajendra Prasad. ICAR Publication.

Suggested Readings

1. Recent Strategies on Crop Production by B. Gurarajan, R. Balasubramanian and V. Swaminathan, Kalyani Publishers, New Delhi.
2. Modern techniques of raising field crops by Chidda Singh, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Agronomy of Field Crops by S.R. Reddy, Kalyani Publishers, New Delhi.
4. Crop Management by S.S. Singh, Kalyani Publishers, New Delhi.
5. Agronomy of Field crops by Reddy S.R, Kalyani Publishers, Ludhiana.
6. Forage Production by Subhash Chandra Bose, M. and Balakrishnan, V, South Asian Publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AGRO-204**
Course Title	**:**	**Water Management**
Credits	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
2. To study different methods of irrigation and water management practices of both field and horticultural crops and drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas

Course Outlines

Theory

Irrigation: definition and objectives, Importance function of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships; Available and unavailable soil moisture – distribution of soil moisture – water budgeting – rooting characteristics – moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation; Methods of irrigation: surface and sub-surface, pressurized methods viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water; Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); Agricultural drainage. Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops., drip, sprinkler. Layout of underground pipeline system.

Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water by using water measuring devices viz., flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check

basin and basin method of irrigation; Visit to farmers field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; layout for different methods of irrigation, Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, bio-carbonates, Ca++ and Mg++ in irrigation water (quality parameters).

A) Theory Lecture Outlines

Lec. No. Topics

1. Irrigation – Introduction, importance, definition and objectives - water resources of world.
2. Surface and ground water resources in India and Andhra Pradesh – Important major irrigation projects in India and Andhra Pradesh - Irrigation development over years for different crops in India
3. Soil-water relations – physical properties of soil *viz.,* depth, soil texture, soil structure, particle density, bulk density and porosity influencing water retention, movement and availability.
4. Water retention in soil – adhesion and cohesion – Soil moisture tension – pF concept, soil moisture characteristic curves - Water movement in soils – infiltration, percolation, seepage, permeability and hydraulic conductivity – Saturated and unsaturated water flow.
5. Kinds of water in soil – gravitational water, capillary water, hygroscopic water and their importance in crop production - Soil moisture constants – saturation, Field capacity (FC) – Permanent Wilting Point (PWP) and hygroscopic coefficient - Available soil moisture (ASM)- Theories of soil water availability.
6. Plant-water relationships – rooting characteristics - effective rooting depth and moisture extraction pattern - Moisture sensitive periods of crops – Soil Plant Atmospheric Continuum (SPAC).
7. Evaporation – Transpiration – Evapotranspiration - factors influencing evapotranspiration – Reference evapotranspiration (ETo) – Crop evapotranspiration (ETc) - Crop coefficient (Kc) - Daily, seasonal and peak period consumptive use.
8. Crop water requirement – irrigation requirement – net and gross irrigation requirement – irrigation interval – irrigation period – seasonal water requirement of important crops – Duty of water, delta and base period – relation between duty, delta and base period – Conjunctive use of water – advantages.
9. Scheduling of irrigation – Soil moisture regime approach – feel and appearance, soil moisture tension, ASMD method etc. - Climatological approach – pan evaporation, IW/CPE ratio method etc. - Plant indices approach – visual symptoms, growth rate, plant water potential, canopy temperature etc.
10. Methods of irrigation - Surface methods – wild flooding, check basin, ring basin, border strip, furrow and corrugations – advantages and disadvantages - Sub surface irrigation.
11. Micro irrigation systems - sprinkler irrigation – merits and demerits, system components and layout – suitable crops – rain guns.
12. Drip irrigation - Surface and sub surface drip – merits and demerits – system components and layout – suitable crops - fertigation and maintenance of micro irrigation systems
13. Water Use Efficiency (WUE) – crop and field water use efficiency – factors influencing WUE – climatic, genetic and agronomic factors - Irrigation efficiencies – water conveyance efficiency, water application

efficiency, water storage efficiency & water distribution efficiency - Project efficiency.

14. Quality of irrigation water – salinity hazard, sodium hazard, residual sodium carbonate and boron toxicity – Criteria and threshold limits – Management practices for using poor quality water - Water logging – drainage, surface and sub-surface drainage systems and relative merits
15. Water management in crops - rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato
16. Climate-based/smart irrigation practices - Artificial intelligence - Precision water management technologies – Automation in irrigation: moisture sensors, wireless sensor networks, IoT application etc.

B) Practicals

1. Determination of bulk density of soil
2. Determination of soil moisture content by gravimetric and volumetric method
3. Installation and working with tensiometer and resistance blocks
4. Determination of infiltration rate
5. Determination of field capacity by field method
6. Measurement of soil moisture content by moisture probe
7. Measurement of irrigation water through flumes, weirs and V notches
8. Scheduling of irrigation by IW / CPE ratio method
9. Calculation of irrigation water requirements (problems)
10. Problems on duty of water and irrigation efficiencies
11. Lay out of surface irrigation methods, Furrow and check basin method of irrigation
12. Demonstration of drip irrigation system & Field cost estimation
13. Demonstration of operation of sprinkler irrigation syste & field cost estimation
14. Demonstration of filter cleaning, flushing of laterals and fertigation practices
15. Design and laying out of underground pipeline system
16. Visit to micro irrigation systems in farmers' fields

Textbooks

1. Irrigation Theory and practice by Michael, A.M. Vikas publishing house Pvt, Ltd.
2. Irrigation technology. Theory and practice by Rao, Y.P. and Bhaskar, S.R. Agrotech publishing Academy, Udaipur

Suggested Readings

1. Advances in Irrigation Agronomy by Carr M. K. V. and Elias Fereres, Cambridge University Press
2. Irrigation water management: Principles and practices by Majumdar, D.K, PHI learning Pvt Ltd, Delhi-92
3. Irrigation Agronomy 3rd Edition by Reddy, S.R, Kalyani Publishers, Ludhiana.
4. Efficient Use of Irrigation Water by Sankara Reddi, G.H. and Yellamanda Reddy, T, Kalyani Publishers, Ludhiana

Course No.	**:**	**AU-GPBR-212**
Course Title	**:**	**Basics of Plant Breeding**
Credits	**:**	**3 (2+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

To acquaint with different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques for breeding new varieties, which are higher yielding, resistant to biotic and abiotic stresses for ensuring food security.

Course Outlines

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male-sterility-genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/ diversity, Components of Genetic variation. Heritability and genetic advance. Pre-breeding and Universal Plant Breeder's equation. Genetic basis and breeding methods in self-pollinated crops- mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept, Concepts of population genetics and Hardy -Weinberg Law, Genetic basis and methods of breeding cross-pollinated crops, modes of selection. Population movement schemes- Ear to Row method, Modified Ear to Row, recurrent selection schemes. Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties. Breeding methods in asexually propagated crops, clonal selection and hybridization. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding- methods and uses. Breeding for important biotic and abiotic stresses. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

Practical

Plant Breeder's kit, Study of germplasm of various crops, Study of floral structures of self-pollinated and cross-pollinated crops, Emasculation and hybridization techniques in self and cross pollinated crops, Consequences of inbreeding on genetic structure of resulting populations, Study of male sterility system, Handling of segregating populations, Methods of calculating mean, range, variance, standard deviation, heritability, Designs used in plant breeding experiments, analysis of Randomized Block Design, To work out the mode of pollination in a given crop and extent of natural out-crossing, Prediction of

performance of double cross hybrids, Maintenance of breeding records and data collection, Screening tests for biotic and abiotic stresses.

A) Theory Lecture outlines

Lec. No. Topics

1. Plant Breeding – Definition, aim, objectives, history and developments of plant breeding, scientific contributions of eminent scientists – Landmarks in plant breeding – Scope of plant breeding.
2. Modes of reproduction – Asexual reproduction (vegetative reproduction and apomixis) and sexual reproduction – Their classification and significance in plant breeding.
3. Modes of pollination – Classification of crop species based on mode of pollination – Mechanisms promoting self-pollination – Genetic consequences of self-pollination – Mechanisms promoting cross-pollination – Genetic consequences of cross-pollination.
4. Genetic erosion – Extinction – Introgression – Germplasm/Genetic Resources – Components – Activities in germplasm collection – Centres of Origin – Law of homologous series – Centres of diversity – Types of centres of diversity.
5. Selection – Basic principles of selection – Basic characteristics and requirements of selection – Natural and Artificial selection – Selection Intensity – Selection Differential – Heritability (narrow and broad sense) – Selection Response (Universal Plant Breeder's equation) – Expected Genetic Advance.
6. Progeny test – Johannsen's pure line theory and its conclusions – Variation in pure lines– Characters of pure lines – Genetic basis of pure lines.
7. Hybridization – Objective and Aims – Types of hybridization – Procedure / steps involved in hybridization – Components of genetic variation – Additive, Dominance and Epistatic variance.
8. Self-incompatibility – Classification – Heteromorphic, Homomorphic, Gametophytic and Sporophytic systems of incompatibility – Advantages and disadvantages – Utilization in crop improvement.
9. Male sterility – Genetic, Cytoplasmic and Cytoplasmic Genetic Male Sterility –Inheritance and maintenance –Utilization of male sterile lines in hybrid seed production–Their advantages and disadvantages.
10. Heterosis – Brief history – Estimation of different types of heterosis (Average heterosis, Heterobeltiosis and Standard heterosis) – Hybrid vigour – Luxuriance – Heterosis in cross- pollinated and self-pollinated species – Manifestations/Effects of heterosis.
11. Genetic basis of heterosis – Dominance, over dominance and epistasis hypotheses – Objections and their explanations – Commercial utilization.
12. Inbreeding depression - Brief history – Effects of inbreeding – Degrees of inbreeding depression – Development of inbred lines.
13. Concepts of population genetics and Hardy – Weinberg Law – Hardy Weinberg Law – Factors affecting equilibrium frequencies in random mating populations.
14. Breeding methods classification – Domestication, Acclimatization and Plant introduction– Primary introduction and secondary introduction – Plant introduction agencies in India– National Bureau of Plant

Genetic Resources (NBPGR) and its activities – Procedure of plant introduction – Merits and demerits of plant introduction.

15. Mass selection – Applications and procedures – Modification of mass selection – Merits, demerits and achievements. Pureline selection – Procedure – Merits, demerits and achievements – Comparison between mass and pure line selections.
16. Handling of segregating population – Pedigree method – Procedure – Merits, demerits and achievements.
17. Bulk method – Procedure – Merits, demerits and achievements – Comparison between pedigree and bulk methods – Single seed descent method – Merits and demerits.
18. Backcross method – Requirements and applications – Procedure for transfer of single dominant gene.
19. Backcross method – Procedure for transfer of single recessive gene – Merits, demerits and achievements – Comparison between pedigree and backcross methods – Multiline – Definition – Characteristics of multiline – Achievements.
20. Heterosis Breeding – History of hybrid varieties (maize, sorghum, bajra, sunflower, cotton and rice) – Exploitation of heterosis – Steps in production of single and double cross hybrids.
21. Composite and synthetic varieties – Production procedures – Merits, demerits and achievements – Factors determining the performance of synthetic varieties – Comparison between synthetics and composites.
22. Population Improvement methods – Selection without progeny testing (mass selection) – Selection with progeny testing (ear-to-row method and its modifications) – Merits and demerits of ear-to- row method – Achievements.
23. Selection with progeny testing – Recurrent selection – Different types – Detailed procedures – Conclusion on the efficiency of different recurrent selection schemes.
24. Breeding methods in asexually propagated crops – Characteristics of asexually propagated crops – Characteristics of clones – Clonal selection – Procedure (with and without hybridization) – Advantages and disadvantages – Problems in breeding asexually propagated crops – Genetic variation within clones – Achievements – Comparison among clones, purelines and inbreds.
25. Mutation breeding – Steps in mutation breeding – Applications – Limitations and achievements.
26. Polyploidy in relation to plant breeding – Autopolyploids – Morphological and cytological features – Applications in crop improvement – Limitations – Allopolyploidy – Morphological and cytological features – Applications in crop improvement – Limitations.
27. Wide hybridization – History – Barriers to produce distant hybrids – Techniques for production of distant hybrids – Applications of wide hybridization in crop improvement – Limitations – Achievements – Pre-breeding.
28. Biotic stress resistance - Disease resistance – Mechanisms – Genetic basis of disease resistance – Horizontal and vertical resistance – Gene for gene hypothesis – Sources of disease resistance – Breeding methods for disease resistance – Achievements.
29. Insect resistance – Mechanisms – Nature of insect resistance – Genetics of insect resistance – Sources

of insect resistance – Breeding methods for insect resistance – Problems in breeding for insect resistance – Achievements.

30. Abiotic stress resistance – Drought resistance, Salt tolerance, Resistance to water logging, Heat stress resistance – Their Mechanisms of resistance / tolerance – Plant features associated with their resistance / tolerance – Sources of resistance / tolerance – Breeding methods – Limitations.
31. Participatory plant breeding – Definition – Goals – Methodology – Advantages and limitations – Varietal Release and Notification
32. Intellectual Property Rights – Forms of IPRs – Criterion for Patenting – Plant Breeder's and Farmer's Rights.

B) Practicals

1. Plant Breeder's kit for hybridization.
2. Work out the mode of pollination in a given crop and extent of natural out crossing.
3. Floral structure, emasculation and hybridization techniques in self-pollinated crops – rice, groundnut.
4. Floral structure, emasculation and hybridization techniques in self-pollinated crops – green gram, sesame.
5. Floral structure, emasculation and hybridization techniques in cross-pollinated crops – maize, castor.
6. Floral structure, emasculation and hybridization techniques in often cross-pollinated crops cotton, red gram.
7. Study of germplasm of various crops.
8. Study of male sterility systems.
9. Handling of segregating populations.
10. Consequences of inbreeding on genetic structure of resulting populations.
11. Estimation of heterosis and inbreeding depression.
12. Prediction of performance of double cross hybrids.
13. Screening tests for biotic and abiotic stresses.
14. Designs and layouts of field experiments used in plant breeding.
15. Mean, range, variance, standard deviation and analysis of Randomized Block Design.
16. Maintenance of breeding records and data collection.

Textbooks

1. Fundamentals of Plant Breeding. B.D. Singh. Kalyani Publishers, New Delhi
2. Principles of Plant Breeding (1st & 2nd Edition). RW Allard. John Wiley and Sons publishers

Suggested Readings

1. Plant Breeding: Principles & Practices by JR Sharma by Tata McGraw – Hill Publishing Company Limited, New Delhi
2. Principles and Procedures of Plant Breeding - Biotechnical and Conventional approaches by GS Chahal

and SS Gosal, Narosa Publishing House, New Delhi

3. Principles of Plant Genetics and Breeding by George Acquaah, Blackwell Publishing Ltd

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(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-ENTO-232**
Course Title	**:**	**Fundamentals of Nematology**
Credits	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

1. To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.
2. To impart knowledge on nematode pests of different crops of national and local importance and their management

Course Outlines

Theory

Introduction- History of phytonematology, habitat and diversity, economic importance of nematodes. General characteristics of plant parasitic nematodes. Nematode - definition, general morphology and biology. Classification of nematodes upto 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, Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses. Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseed and fiber crops, citrus and banana, tea, coffee and coconut. Different methods of nematode management: Cultural methods, physical methods, biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.

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 upto generic level with the help of keys and description: Meloidogyne, Pratylenchus; Heterodera, Tylenchulus, Xiphinema, 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.

A) Theory Lecture Outlines

Lec. No.	**Topics**
1.	Introduction, definition of nematode, habitat (free living, parasitic nematodes) and diversity. Economic importance of nematodes in agriculture. History of phytonematology – ancient, early and modern history

of nematology.

2. Contributions of N. A. Cobb, landmarks in history of nematology. Development of nematology in India.
3. General characteristics cuticle, body wall, symmetry, Nervous system of plant pathogenic nematodes – shape, size, body regions, segmentation, cuticle, body wall, symmetry, Nervous system
4. General morphology of nematodes ¯Stylets, inner body tube (digestive system), oesophagus parts and associated glands.
5. General morphology of nematodes – Reproductive system of male and female nematodes, excretory system
6. Biology – life cycle of nematodes, embryogenesis, hatching, moulting, host finding,
7. host feeding and reproduction. Orders: Dorylaimida and Tylenchida, Aphelenchida. Classification
8. Nematode taxonomy - phylum Nematoda –classes Adenophorea and of Secernentea, nematodes based on feeding and parasitic habitat (Below and above ground parts).
9. Pathological interactions of nematodes with other organisms – Fungi, Bacteria and viruses.
10. nematode Nematode pests of crops – Rice -white tip nematode – *Aphelenchoides* sp. Rice root *Hirschmanniella* sp. Ufra disease – *Ditylenchus* sp.
11. Nematode pests of crops – Wheat - Wheat gall nematode – *Anguina* sp. Cereal cyst
12. nematode - *Heterodera* sp. Molya disease – *Heterodera avenae*; Vegetables – Root knot nematode- *Meloidogyne* sp., Cyst nematode – *Globodera* sp. Nematode pests of pulses, oil seeds and fibre crops- Onion bulb and stem nematode
13. *Ditylenchus* sp., Sting Nematode – *Meloinolaimus* sp., Pea (early yellowing nematode) – *Rotylenchus* sp. Nematode pests of perennial crops – Citrus – *Tylenchulus semipenetrans*, *Pratylenchus* sp.; Banana – Burrowing nematode – *Radopholussimilis*; Tea, Coffee and Coconut – *Radopholus* sp. *Rotylenchus* sp. Palm red ring nematode – *Bursaphelenchus* sp. Nematode management - cultural and physical methods
14. Nematode management – chemical methods (fumigants and non-fumigants),
15. Biological methods (*Paecilomyces, Pasteuria, Trichoderma*, *Pseudomonas, Azotobacter and Gluconobacter*), VAM fungi.
16. Integrated nematode management Nematode management – regulatory *Meloidogyne* methods – quarantine; Plant resistance, Entomopathogenic nematodes and their mode of action, significance of Entomopathogenic nematodes in biological control

B) Practicals

1. Apparatus and equipment used in Nematology laboratory
2. & 3. Sampling methods for nematode extraction, collection of soil and plant samples
4. Extraction of nematodes from soil following Cobb's sieving and decanting technique and Baermann funnel technique
5. Extraction of nematodes from plant tissues - Baermann funnel technique
6. Picking and mounting of plant parasitic nematodes

7. Counting of plant parasitic nematodes
8. Direct examination of infected roots by staining
9. Study of symptoms caused by important nematode pests of cereals
10. Study of symptoms caused by important nematode pests of vegetables
11. Study of symptoms caused by important nematode pests of pulses
12. Study of symptoms caused by important nematode pests of plantation crops
13. Identification of economically important plant parasitic nematodes up to generic level with the help of keys and description- *Meloidogyne* sp.
14. Identification of economically important plant parasitic nematodes up to generic level with the help of keys and description- *Pratylenchus* sp. And *Tylenchulus* sp.
15. Identification of economically important plant parasitic nematodes up to generic level with the help of keys and description- *Heterodera* sp. *Xiphinema* sp. And *Helicotylenchus* sp
16. Methods of application of nematicides and organic amendments

Textbooks

1. Textbook of Introductory Plant-Nematology by Raman K. Walia, Harish K. Bajaj, Indian Council of Agricultural Research.
2. Handbook of Practical Nematology by Harish K. Bajaj, R. S. Kanwar, D. C. Gupta, Scientific Publishers (India)

Suggested Readings

1. Economic Nematology by Webster J.M, Academic Press, Cambridge, Massachusetts
2. Plant Parasitic Nematodes by Zukerman, B.M., Mai, W.F. and Rohde, R.A, Academic Press, Cambridge, Massachusetts
3. Plant Parasitic Nematodes of India: Problems and Progress by Gopal Swarup, Dasgupta, D. R., Koshy, P. K, Indian Agricultural Research Institute, New Delhi
4. Text book on Introductory Plant Nematology by Walia R.K. and Bajaj H.K, ICAR, New Delhi.

Course No.	**:**	**AU-AECO-241**
Course Title	**:**	**Principles of Agricultural Economics and Farm Management**
Credits	**:**	**3 (2+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

1. To aware the students about broad areas covered under agricultural Economics and farm management
2. To impart knowledge on judicious use of resources for optimum production

Course Outlines

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.

Practical

Consumer surplus, Consumer equilibrium, Measurement of elasticities of demand, Seven types of production costs – Tabular and Graphical presentation, Classical production function – Graphical illustration of three stages of production, Determination of optimum level of input use and output to produce, Determination of least cost combination of resources, Determination of optimum product combination, Principle of equi-marginal returns, Time comparison principle: Compounding & Discounting;, Farm holding survey, Methods of computation of depreciation - straight-line, declining balance, and sum-of-the- years' digits methods, Enterprise budget, Cost concepts and farm income measures, Break even analysis

A) Theory Lecture Outlines

Lec. No	**Topics**
1.	Introduction to Economics – Definitions, Meaning, Scope; Economic activity - Households, Firms and Govt. sector
2.	Subject matter of economics: Traditional approach – Production, Consumption, Distribution and Exchange; Modern approach – Microeconomics and Macroeconomics
3.	Methods of economic investigation - Deduction and Inductive approaches; Positive and Normative analysis; Agricultural Economics – Meaning and Definition
4.	Basic concepts - Goods and Services - Characteristics and Classification; Human wants - Characteristics and Classification
5.	Utility - Forms of utility; Concepts - cost, price, value, wealth, welfare, capital, income, investment, efficiency, firm and industry.
6.	Theory of Consumer Behaviour - Cardinal and Ordinal approaches - Assumptions of consumer behaviour – Marginal utility, Total utility - Law of Diminishing Marginal Utility - Meaning, assumptions, explanation, application and exceptions
7.	Law of Equi Marginal Utility and Consumer's Surplus - Meaning, assumptions, explanation, application and exceptions
8.	Indifference curve analysis - Indifference curves - Meaning, basic assumptions, properties and importance - Budget line and its properties – Consumer’s equilibrium.
9.	Demand – meaning, demand function, law of demand, demand schedule, characteristics of demand curve, determinants of demand, derivation of demand curve, changes in demand
10.	Elasticity of demand - types and degrees of elasticity of demand - factors affecting elasticity of demand - practical importance of elasticity of demand
11.	Supply – Stock and Supply, law of supply, supply schedule, characteristics of supply curve, determinants of supply, elasticity of supply
12.	Price determination under perfect competition – Perishable and Durable commodities; Equilibrium analysis - Numerical and graphical explanation

13. Distribution theory: meaning, factor market – pricing of factors of production;
14. Rent - Ricardian theory & Modern theory; Wage – kinds of wages and modern theory of wages; Backward bending supply curve of labour; Interest and Profit - meaning
15. National income: meaning, importance, circular flow - Three sector economy
16. Concepts of national income accounting - Approaches to and difficulties in measurement of National Income.
17. Population - Importance, Malthusian theory and optimum population theory - Natural and socio-economic determinants
18. Money – Barter system of exchange and its problems - Classification of money, Functions of money; Money market – demand for money and supply of money in the economy
19. Meaning of Inflation, deflation, Disinflation, Reflation & stagflation; Types of inflation – Creeping, Walking, Running, Galloping, Suppressed, Comprehensive, Sporadic, Mark- up, Demand-pull, Cost-push inflation
20. Measurement of inflation - General price index, Rate of inflation, Consumer price index, Wholesale price index – Control measures of inflation
21. Economic system – concepts and functions of economy; Types and Features of economic systems - Capitalism, Socialism and Mixed economy
22. Elements of Economic planning - Five-year plans - meaning and objectives; NITI Ayog - Genesis and its objectives
23. Farm Management – Definition and Objectives; Farm Management vs Production Economics
24. Production – Meaning and Factors of production; Production function – Meaning; Laws of returns – Increasing returns, Decreasing returns and Constant returns
25. Factor - Product relationship – Three stages of production function
26. Factor - Factor relationship; Isoquant - properties, Marginal rate of technical substitution (MRTS); Types of factor substitution; Iso cost line – properties; Least cost combination (LCC)
27. Product - Product relationship; Production possibility curve – properties; Relationship among the products; Marginal rate of product substitution; Iso revenue line – characteristics – Optimum product combination
28. Returns to scale; Differences between returns to scale and law of variable proportions
29. Seven principles of farm management - Law of diminishing returns, Principle of factor substitution, Principle of product substitution
30. Seven principles of farm management - Minimum loss principle, Principle of equi - marginal returns/ Opportunity cost principle
31. Seven principles of farm management - Principle of comparative advantage, Time comparison principle.
32. Types of farming - Forms of farm business organizations

B) Practicals

1. Consumer surplus

2. Consumer equilibrium
3. Measurement of elasticities of demand
4. Seven types of production costs – Tabular and Graphical presentation
5. Classical production function – Graphical illustration of three stages of production
6. Determination of optimum level of input use and output to produce.
7. Determination of least cost combination of resources
8. Determination of optimum product combination
9. Principle of equi-marginal returns
10. Time comparison principle: Compounding & Discounting
11. & 12. Farm holding survey
13. Methods of computation of depreciation - straight-line, declining balance, and sum-of-the- years' digits methods
14. Enterprise budget
15. Cost concepts and farm income measures
16. Break even analysis

Textbooks

1. Agricultural Economics. Subba Reddy S., Raghu Ram P., Neelakanta Sastry T P and I Bhavani Devi. Oxford & IBH publishing
2. Elementary Economic Theory. Dewett K. K and S Chand. S Chand and Co. Publishers

Suggested Readings

1. Economics by Paul A Samuelson and William D Nordhus, McGraw Hill Publishers, New Delhi
2. Economics of Farm Production and Management by Raju V T and D V S Rao, Oxford & IBH Publishing Co. New Delhi.
3. Fundamentals of Farm Business Management by Johl, S S and T R Kapur, Kalyani Publishers, New Delhi
4. Microeconomic Analysis in Agriculture by Ravi Kumar K N, Daya Publishing House, New Delhi

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AENG-251**
Course Title	**:**	**Farm Machinery and Power**
Credits	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**II**

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.

Course Outlines

Theory

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of IC 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, implements 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. To study 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 transplanter 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.

A) Theory Lecture Outlines:

Lec No. **Topics**

1. Farm power–Different farm power sources, their advantages and disadvantages; Status of farm power in India.
2. Internal combustion engine-Different components and their functions-Working principles of four stroke and two stroke cycle engine-Comparison between diesel and petrol engine- Difference between four stroke and two stroke engines.
3. Terminology related to engine power –firing order, ip, bp, fp, dp, compression ratio, stroke- bore ratio, piston displacement, mechanical efficiency, TDC and BDC; Numerical problems on calculation of ip, bp, mechanical efficiency, compression ratio and stroke- bore ratio.
4. Fuel supply and ignition systems of I.C. engine – Types, components and their functions, working principle of fuel supply systems in petrol and diesel engines; working principle of petrol battery ignition system.
5. Lubrication and cooling systems of I.C engine – Types, components and their functions working principle of forced feed lubrication system in IC engine; working principle of forced circulation cooling system.
6. Farm tractor – Tractor's classification, types, points to be considered in selection of tractors, power transmission system in the tractor; estimating the cost of operation of tractor power and farm machinery.
7. Tillage – Primary tillage, secondary tillage and their objectives - M.B. plough - functions, constructional features, operational adjustments and maintenance.
8. Disc plough – Functions, constructional details, operational adjustments and maintenance, chisel plough and sub-soiler.
9. Harrows – Types, functions, operation of disc harrows; Cultivators – Rigid and spring loaded tyne types; Rotovator, puddler and cage wheel.
10. Land levelling equipment – Levelling blade, bund former and ridger.
11. Sowing equipment-Seed cum fertilizer drills –Types, functions, functional components – type of metering mechanisms, calibration of seed drill.
12. Introduction to planters and transplanters; Intercultural implements – Hoes and weeders for dry and wetland cultivation.
13. Plant protection equipment – Types of sprayers; constructional features of knapsack sprayer, hand compression sprayer, foot sprayer, rocker sprayer and power sprayer (engine and tractor operated); care and maintenance of sprayers.
14. Dusters – Hand operated and power operated dusters; duster care and maintenance.
15. Harvesting equipment–Sickle, mower, alignment and registration in mower, self-propelled reaper.
16. Threshing – principle of threshing and components of threshers; Introduction to combine harvester and working principles of combine harvester.

B) Practicals

1. Showing the difference between EC and IC engines; Constructional details of IC engine.

2. Dismantling of IC engine and explaining the functional aspects of components.
3. Familiarizing with fuel supply and ignition systems of an engine.
4. Familiarizing with lubrication and cooling systems of an engine.
5. Familiarizing with dash board, clutch, gearbox, differential, final drive and PTO of tractor along with brake, steering and hydraulic controls.

6. & 7. Tractor driving.

8. Mini tractor/Power tiller operation.
9. Attachment of an implement by using 3-point hitch system of a tractor.
10. Familiarization with primary tillage implements like M.B. Plough, disc plough and its adjustments, Calculation of field capacities and power requirement of implements.
11. Study of secondary tillage implements and its constructional details- Emphasis on disc harrow, spike tooth harrow, blade harrow, rotavator, power harrow;
12. Familiarization with seed metering mechanism and its calibration; Calculation of seed rate.
13. Study on planters and transplanters
14. Practicing with plant protection equipment, different types of sprayers and dusters.
15. Familiarization with inter-cultural equipment and different types available in the market.
16. Exposure on harvesting equipment and combine harvester.

Textbooks

1. Principles of Agricultural Engineering by Ojha, T.P. and A.M. Michael, Vol.I, Jain Brothers
2. Farm Machinery-Principles and Applications by Surendra Singh, ICAR, New Delhi

Suggested Readings

1. Elements of Agricultural Engineering by Jagadishwar Sahay, Standard Publishers Distributors, New Delhi
2. Farm Tractor–Maintenance and Repair by Jain, S.C and C.R. Rai, Standard Publishers,1705- B, Nai Sarak, Delhi–110006.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-HORT-282**
Course Title	**:**	**Production Technology of Vegetables and Spices**
Credits	**:**	**2 (1+1)**
Year	**:**	**II**
Semester	**:**	**II**

Objectives

1. To educate about the different forms of classification of vegetables
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices
3. To educate about the physiological disorders of vegetables and spices

Course Outlines

Theory

Importance of vegetables and spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important vegetable and spices (tomato, okra, brinjal, chilli, cucumber, bitter gourd , bottle gourd, water melon, muskmelon, sweet potato, cassava and moringa, pumpkin, French bean, peas; cole crops such as cabbage, cauliflower, knol-khol; bulb crops such as onion, garlic; root crops such as carrot, radish, beetroot; tuber crops such as potato; leafy vegetables such as amaranth, palak, perennial vegetables, spice crops like turmeric, zinger, garlic, coriander, cumin, black pepper, cardamom, fenugreek, cinnamon, curry leaf, tamarind and herbal spices).

Practical

Identification of vegetables and spice crops and their seeds. Description of varieties. Propagation methods- rapid multiplication techniques - seed collection and extraction. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables and spices. Fertilizers applications. Harvesting and post-harvest practices, Economics of vegetables and spices cultivation, visit to spice gardens.

A) Theory Lecture Outlines

Lec No. Topics

1. Importance of vegetables & spices in human nutrition and national economy – Kitchen gardening
2. Tomato - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield – physiological disorders
3. Brinjal & Chilli - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield
4. Okra & Leafy vegetables (Amaranthus & Palak) - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield
5. Cucurbits – Flowering, Sex expression, sex ratio; Cucumber, Bitter gourd, Bottle gourd, Watermelon and muskmelon - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield
6. Cole crops- Cabbage, Cauliflower & Knol-khol - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield - physiological disorders
7. Peas and Beans - Garden pea & French bean - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield - physiological disorders
8. Root crops (Carrot, Radish & Beetroot) - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques- planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield - physiological disorders
9. Sweet potato & Potato - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield - physiological disorders
10. Perennial vegetables – Drumstick, Curry Leaf & Coccinia- Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield
11. Bulb crops – Onion & Garlic - Botanical Name – Family – Origin – area – climate and soil - improved

varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield - physiological disorders

12. Black pepper - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance- fertilizer requirements - irrigation - weed management - harvesting and yield - processing
13. Cardamom- Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance- fertilizer requirements - irrigation - weed management - harvesting and yield – processing
14. Ginger & Turmeric – Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance- fertilizer requirements - irrigation - weed management - harvesting and yield - processing - preservation of seed rhizomes
15. Coriander, Fenugreek & Mint - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield
16. Cinnamon & Tamarind - Botanical Name – Family – Origin – area – climate and soil - improved varieties and cultivation practices such as time of sowing - sowing - transplanting techniques - planting distance - fertilizer requirements - irrigation - weed management - harvesting and yield – processing.

B) Practicals

1. Identification of vegetables and their seeds
2. Identification of spices crops and their seeds
3. Varietal description of vegetables
4. Varietal description of Major spices
5. Propagation methods - rapid multiplication techniques of pepper and cardamom
6. Nursery raising techniques of vegetable crops
7. Direct seed sowing and transplanting
8. Study of morphological characters of different vegetables
9. Study of morphological characters of different spices
10. Fertilizers application methods
11. Harvest indices and maturity standards of vegetable crops
12. Post-harvest handling of vegetables
13. Seed extraction methods in vegetables
14. Seed extraction methods in spices
15. Economics of vegetables and spices cultivation.
16. Visit to spice gardens/vegetable fields

Textbooks

1. Vegetable crops (Production technology, Vol II) by M.S. Fagaria, B.R. Choudhury, R.S. Dhaka, Kalyani Publishers, Ludhiana.
2. Introduction to Spices, Plantation crops, Medicinal and Aromatic Crops by Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P. and Irulappan, I. Oxford and IBH publishing Co, New Delhi.

Suggested Readings

1. Modern technology in vegetable production by Pranab Hazra, A. Chattopadhyay, K. Karmakar and S. Dutta, New India Publishing Agency, New Delhi
2. Basic Concepts of Vegetable Science by Neeraj Pratap Singh, International Book Distributing Co. New Delhi. Academic Press, New Delhi
3. Vegetable Seed Production Technology by Nempal Singh, Singh, D.K., Singh, Y.K. and Virendra Kumar, International Book Distributing Co. Lucknow
4. Vegetable growing in India by Prem Singh Arya and S. Prakash, Kalyani publishers, New Delhi
5. Vegetable Crops Vol. II & III by Bose, T. K, Kabir, J., Maity T. K., Parthasarathy V. A., and Som M. G, Naya Prokash, Kolkata
6. Production Technology of Spices and Plantation Crops by Shanmugavelu, K.G., N. Kumar and K.V. Peter, Agrobios (India), Jodhpur
7. Olericulture, Fundamentals of Vegetable Production (Vol.1) by Singh, K.P. and Anant Bahadur

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC – VI**
Course Title	**:**	**Mushroom Production Technology**
Credits	**:**	**2 (0+2)**
Year	**:**	**II**
Semester	**:**	**II**

Practical Lecture Outlines

1. & 2. Current status and scope of mushroom cultivation in India and Andhra Pradesh and nutritional benefits of mushrooms
3. Important features of edible fungi and study of basidiocarp
4. Acquaintance with the laboratory equipment and tools used in mushroom cultivation
5. Spawn Production technology (Milky/Oyster Mushrooms)- Preparation of culture media for the isolation fungal cultures
6. Spawn production technology -Isolation and purification of mushroom cultures
7. Spawn production technology -Maintenance of mother cultures and their preservation
8. & 9. Spawn production technology -Preparation of mother spawn
10. Spawn production technology -Preparation of commercial spawn
11. Design and economics of commercial spawn production unit
12. Exposure visit to Mushroom production units
13. 14. 15. & 16. Cultivation technology of Milky mushrooms (*Calocybe indica*) - Preparation of substrate and beds, crop management practices and casing preparation
17. Identification of pests and diseases of milky mushrooms and their management
18. 19. & 20. Cultivation technology of Oyster mushroom -Preparation of substrate and beds, crop management practices.
21. Identification of pests and diseases of Oyster mushrooms and their management
22. Mushroom farm design and infrastructure required for commercial unit
23. Harvesting, storage and packaging requirements of mushrooms
24. Preparation of value-added products from mushrooms
25. Marketing of mushrooms and their value-added products
26. Economic analysis of mushroom cultivation enterprise
27. Management of waste derived from Mushroom cultivation
28. &29. Exposure on cultivation technology of *Agaricus bisporus* (button mushroom)-Compost

preparation & Crop management aspects

30. Exposure on cultivation technology of *Lentinus edodes* (Shiitake) and *Volvariella volvacea* (Paddy straw) mushrooms
31. Exposure on Cultivation technology of medicinal mushrooms – *Ganoderma lucidum* and *Cordyceps militaris*
32. Exposure visit to commercial mushroom farm units.

Textbooks

1. Mushroom Technology (2nd edition) by S. Rajan and N. Sivakumar, CBS Publishers and Distributors
2. Mushroom Production Techniques: Principles and Practices by Devendra Kumar, Archana and Jehani, Kalyani Publishers, New Delhi

Suggested Readings

1. ICAR- Directorate of Mushroom Research, Solan, Himachal Pradesh https://dmrsolan.icar.gov.in/
2. ICAR-Indian Institute of Horticultural Research, Bangalore, Karnataka. https://www.iihr.res.in/
3. Mushroom Cultivation in India by Suman, B.C. and Sharma, V.P, Daya Publishing House, Delhi
4. Techniques of Mushroom Cultivation by Santosh K. and Gireesh C, Daya Publishing House, Delhi.
5. The Mushroom Cultivator by Paul Stamets and J.S. Chilton, Richmond Publishing Co Ltd, United Kingdom
6. Diseases and Pests of Mushrooms by Sharma, V.P and Suman, B.C, Agrobios publishers, Jodhpur, Rajasthan.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC – IX**
Course Title	**:**	**Soil, Plant and Water Testing**
Credits	**:**	**2 (0+2)**
Year	**:**	**II**
Semester	**:**	**II**

Practical Lecture Outlines

1. Introduction to Analytical instruments- Calorimetry, Flame photometry and atomic absorption spectrophotometer.
2. Standardization of solutions and reagents and acid base titrations
3. Collection and preparation of soil samples
4. Determination of soil moisture content by gravimetric method
5. Determination bulk density in soil samples
6. Determination of particle density and porosity
7. Determination of aggregate stability by Yoder's apparatus
8. Estimation of soil pH and EC
9. Estimation of soil organic carbon- Qualitative and quantitative
10. Estimation of available soil nitrogen by Subbiah and Asija method
11. Estimation of available soil phosphorus by Olsen's method and Brays & Kurtz method
12. Estimation of available soil potassium by flame photometer method
13. Estimation of soil sulphur by turbidity method
14. Estimation of Ca and Mg in soils
15. Estimation of DTPA extractable soil micronutrients by AAS
16. Estimation of CEC and exchangeable sodium in soil
17. Estimation of Gypsum requirement
18. Estimation of Lime requirement
19. Estimation of calcium carbonate in soil
20. Plant sampling and sample preparation and digestion for analysis
21. Estimation of N in plant sample
22. Estimation of P in plant sample

23. Estimation of K in plant sample
24. Estimation of Sin plant sample
25. Rapid plant tissue test for N, P, and K
26. Collection of irrigation water sample and quality assessment parameters
27. Determination of EC and pH of irrigation water
28. Estimation of Ca and Mg in Irrigation water
29. Estimation of carbonates and bicarbonates in Irrigation water
30. Estimation of chlorides and sulphates in Irrigation water
31. Estimation of sodium and potassium in irrigation water
32. Computation of SAR and RSC

Textbooks

1. Methods of analysis of soils, plants waters, fertilizers and organic manures by H L S Tandon- Fertilizer development and consultation organization, New Delhi, India.
2. A Textbook of soil analysis by Baruha, T.C and Barthakur, H.P, Vikas Publishing House Pvt Ltd, New Delhi

Suggested Readings

1. Methods of analysis of soils, plants waters, fertilizers and organic manures by H L S Tandon- Fertilizer development and consultation organization, New Delhi, India.
2. A Text book of soil chemical analysis by P R Hesse – Sathish Kumar Jain for CBS publishers and distributors, New Delhi
3. Soil, plant water and fertilser analysis by P K Gupta, Agrobios (India), Jodhpur

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-SEC – XII**
Course Title	**:**	**Organic Production Technology**
Credits	**:**	**2 (0+2)**
Year	**:**	**II**
Semester	**:**	**II**

Practical Lecture Outlines

1. Organic farming- Types - Scope - Prospects of organic farming
2. Organic manures - Classification - Identification
3. Farmyard manure - Methods of preparation - Enriched FYM
4. Compost- Types- Aerobic and anaerobic methods of composting- NADEP compost
5. Vermi compost – Methods and processes of production
6. Preparation of liquid organic manures - Panchagavya, Jeevamrutha, Beejamrutha
7. Preparation of special liquid organic manures - Amritpani, Vermiwash, Compost tea
8. Green manure crops - Identification - Incorporation of green manure crops.
9. Concentrated organic manures – Production and application of oil cakes- Matkha Khaad
10. Crop residue management in organic production
11. Bio fertilizers - Types - Methods of Bio-fertilizers application in various crops
12. Mass production and field application of Azolla
13. Seed treatment with Bio-fertilizers - Seedling treatment with liquid Bio-fertilizers
14. Organic nutrient management in crops and cropping systems
15. Organic weed management in crops and cropping systems
16. Study of Indigenous technical Knowledge for Insect pest management in organic farming - Application of panchagavya, sour butter milk, beejamrutham and jeevaamrutam to combat insect pests in organic farming.
17. Study and preparation of NSKE, PSKE, Custard leaf extract, tobacco decoction – Bioefficacy studies, Field application.
18. Study, preparation and bio-assay of cow-based plant extracts and their effect against insect pests in organic farming - Neemastra, Agniastra, Brahmastra, vavilaku, Ipomia kashayam and Dasapatra kashayam.

19. Study and mass production of microbial insecticides *viz.,* Entomopathogenic fungi /NPV/ Entomopathogenic nematodes.
20. Seed treatment and seed pelleting with fungal and bacterial biocontrol agents
21. Mass multiplication of *Trichoderma* on farm yard manure (FYM)
22. Mass multiplication of *Pseudomonas fluorescens* and Bacillus subtilis on FYM
23. Seedling dip, foliar spray and soil application of biocontrol agents
24. Organic production technology package in important crops
25. Organic certification procedures
26. Post-harvest management in organic production and marketing
27. Study of quality aspects of organic products: Grading, Packing and Handling
28. Case studies of ITK's for organic nutrient & weed management
29. Visit to organic fields/farms/cluster
30. Visit of organic experiments (On farm / Off farm)
31. Visit to Organic FPO/ organic stores
32. Economic analysis of organic production

Textbook

Organic farming for sustainable agriculture by A.K. Dahama, Agrobios (India), Jodhpur.

Suggested Readings

1. Hand book of Organic farming by Arun. K. Sharma, Agrobios (India), Jodhpur.
2. Organic farming-Theory and Practice by S. P. Palaniappan and K. Annadurai, Scientific Publishers. Jodhpur
3. Organic farming in India – Problems and Prospects by U. Thapa and P. Tripathy, Agrotech publishing, Udaipur.
4. Organic farming by G.K. Veeresh, Foundation Books. New Delhi.
5. Trends in Organic Farming in India by Puroshit, S. S, Agrobios (INDIA), Jodhpur.
6. Organic Agriculture by Thampan, P.K, Peckay tree Crops Development Foundation, Cochin, Kerala. Sathe, T.V. Vermiculture and Organic.

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Course Structure for B.Sc. (Hons.) Agriculture
Semester-V (Third Year I Semester)

S.No.	Category	Course Number	Course Title	Hours per Week			Credits
				L	T	P	
1.	Core Course	AU-AGRO-301	Weed Management	1	0	2	2(1+1)
2.	Core Course	AU-AGMT-301	Introduction to Agro- meteorology	1	0	2	2(1+1)
3.	Core Course	AU-BICM-301	Essentials of Plant Biochemistry	1	0	2	2(1+1)
4.	Core Course	AU-AGRO-302	Introductory Agro forestry	1	0	2	2(1+1)
5.	Core Course	AU-GPBR-311	Crop Improvement (Kharif crops-I)	1	0	2	2(1+1)
6.	Core Course	AU-ENTO-331	Insect pest management in Field Crops	1	0	2	2(1+1)
7.	Common Course	AU-AECO-341	Agricultural Marketing and Trade	2	0	2	3(2+1)
8.	Core Course	AU-CPHY-361	Fundamentals of Crop Physiology	2	0	2	3(2+1)
9.	Core Course	AU-PATH-371	Diseases of Field & Horticultural crops and their management	2	0	2	3(2+1)
10.			Study Tour				2 (Non gradial)
11.			MOOC				3
						Total Credits	**24**

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AGRO 301**
Course Title	**:**	**Weed Management**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

1.To teach students about principles of weed science

2. To impart practical knowledge of weed management in field and horticultural crops

Course Outlines

Theory

Introduction to weeds, characteristics of weeds; their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds, crop-weed completion, factors of competition, losses on growth and yield of crops; factors affecting growth and development. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management, implements for weed control, robotic weed control, weed management in organic/ natural farming. Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use. Mode of action of herbicides and selectivity phenomenon. Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with Agro-chemicals and their application, Herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management.

Practical

Techniques of weed preservation, weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, Study on shift in weed flora in long term trials, Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide spraying equipments, their parts, use and maintenance. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index.

A) Theory Lecture Outlines

Lec. No. Topics

1. Definition of weeds - major identifying characteristics - harmful and beneficial effect of weeds in Agro-ecosystems.
2. Systematic classification of weeds based on morphological features, life cycle, cotyledon number, origin, crop association, and distinctive characteristics with suitable examples.
3. Reproduction of weeds- sexual and vegetative propagation - methods of weed dissemination - agents involved in dispersal, and mechanisms of weed seed spread.
4. Definition of Crop–weed competition - critical period of crop weed competition - factors influencing crop weed competition; Role of allelopathy and weed seed banks.
5. Management of weeds – Principles of weed management - preventive, physical/mechanical, and cultural approaches, Implements used in weed management and use of robotic applications in weed management
6. Biological control of weeds - types of bio-agents - criteria for selecting suitable agents; The concept of bio-herbicides - advantages and limitations.
7. Chemical methods of weed control; Definition of herbicides - advantages and constraints associated with herbicide use in agriculture.
8. Classification of herbicides based on chemical composition, selectivity, time of application, and residual behaviour in soil.
9. Mode of action of herbicides – important biochemical pathways affecting photosynthesis, respiration, growth and development, protein synthesis and lipid synthesis.
10. Types of adjuvants - functions of adjuvants - advantages of their use; Herbicide formulations - definitions and categories - merits; Precision weed management - Concept of Nano-herbicides.
11. Herbicide selectivity - principles of selectivity - differential rate of absorption, translocation, metabolism, and protoplasmic resistance in crops and weeds.
12. Compatibility of herbicides with fungicides, insecticides, and fertilizers - Concept of herbicide mixtures - their classification - advantages, and limitations in agricultural practices.
13. Integrated weed management – definition – objectives – Advantages - weed management practices in organic and natural farming - stale seedbed - soil solarization, mulching, brown manuring; Bio-herbicides - Herbicide resistance- Causes and its management
14. Weed management strategies in major field crops- yield losses - weed flora - management practices in rice, wheat, maize, jowar, redgram, greengram, blackgram, groundnut, soybean, sesame, and castor.
15. Weed management in different field crops- Yield Loss-Weed flora and Management in sugarcane, cotton-Horticultural crops -onion, chillies, tomato, Turmeric

16. Types of aquatic weeds - problems and control methods, weed management in different cropping systems.

B) Practicals

1. Weed preservation techniques
2. Identification of weeds
3. Survey of weed species in different Agro-ecosystems
4. Study of the biology and growth behaviour of important weeds - water hyacinth, purple nut sedge, barnyard grass, and Cuscuta.
5. Estimation of crop yield losses caused by weed infestation in ongoing field experiments.
6. Study of different herbicide formulations and interpretation of label information
7. Study of various herbicide application equipment
8. Calibration of spraying equipment for application of herbicides.
9. Study of different methods employed for the application of herbicides
10. Study of weed control implements, including the use of robots
11. Computation of recommended herbicide doses.
12. Calculation of weed control efficiency, weed index, and determination of weed density, frequency, and abundance.
13. Study of phytotoxic symptoms induced by herbicides in different crops.
14. Weed management practices in fallow lands and non-cropped
15. problematic weeds and their management.
16. Management of parasitic weeds.

Textbooks

1. Weed Management Principles and Practices by O.P. Gupta. Agrobios Publishers, Jodhpur, Rajasthan, India
2. Weed science basics and applications by Das. Jain Brothers Publications, New Delhi.

Suggested Readings

1. Principles of Weed Science by Rao, V. S. (3rd edition), CBS publishers and distributors Pvt. Ltd., New Delhi.
2. Hand Book of Weed Identification by Naidu, V.S.G.R., Directorate of Weed Research, Jabalpur

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AGMT 301**
Course Title	**:**	**Introduction to Agro-meteorology**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

1. To introduce the students to the concept of weather and climate and the underlying physical processes occurring in relation to plant and atmosphere
2. To impart the theoretical and practical knowledge of instruments/ equipments used for measurement of different weather variables in an agrometeorological observatory
3. To study the meteorological aspects of climate change in agriculture and allied activities

Course Outlines

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, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor 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 coldwave; Agriculture and weather relations; Modifications of crop microclimate, climatic normals 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.

A) Theory Lecture Out lines

Lec. No. **Topics**

1. Definitions and concepts of Meteorology, Agrometeorology, Scope and importance of Agrometeorology in agriculture.
2. Composition of the atmosphere; atmospheric weather elements; extent, layers and structure of the atmosphere.
3. Humidity and Pressure – Concept of saturation; vapour pressure; different types of humidity; influence of humidity on crop growth; atmospheric pressure—definition, standard atmospheric pressure and its variation with altitude.
4. Solar Radiation and Energy Balance – Nature and characteristics of solar radiation; modes of heat transfer – conduction, convection and radiation; solar spectrum; penetration and distribution of radiation within crop canopies; physiological responses to short-wave, long-wave and thermal radiation; solar constant, albedo, net radiation; earth's energy balance; solstices and equinoxes.
5. Atmospheric Temperature – Temperature inversion and lapse rate; diurnal and seasonal temperature variations; vertical temperature profile of the atmosphere; application of thermal time concept and crop/pest weather calendars.
6. Temperature Effects on Crops – Influence of temperature on crop growth and development; plant injuries due to low and high air temperatures; soil temperature and factors affecting soil temperature.
7. Wind – Definition and classification of winds; planetary winds (trade winds, westerlies and polar easterlies); cyclones and anticyclones; periodic and local winds (sea breeze, land breeze, mountain and valley winds); daily and seasonal wind variations; impact of wind on crops.
8. Precipitation – Process of precipitation; types of precipitation—solid, liquid and mixed; types of rainfall such as orographic, convectional and cyclonic.

9. Condensation – Process of condensation and its various forms including dew, fog, mist, frost and clouds.
10. Clouds and Rainfall – Definition of clouds; WMO classification of clouds; principles and methods of artificial rainmaking.
11. Monsoons – Characteristics of Indian monsoons; south-west and north-east monsoons; role of monsoons in Indian agriculture; onset of monsoon and length of the crop growing season.
12. Weather Hazards – Droughts, floods, tropical cyclones, heat waves and cold waves; their effects and management practices in agriculture.
13. Agriculture–Weather Relationship – Interaction between agriculture and weather; modification of crop microclimate; climatic requirements for crop and livestock production.
14. Weather Forecasting – Importance of weather forecasting; types of forecasts and their agricultural applications; interpretation of synoptic charts.
15. Remote Sensing and Advisory Services – Concept of remote sensing; applications of remote sensing in agriculture; agrometeorological advisory services in India.
16. Climate Change – Climate variability and global warming; causes of climate change; impact of climate change on regional and national agriculture.

B) Practicals

1. Field visit to an agrometeorological observatory with emphasis on site selection criteria and preparation of the observatory layout plan.
2. Familiarization with agrometeorological instruments and procedures for recording weather data.
3. Measurement of surface albedo and determination of sunshine duration.
4. Estimation of radiation intensity using recorded bright sunshine hours.
5. Measurement of maximum and minimum air temperatures; tabulation of data and analysis of trends and variations.
6. Measurement of soil temperature and computation of soil heat flux.
7. Determination of relative humidity, dew point temperature and vapour pressure.
8. Measurement of atmospheric pressure.
9. Measurement of wind speed and wind direction; preparation and interpretation of wind rose diagrams.
10. Measurement of rainfall; tabulation and statistical analysis of rainfall data.
11. Measurement of open pan evaporation and evapotranspiration.
12. Computation of Potential Evapotranspiration (PET) and Actual Evapotranspiration (AET).
13. Preparation and interpretation of synoptic charts and weather reports.
14. Study of types and methods of weather forecasting and preparation of crop weather calendars.
15. Calculation and interpretation of Growing Degree Days (GDD), Helio Thermal Units (HTU)

and Photo Thermal Units (PTU); estimation of crop duration.

16. Crop planning strategies under climate change conditions.

Textbook

1. Introductory AgroMeteorology and climate change by S.R. Reddy. Kalyani Publishers, New Delhi

Suggested Readings

1. Agricultural Meteorology by G.S.L.H.V. Prasad Rao, PHI Publishers, Delhi.
2. Agrometeorology and Climate Change by R.K. Naresh. Jaya Publishing House, Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-BICM 301**
Course Title	**:**	**Essentials of Plant Biochemistry**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objective

To impart the fundamental knowledge on structure and function of cellular components, biomolecules and the biological processes in plants

Course Outlines

Theory

Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components. Bio-molecules – Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids. Vitamins – physiological and metabolic role. Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes. Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. Biosynthetic Pathways - Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

Practical

Preparation of standard solutions and reagents, Determination of pH, Qualitative tests of carbohydrates and amino acids, Quantitative estimation of soluble sugars and starch, Estimation of protein by Kjeldhal method and Lowry's method, Preparation of mineral solution from ash, Estimation of fat by Soxhlet method, Determination of acid value, saponification value and iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites.

A) Theory Lecture Outlines

Lec. No. Topics

1. Biochemistry - Definition, Scope; Historical Developments of Biochemistry; Application of Biochemistry in Agriculture, Nutrition and Medicine.
2. Water - Structure and Properties & Role of Water in Biochemical Reactions; pH –Concept, Biological Significance, Buffer Systems (Bicarbonate, Phosphate Buffers), Henderson- Hassel balch Equation
3. Carbohydrates – Classification: Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides; Structure and Biochemical importance; Optical activity of sugars, Stereo chemical properties of monosaccharide, structure of Pyranose & furanose, Muta rotation – Anomers, Reducing properties of sugars; Roles of Carbohydrates.
4. Amino Acids - General Structure, Classification & function Based on R-Group Characteristics, Essential and Non-Essential Amino Acids, Physical properties (Solubility, Optical properties, Zwitterion, Isoelectric point), Acid-Base behavior- Titration curve: Non-standard Amino acids, Biologically important peptides.
5. Proteins - Primary, Secondary, Tertiary and Quaternary Structures of Proteins, Types of Bonds and Forces of Protein Structure, Structural Domains and Motifs in Proteins; Importance of Protein Folding and Denaturation.
6. Proteins: Simple, Conjugated, Derived Proteins; functional and nutritional Classification of Proteins; isoelectric pH, Precipitation by salting out, Denaturation, Protein Degradation and Turnover.
7. Lipids: Classification (Simple, Compound, and Derived Lipids), Biological Functions: Structure of fatty acids; Essential fatty acids; Structure of Triacylglycerol, Phospholipids, Sterols; Tests to check purity of fats and oils, Lipid Peroxidation, Rancidity.
8. Nucleic acids – Classification, Functions; Structure of Nucleotides; DNA vs. RNA; DNA & RNA Structure; Denaturation of DNA Strands - Melting temperature.
9. Water-Soluble Vitamins (B-Complex, Vitamin C); Metabolic Functions: Coenzymes in Energy Metabolism; Deficiency Symptoms; Recommended Daily Allowances (RDA), Dietary Sources
10. Fat-Soluble Vitamins (Vitamins A, D, E, K); Absorption, Transport and Storage; Biological Functions, Deficiency Symptoms and Associated Disorders, RDA, Dietary Sources
11. Enzymes - Definition, Importance, Classification; Properties of Enzymes - Enzyme specificity: Features of Active Site; Cofactors and Coenzymes
12. Enzymatic Action: Lock-and-Key vs. Induced Fit Models; Mechanism by lowering activation energy; enzyme catalysis; Factors affecting enzyme activity – Concentration of Enzyme, Substrate, Effect of temperature, pH & product concentration; Feedback Inhibition and Its Role in Metabolic Pathways

13. Michaelis-Menten Kinetics - Km and Vmax; Enzyme inhibition, types – Irreversible and Reversible inhibition: Competitive, Non-Competitive, Uncompetitive – Double Reciprocal (Line weaver-Burk) Plot for Enzyme Kinetics; Interpretation of Km and Vmax from Line weaver-Burk Plot.
14. Allosteric Enzymes – Definition, Properties; Allosteric Regulation: Positive and Negative Modulators; Sigmoidal Kinetics vs. Michaelis-Menten Kinetics; Role of Enzymes in Textile Detergent Industry, Brewing & Dairy and Food Processing.
15. Metabolism – Definition, Importance; Types: Anabolism and Catabolism; Overview of Bioenergetics: Concept of Free Energy (ÄG), Entropy, Enthalpy; ATP - The Energy Currency of the Cell; Energy-rich Compounds: NADH, FADH, GTP; Redox Reactions; Overview of intermediary metabolism.
16. Secondary Metabolites –Importance in plant defense; Alkaloids – heterocyclic secondary metabolites, their ecological significance; Terpenoids – Precursors, Example & their multiple functions in plant metabolism; Phenolics – Functions of phenyl propanoids, role as secondary cell wall components, flavonoids- Functions and Applications of Secondary Metabolites in Food and Pharmaceutical Industries, Therapeutic Potential of Secondary Metabolites.

B) Practicals

1. Preparation of reagents and standard solutions
2. Determination of p^H and Buffer preparation
3. Qualitative tests for carbohydrates
4. Qualitative tests for amino acids
5. Quantitative estimation of soluble sugars
6. Quantitative estimation of starch
7. Estimation of protein by Kjeldhal method
8. Estimation of soluble protein by Lowry's method
9. Preparation of mineral solution from ash
10. Estimation of fat by Soxhlet method
11. Determination of acid value
12. Determination of saponification value
13. Determination of iodine number
14. Estimation of ascorbic acid
15. Qualitative tests of secondary metabolites
16. Quantitative estimation of secondary metabolites

Textbook

1. Principles of Biochemistry by Nelson and Cox, Lehninger. Fourth/Fifth edition. Freeman Publishers, New York.

Suggested Readings

1. Outlines of Biochemistry by Conn, Stumpf, Bruening and Doi. Fifth Edition. Wiley Publishers, New Delhi.
2. Principles of Biochemistry by Horton, Moran, Rawn, Scrimgeour, Perry. Fifth Edition. Pearson/ Prentice Hall, New Jersey.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-AGRO 302**
Course Title	**:**	**Introductory Agro forestry**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

1. To study Agro forestry as an alternate system of land use
2. To study different types of Agro forestry for soil and water conservation
3. To study the characteristics of Agro forestry in terms its potential for soil moisture conservation practices

Course Outlines

Theory

Agro-forestry**:** Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in NE India, MPTS-definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of NE India, Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling, Traditional Agroforestry as a viable choice to conserve Agro biodiversity in North-East India. Management of Agro-forestry system**,** Role of agroforestry in soil and water conservation, windbreak, shelterbelt–definition, objectives., Socio- economic aspects of Agroforestry system, Design and Diagnostic study of agroforestry system, Silviculture**:** Definition and scope of silviculture system, Propagation of tree species**,** Regeneration by seed, coppice, root suckers, Transplanting, stamp, 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.

Practical

Study of tree growth measurement, Study of environmental parameters affecting AF System. Plant propagation methods, Pre-sowing seed treatment, preparation of nursery bed exercise, practicing students experience in vegetation, afforestation method, practical training, pruning, coppicing, pollarding etc. natural and artificial regeneration. Design and diagnostic survey of agro-forestry system. Evaluation of agro-forestry system in different agro climatic zones. Exposure Visit to prevailing agroforestry systems of the state and related important institutions.

A) Theory Lecture Outlines

Lec. No. Topics

1. Agroforestry – Meaning, concept and scope of agroforestry; historical development, importance and fundamental principles of agroforestry.
2. Agroforestry Systems – Types and classification of agroforestry systems; based on crop rotation, spatial arrangement and component combinations; potential of agroforestry systems in India
3. Multipurpose Tree Species (MPTS) – Definition - importance of multipurpose tree species; role of MPTS in agroforestry systems; tree–crop interactions - competition and nutrient recycling.
4. Traditional Agroforestry – Sustainable option for conservation of agrobiodiversity in India; management of trees in agroforestry.
5. Agroforestry for Soil and Water Conservation – Role of agroforestry in soil and water conservation; windbreaks and shelterbelts—definition, objectives, design principles; characteristics of tree species suitable for windbreaks and shelterbelts; factors influencing protection efficiency.
6. Ecological and Socio-economic Aspects – Ecological aspects of agroforestry systems; socio-economic importance of agroforestry; diagnostic study and design of agroforestry systems.
7. Forests – Definitions of forests and related terms; branches of forest; role of forests in regulating climate, conserving soil, and contributing to human health and recreation.
8. Silviculture – Definition, objectives, scope & concept; Indian forest policies and its salient features
9. Forest Regeneration – Natural and artificial regeneration of forests; objectives; criteria for selecting natural or artificial regeneration; essential preliminary considerations.
10. Propagation of Tree Species – Methods of tree propagation; field planting techniques; seed, coppice, root suckers, transplanting, stump planting, branch cuttings and rhizomes.

11. Nursery Management – Nursery bed preparation and management; types of nurseries; cultural practices for bare-root and seedlings; field handling of nursery stock.
12. Tending Operations – Definition and importance of tending; various tending operations - weeding, cleaning, thinning, fire tracing, coppicing, pollarding, irrigation, soil working and brashing; thinning types and crown classification.
13. Silviculture of Important Tree Species – I – Cultivation practices of eucalyptus, subabul and bamboo - site factors, root, crown and bole characteristics, phenology, nutrient and water requirements, ground operations, tending, harvesting and utility.
14. Silviculture of Important Tree Species – II – Cultivation practices of teak, casuarina and neem - site requirements, growth characteristics, phenology, nutrient and water needs, management practices, harvesting and uses.
15. Forest Utilization – Major Forest products - paper and pulp, plywood, matchwood, pencils, sports goods, artificial limbs and packing cases; minor forest products - tendu leaves, essential oils, resins, gums, lac, tans, dyes and incense products.
16. Agroforestry Models – Horticulture- and forage-based agroforestry models developed by ICAR-IGFRI; agroforestry models developed by ICFRE; successful agroforestry models for different agro-ecological zones of India and Andhra Pradesh.

B) Practicals

1. Identification of tree species suitable for timber, fuelwood, fodder, bio-aesthetic purposes and multipurpose tree species.
2. Identification of tree species commonly used in agroforestry systems.
3. Measurement of tree diameter using callipers and measuring tape; diameter measurement of forked, buttressed, fluted and leaning trees.
4. Measurement of height of standing trees using shadow method, single-pole method and hypsometer/altimeter.
5. Study of environmental parameters affecting Agroforestry System
6. Application of pre-sowing seed treatments to forest tree seeds.
7. Layout of nursery, preparation of nursery beds and sowing of seeds.
8. Afforestation- methods of planting patterns and designs for forest plantations.
9. Natural and artificial regeneration practices; hands-on training in pruning, coppicing and pollarding.
10. Practice of different propagation techniques for forest tree species.
11. Field planting techniques for natural and artificial regeneration of forest trees.
12. Design and diagnostic survey of agroforestry systems.
13. Evaluation of agroforestry systems in different agro-climatic zones.
14. Exposure visit to prevailing agroforestry systems and related important institutions.

15. Visit to forest nurseries, research stations and forest-based industries.
16. Virtual exposure to agroforestry models developed by ICAR-IGFRI and ICFRE.

Textbook

1. Textbook of Agroforestry by Chundawat D.S. and Gautham S.K. Oxford and IBH Publishers, New Delhi.

Suggested Readings

1. Introduction to Forestry & Agroforestry by K. T. Parthiban, N. Krishnakumar & M. Karthick. Scientific Publishers, Jodhpur, India
2. Agroforestry: Principles and Practices by Alok Kumar Patra. New India Publishing Agency, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-GPBR – 311**
Course Title	**:**	**Crop Improvement (*Kharif* crops) – I**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

1. To impart knowledge on self-pollinated and cross-pollinated Kharif crops.
2. To study the origin and geographical distribution of Kharif crops.
3. To formulate breeding objectives for major Kharif crops.
4. To provide information on important crop varieties cultivated during the Kharif season.

Course Outlines

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops of *kharif* season; 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 rice, pearl millet and pigeonpea etc. 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, pearl millet, ragi, pigeonpea, uradbean, 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 descent 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.

A) Theory Lecture outlines

Lec. No. **Topics**

1. Breeding concepts in sexually propagated (self-pollinated and cross-pollinated) and vegetatively propagated *kharif* crops; plant genetic resources and their utilization and conservation.
2. Cereals – **Rice**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
3. Millets – **Pearl millet, finger millet, kodo millet and proso millet**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
4. Pulses – **Pigeonpea**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
5. Pulses – **Urdbean and Mungbean**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
6. Oilseeds – **Soyabean and Groundnut**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
7. Oilseeds – **Sesame and Castor**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
8. Fodder crops – **Cowpea and Horsegram**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
9. Fibre crops – **Jute and Cotton**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
10. Cash crops – **Tobacco**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
11. Vegetable crops – **Brinjal and Okra**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding

procedures (conventional and modern innovative approaches) and seed production technology.

12. Vegetable crops – Cucurbitaceous crops – **Cucumber and Watermelon**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
13. Fruit crops – **Banana and Guava**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
14. Fruit crops – **Lime, Lemon and Apple**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
15. Flower crops – **Chrysanthemum and Marigold**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
16. Ideotype concept and development of climate-resilient crop varieties for multiple stresses in kharif crops—achievements.

B) Practicals

1. Floral biology, emasculation and hybridization techniques in Rice and Pearl Millet.
2. Floral biology, emasculation and hybridization techniques in Finger millet, Kodo millet and Prosomillet.
3. Floral biology, emasculation and hybridization techniques in Pigeonpea, Urdbean and Mungbean.
4. Floral biology, emasculation and hybridization techniques in Soybean, Groundnut, Sesame and Castor.
5. Floral biology, emasculation and hybridization techniques in Cowpea and Horsegram.
6. Floral biology, emasculation and hybridization techniques in Cotton, Jute and Tobacco.
7. Floral biology, emasculation and hybridization techniques in Brinjal and Okra.
8. Floral biology, emasculation and hybridization techniques in Cucumber and Watermelon.
9. Floral biology, emasculation and hybridization techniques in Banana and Guava.
10. Floral biology, emasculation and hybridization techniques in Lime, Lemon and Apple.
11. Floral biology, emasculation and hybridization techniques in Chrysanthemum and Marigold.
12. Handling of germplasm and segregating populations using different methods—pedigree, bulk, and single seed descent methods.
13. Study of field techniques for varietal and hybrid seed production in kharif crops.
14. Estimation of heterosis, inbreeding depression and heritability.

15. Visit to seed production plots.
16. Visit to AICRP breeding plots of different crops.

Textbooks

1. Breeding field crops -I by V.L. Chopra. Biogreen Publishers, New Delhi.
2. Practical manual on Crop Improvement I (*Kharif* crops) by Rajendra Kumar Yadav. S.K. Kataria & Sons Publishers, New Delhi.

Suggested Readings

1. Genetic improvement of field crops by C.B. Singh and D. Khare. Scientific publishers (India), Jodhpur, Rajasthan
2. Genetics and Breeding of Pulse crops by D.P. Singh. Kalyani Publishers, New Delhi.
3. Vegetable breeding – Principles and Practices by Hari Har Ram. Kalyani Publishers, New Delhi.
4. Breeding field crops by D.A. Sleper and J.M. Poehlman. Blackwell Publishers, UK.
5. Plant Breeding –theory and practice by S.K. Gupta. Agrobios Publishers, Jodhpur, Rajasthan, India.
6. Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur. Oxford and IBH Publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-ENTO 331**
Course Title	**:**	**Insect Pest Management in Field Crops**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

1. Diagnosis and management of major insect and non- insect pests of field crops.
2. Structural Entomology and household pest management

Course Outlines

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 field crops. Scientific name, order, family, host range, distribution, nature of damage and control practices for other important arthropod pests of various field crops. Management of non-insect pests, mites, snails and slugs, birds, nematodes, vertebrates and rodent pests of field crops. Locust management. Structural Entomology and important household pests, their nature of damage and management.

Practical

Field visit, Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking different field crops. Identification of mites, birds, rodent and vertebrate pests of field crops. Calculations of the doses of insecticides. Spraying techniques for selected field crops Study on structural entomology and household pests. Vertebrate pest management.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. **Introduction to Economic Entomology** – Importance, scope and economic classification of insect pests.
2. **Pests of Rice – I:** Yellow stem borer and other borers, gall midge, brown plant hopper, green leafhopper and thrips.

3. **Pests of Rice – II:** Hispa, leaf folder, ear head bug, grasshoppers, root weevil, swarming caterpillar, paddy skipper, climbing cutworm, caseworm, whorl maggot, leaf mite and panicle mite – Integrated Pest Management (IPM) practices in rice.
4. **Pests of Maize and Wheat:** maize earworm, fall armyworm, Deccan wingless grasshopper, aphids and maize shoot bug, Wheat pests: Ghujia weevil, termites and other major pests – IPM strategies.
5. **Pests of Sorghum and Ragi:** Sorghum shoot fly, stem borer, pink borer, sorghum midge, ear head bug, red hairy caterpillar, Ragi pink borer, ragi cutworm and ragi root aphid – IPM practices.
6. **Pests of Sugarcane:** Early shoot borer, internode borer, top shoot borer, scales, leafhoppers, white grub, mealybugs, termites, whiteflies, woolly aphid and yellow mite – IPM practices.
7. **Pests of Cotton:** Spotted bollworm, American bollworm, pink bollworm, tobacco caterpillar, leafhopper, whitefly, aphids, mites, thrips, red cotton bug, dusky cotton bug, leaf roller, stem weevil, grasshoppers and mealybug – IPM practices.
8. **Pests of jute, mesta and sunhemp:** Jute pests: Semilooper, stem weevil, stem girdler and Bihar hairy caterpillar. Mesta pests: Hairy caterpillars, stem weevil, mealybugs, leafhopper and aphid. Sun-hemp pests: Hairy caterpillars, stem borer and flea beetle – IPM practices.
9. **Pests of Pulses – I:** Gram caterpillar, plume moth, pod fly, stem fly and spotted pod borer – IPM strategies for gram caterpillar and spotted pod borer.
10. **Pests of Pulses – II:** Cowpea aphid, thrips, cowbug, pod bug, leafhopper, stink bug, green pod borer, blue butterflies, leaf webber and redgram mite. Soybean: Stem fly, stem girdler, cutworm, leaf miner and whitefly. Pea: Pea leaf miner and pea stem fly – IPM practices.
11. **Pests of Groundnut:** White grub, leaf miner, red hairy caterpillar, tobacco caterpillar, leafhoppers, thrips, aphids, leaf bud borer, pod bug, wireworm, earwig, jewel beetle and mites – IPM practices.
12. **Pests of Castor:** Semilooper, shoot and capsule borer, tobacco caterpillar, leafhopper, castor butterfly, whitefly, thrips, castor slug and mites – IPM practices.
13. **Pests of Oilseed Crops:** Sesame pests: Leaf webber and pod borer, gall fly and sphinx caterpillar. Safflower pests: Aphids and leaf eating caterpillars. Mustard pests: Aphid, sawfly, diamondback moth and painted bug. Sunflower pests: *Helicoverpa*, *Spodoptera*, leafhopper, Bihar hairy caterpillar and thrips – IPM practices.
14. **Locusts and Mites:** Biology and management of locusts; economically important phytophagous mites of field crops and their management.
15. **Vertebrate Pests of Field Crops:** Rodents damaging field crops and their management; birds infesting agricultural crops and their management strategies.

16. **Household and Public Health Pests:** Important household pests – termites, cockroaches, bed bugs, mosquitoes and houseflies – nature of damage, management methods and precautions in household pest control.

B) Practicals

1. Study of typical symptoms of damage caused by various phytophagous (plant-feeding) insect pests.
2. Identification of major insect pests of rice and their characteristic damage symptoms.
3. Identification of minor insect pests of rice and associated damage symptoms.
4. Identification of important insect pests of sorghum with diagnostic features.
5. Identification of major insect pests of maize and their nature of damage.
6. Identification of insect pests of wheat and other millets (ragi, bajra, small millets).
7. Identification of major insect pests of pulses and their damage symptoms.
8. Identification of minor insect pests of pulses affecting different pulse crops.
9. Identification of insect pests of groundnut with field level damage recognition.
10. Identification of insect pests of sesame (sesamum) and their injury symptoms.
11. Identification of insect pests of castor and their diagnostic characters.
12. Identification of insect pests of other oilseed crops such as sunflower, safflower and mustard.
13. Identification of major insect pests of sugarcane and their damage symptoms.
14. Identification of major insect pests of cotton with characteristic injury patterns.
15. Identification of insect pests of other fibre crops such as jute, mesta and sun-hemp.
16. Identification of major vertebrate pests of field crops (rodents and birds) and study of their damage symptoms.

Textbook

1. Elements of Economic Entomology by Vasantharaj David, B. and Ramamurthy V.V, Popular Book Depot, Coimbatore.

Suggested Readings

1. A Textbook of Applied Entomology by Srivastava K.P and Dhaliwal G. S. Kalyani Publishers, New Delhi.
2. Essentials of Pest Management*:* Key Information on Pest Identification and its Management by Prakash Rambhat Thalya and Ravi Chandra. Wings Publications International, Maharashtra.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU -AECO 341**
Course Title	**:**	**Agriculture Marketing and Trade**
Credits	**:**	**3 (2+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

1. To understand the fundamental principles of agricultural marketing and trade.
2. To analyse the key factors influencing supply and demand in agricultural markets.
3. To explore various marketing channels and strategies within the agricultural sector.
4. To examine the role of government policies and regulations in shaping agricultural markets.

Course Outlines

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 – meaning, 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 labelling (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, definition 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- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & 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 government in agricultural marketing. 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.

A) Theory Lecture outlines

Lec. No. Topics

1. Agricultural Marketing - Concepts, definitions of market, marketing, agricultural marketing; Significance of Agricultural Marketing in National Economic Development
2. Structure and Components of Markets; Dynamics of Agricultural Marketing, Conduct and Performance
3. Agricultural Markets Classification and Characteristics of Based on Different Criteria
4. Demand and Supply in Agriculture, Determinants of demand and supply of Farm Products
5. Concept of Producer's Surplus: Types, Marketable and Marketed Surplus, and Factors affecting marketable surplus of Agri Commodities
6. Marketing Process: Concentration, Dispersion and Equalization
7. Classification of Market Functions Based on Thomsen and Kohls and Uhl- Functional Approaches
8. Physical Marketing Functions: Meaning and Importance of Packaging and Packing, Transportation, Processing, and Storage
9. Exchange Functions: Meaning of Buying and Selling and Methods of Sale of Agricultural Produce in India
10. Facilitating Functions: Meaning and Importance of Grading and Standardization, Branding,

Market Financing, Market Intelligence, and Risk Bearing

11. Risks in Agricultural Marketing: Types, Speculation, and Hedging
12. Future Trading in Agricultural Commodities: Meaning of Forward and Futures Markets- Merits and Demerits.
13. Commodity exchanges in India - Role and Importance of NCDEX, MCX, NMCE, ICEX and Ace Derivatives
14. Market Functionaries in Agricultural Marketing: Types and Importance of Agencies
15. Marketing Channels in Agriculture- Definitions, Meaning-Marketing Channels for Major Commodities in Agriculture
16. Price Spread: Meaning and Definition of Price Spread, Marketing Costs, Marketing Margins, Factors Affecting Marketing Costs, Causes of High Marketing Costs of Agricultural Commodities, Ways to Reduce Marketing Costs, Marketing Efficiency- Meaning, definition and Types of Marketing Efficiency
17. Importance of Supply Chain Management and Value Chain Management
18. Marketing Mix- Meaning and 4Ps of Marketing – Significance and Characteristics of Agriculture Pricing
19. Quality Control and Labelling in Agriculture: Need and Importance of FSSAI, AGMARK, HACCP, and CODEX
20. Agricultural Product Pricing: Considerations, Approaches, Cost-Based and Competition-Based Pricing- Advantages and Disadvantages
21. Market Segmentation- Meaning, Significance, Types, and Benefits of market Segmentation; Market Integration: Definition and Types
22. Market Promotion in Agriculture: Meaning, Advertising, Personal Selling, Sales Promotion, Public Relations, Direct Marketing, Celebrity Endorsement/Sponsorship: Digital Marketing: Meaning, Advantages and Disadvantages
23. Agricultural Price Policy: Definition and Functions of Prices, Administered Prices, and the Need for Price Policy Innovations.
24. Government role in agricultural marketing; Objectives and Functions of Public sector institutions – FCI, DMI, CWC, SWC, CACP, NAFED, MARKFED, Rythu Bazars
25. APMC: Model Regulated Markets Act – Features and Contemporary Relevance
26. Farmer Producer Organizations (FPO) and Farmer Producer Companies (FPC): Meaning and Importance; Contract Farming: Meaning and Significance
27. Marketing Agricultural Products -Online and Digital Platforms
28. International Trade: Concept, Need, Theories of Absolute and Comparative Advantage, and Balance of Trade
29. International Trade in Agricultural Commodities: Current Status and Future Prospects

30. GATT and WTO - Genesis, Objectives, Significance
31. Agreement on Agriculture (AoA) and its impact on Indian agriculture
32. Intellectual Property Rights (IPRs) and TRIPS: Patents, Design, Copyrights, Trademarks, Trade Secrets, Geographical Indications, and Protection of New Plant Varieties – Impacts on Indian Agriculture

B) Practicals

1. Plotting and study of demand curve and supply curve for major agricultural commodities
2. Calculation of elasticities, equilibrium quantity and equilibrium price from demand and supply equations
3. Construction of index numbers - Moving averages, General PI, WPI, CPI
4. Correlation analysis between market arrivals and market prices of major agricultural commodities
5. Determinants of market prices of major commodities (Regression analysis) and interpretation of findings
6. Trend fitting of market arrivals and prices of major commodities
7. Computation of marketable surplus and marketed surplus of major commodities
8. Identification of marketing channels for major commodities
9. Collection of data and estimation of marketing cost, marketing margin and price spread
10. Calculation of marketing efficiency by different methods
11. Study on comparative advantage of different agricultural commodities of India in international trade - Calculation of RCA and RSCA
12. Visit to APMC / Regulated market to study the regulation of various market prices
13. Visit to SWC / CWC / FCI to study the objectives, role, organization, functioning and performance
14. Visit to Agri input Unit – Seed / Fertilizer / Agro processing unit to study the objectives and functioning
15. Visit to Rythu Bazar to study the objectives and functioning
16. Visit to FPOs – to study the objectives, organization, functioning and performance

Textbook

1. Agricultural Marketing in India by Acharya, S.S. and Agarwal, N.L., Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-CPHY 361**
Course Title	**:**	**Fundamentals of Crop Physiology**
Credits	**:**	**3 (2+1)**
Year	**:**	**III**
Semester	**:**	**I**

Objectives

To explain about the basic physiological process of plant viz. plant cell and water relations, mineral nutrition, carbon metabolism, reproductive physiology and plant growth and development.

Course Outlines

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; 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; Aeroponics Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap – theories and mechanism; Soil-plant-atmospheric continuum. Significance of transpiration. Stomatal opening and closing mechanisms. Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand culture. Overview of plant cell - organelle and their functions. Brief outline 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 and II.

Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of O_2 during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to C_3, C_4 and CAM pathways: Calvin Cycle, Hatch and 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 (light, temperature, CO_2, O_2 etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Kreb Cycle and ETC, Factors affecting respiration (O_2, temperature, CO_2 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. Photoperiodism: 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 (What is vernalization, devernalization etc.), Meaning, classification (seasonal, sequential etc), relation with 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 Abscisic 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 C_3 and C_4 plants.

A) Theory Lecture Outlines

Lec. No. Topics

1. Introduction to plant physiology and crop physiology: definitions, scope and importance in agriculture and allied sciences; historical development; interrelationship of crop physiology with other branches of crop science.
2. Plant Cell Architecture - Plant cell organelles its structure and role of cell organelles in different plant physiological processes

3. Plant–water relations: structure, properties and functions of water; physiological roles of water in crop plants; diffusion and osmosis—definitions; Fick's law of diffusion; concept of water potential and its components in plant cells.
4. Soil water – Types of water in soil and concepts of water potential and Soil moisture constants - Available soil moisture, soil water saturation, field capacity and permanent wilting point (PWP)
5. Water absorption in plants: mechanisms of active and passive absorption; pathways of water movement across root tissues through apoplast, symplast and transmembrane routes.
6. Ascent of sap-theories and mechanisms of ascent of sap-Cohesion-Tension theory - cavitation or embolism in xylem; Concept of Soil-plant-atmospheric continuum (SPAC) and its significance
7. Water loss in plants: Transpiration—definition and types; physiological significance of transpiration; guttation; Stomatal physiology - structural organization of stomata in monocots and dicots; characteristics of stomata (density, size, and shape).
8. Stomatal Characteristics and Regulation: Stomatal frequency- mechanism of stomatal opening and closure by active potassium (K^+) transport; Antitranspirants - Concept, Types of antitranspirants and examples.
9. Water Use and Productivity in Plants: Water Use Efficiency (WUE) and Water Requirement (WR)- comparative WUE and WR of C_3, C_4 and CAM plants - Transpiration in relation to productivity- Passioura's yield model- Factors influencing WUE
10. Mineral Nutrition in Plants: Definitions of essential and beneficial elements; criteria for essentiality of plant nutrients; Mengel's classification of essential nutrients; mechanisms of passive and active transport of mineral nutrients.
11. Functional roles of N, P, K, S, Ca and Mg
12. Functional roles of Fe, Mn, Cu, Zn, B, Mo, Cl, Na, Si, Co and Ni
13. Macronutrients - Deficiency symptoms and their corrective measures
14. Foliar nutrition and root feeding- Mechanism of uptake- Significance of foliar nutrition- Practical utility in agriculture; Hydroponics- Types of solution culture techniques; Sand culture- types and techniques of Sand Culture; Aeroponics; Practical applications of Sand Culture, hydroponics and aeroponics in Agriculture
15. Photosynthesis- Photosynthetic apparatus- Chloroplast and its structure- Photosynthetic pigments (chlorophylls, carotenoids and phycobilins)- structure and role of chlorophyll a and b - Light absorption by photosynthetic pigments - concept of energy transfer during photosynthesis

16. Photosynthesis: Quantum yield and quantum requirement of photosynthesis - Red drop and Emerson enhancement effect - Photosystem-I and II – Light reactions- Hill reaction – non-cyclic, cyclic and pseudo cyclic photophosphorylation
17. Photosynthesis- pathways CO_2 fixation - C_3 pathway- Energy requirement- C_4 pathway- Types of C_4 pathway- Energy requirement and its significance.
18. Photosynthesis – CAM pathway – significance; Photorespiration - Concept - The C_2 photosynthetic carbon oxidative cycle – significance - Factors affecting photosynthesis
19. Respiration in Plants: Definition and Significance- Glycolysis, Kreb's Cycle and ETC, - Energy budget of respiratory pathway-Factors affecting respiration - Respiratory quotient
20. Alternative Respiratory pathways: Oxidative Pentose Phosphate pathway-cyanide resistant respiration-SHAM (Salicyl hydroxamic Acid)- Concept of growth and maintenance respiration
21. Definitions of growth, development, and differentiation; determinate and indeterminate growth; measurement of plant growth (fresh weight, dry weight, linear and area methods); growth analysis; growth parameters—definitions and mathematical formulae.
22. Photoperiodism and flowering- Concept and Significance of photoperiodism- Classification of plants based on photoperiodic responses- Perception of photoperiodic stimulus- Biological clock
23. Phytochrome- Structure and role of phytochrome in inducing flowering in short day and long day plants; Vernalization: Concept, Perception of cold stimulus; Devernalization and its significance
24. Senescence: definition- Classification -Physiological and biochemical changes during senescence - Significance.
25. Abscission and its relationship with senescence- Concept of stay green trait and its importance inAgriculture- hormonal regulation of senescence and abscission.Use of hormones in increasing the vase life of flowers
26. Plant Growth Regulators –Definition of plant growth regulator, plant hormone, growth inhibitor- growth retardant; Auxins- Occurrence, transport, biosynthesis, mode of action, physiological roles and commercial applications
27. Gibberellins and cytokinins - Occurrence, transport, biosynthesis, mode of action, physiological roles and commercial applications
28. Abscisic Acid (ABA) and Ethylene - Occurrence, transport, biosynthesis, mode of action, physiological roles and commercial applications
29. Novel plant growth regulators- Brassinosteroids, strigolactones, Jasmonates, salicylic acid and triacontanol- Physiological roles- and Commercial applications

30. Crop Maturity- Concept of Physiological and harvestable maturity; Fruit ripening- climacteric and non- climacteric fruits; metabolic changes during fruit ripening- ripening induction and ripening inhibition
31. Stress physiology-Definition, Types of abiotic stresses- drought, waterlogging, salinity, high and low temperature stresses - influence on crop productivity - Acclimation and adaptation mechanisms of plants to abiotic stresses 0
32. Tolerance mechanisms of crop plants for drought and Salinity Stress - Concept of osmoregulation in stress adaptation.

B) Practicals

1. Preparation of standard Solutions, units of concentration and dilution
2. Effect of moisture stress on seed germination and seedling vigour
3. Measurement of leaf area by various methods
4. Estimation of water potential of plant tissues using Chardakov's method
5. Measurement of water status of plant in roots, stems and leaves by estimation of relative water content
6. Development of nutrient deficiencies and toxicity symptoms in hydroponically grown plants
7. Correction of nutrient deficiency symptoms in crop plants using appropriate chemicals
8. Rapid tissue test for measuring mineral nutrients in plants
9. Estimation of photosynthetic pigments and measurement of absorption spectrum
10. Measurement of rate of photosynthesis, respiration and transpiration by IRGA
11. Leaf anatomy in C_3 and C_4 plants
12. Plant growth analysis- Calculation of growth parameters
13. Measurement of stomatal frequency and stomatal index
14. Demonstration of effect of cytokinin on chlorophyll retention and Induction of leaf abscission by ethylene
15. Preparation of growth hormone solutions and their effect on plant growth
16. Measurement of crop canopy microclimate using psychrometer, Light meter and IR thermometer

Textbooks

1. Plant Physiology by S.N. Pandey and B.K. Sinha, 4th Ed. S. Chand Publishers, Uttar Pradesh.
2. Plant Physiology and Development by Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy, 6th Ed. Sinauer Associates Inc Publishers, US.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No. : **AU-PATH 371**

Course Title : **Diseases of Field & Horticultural crops and their management**

Credits : **3 (2+1)**

Year : **III**

Semester : **I**

Objectives

1. To study the symptoms produced on the host
2. To study the etiology of the diseases
3. To know about the disease cycle of the pathogens during pathogenesis
4. To study the epidemiological factors responsible for disease development
5. To study the management techniques for curbing the major diseases of field and horticultural crops

Course Outlines

Theory

Symptoms, etiology, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops: Field crops- Rice (blast, brown spot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, khaira); Wheat (rusts, loose smut, Karnalbunt); Maize (banded leaf and sheath blight, southern and northern blight, downy mildew); Sorghum (smuts, grain mold, anthracnose); Bajra (downy mildew, ergot) and Finger millet (blast, leaf spot); Groundnut (early and late leaf spots, rust, wilt); Soybean (rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic); Grams (Ascochyta blight, wilt, grey mold); Pea(downy mildew, powdery mildew, rust); Black gram and Greengram (web blight, Cercospora leaf spot, anthracnose, yellow mosaic); Sugarcane (red rot, smut, grassy shoot, ratoon stunting, PokahBoeng); Mustard (Alternaria blight, white rust, downy mildew, sclerotinia stem rot) and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, blackarm). Horticultural crops: Citrus (canker, gummosis) and Guava (wilt, anthracnose); Banana(sigatoka, Panama wilt, bacterial wilt, bunchy top); Papaya (foot rot, leaf curl, mosaic) and Pomegranate (bacterial blight); Apple (scab, powdery mildew, fire blight, crown gall) and Peach (leaf curl); Grapevine (downy mildew, powdery mildew, anthracnose) and Strawberry(leaf spot); Coconut

(bud rot, Ganoderma wilt), Tea (blister blight) and Coffee (rust); Mango (anthracnose, malformation, bacterial blight, powdery mildew); Potato (early and late blight, black scurf, leaf roll, mosaic) and Tomato (damping off, wilt, early and late blight, leaf curl, mosaic); Brinjal (phomopsis blight and fruit rot, sclerotinia blight) and Chilli (anthracnose and fruit rot, wilt, leaf curl); Cucurbits (powdery and downy mildew, wilts) and Cruciferous vegetables (Alternaria leaf spot, black rot, cauliflower mosaic); Beans (anthracnose, bacterial blight) and Okra (yellow vein mosaic); Ginger (soft rot), Turmeric (leaf Spot) and Coriander (stem gall); Rose (dieback, powdery mildew, black leaf spot) and Marigold (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 mildew of cucurbits, rhizoctonia and Cercospora leaf spot of green gram / black gram, Alternaria blight and downy mildew of mustard, early blight of 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 visit for the diagnosis of field problems, Collection and preservation of plant diseased specimens for herbarium.

A) Theory Lecture outlines

Lec No. **Topics**

1. Fungal Diseases of Rice– blast, brown spot, sheath blight, sheath rot, false smut
2. Bacterial, Viral, and Nutritional Disorders of Rice: bacterial leaf blight, Bacterial leaf streak, tungro and Khaira.
3. Major Diseases of Wheat: Rusts, loose smut, Karnal bunt
4. Major Diseases of Maize: Banded leaf and sheath blight, northern and southern corn leaf blight, downy mildew
5. Major Diseases of Sorghum: anthracnose, charcoal rot, Smuts, grain mold Bajra: Downy mildew and ergot
6. Major Diseases of Finger millet: Blast and leaf spot (Helminthosporium and Cercospora)
7. Important Diseases of Groundnut: Early and late leaf spots, Sclerotium wilt, rust, Kalahasti malady
8. Important Diseases of Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic
9. Important Diseases of Sunflower: Sclerotinia stem rot and Alternaria blight

10. Important Diseases of Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot
11. Important Diseases of Redgram: Phytophthora seedling blight, Fusarium wilt, Sterility mosaic
12. Important Diseases of Blackgram, greengram: Cercospora leaf spot, anthracnose, web blight and yellow mosaic
13. Important Diseases of Gram (Chickpea): Ascochyta blight wilt, grey mold Pea: Downy mildew, powdery mildew, rust
14. Major Diseases of Sugarcane: Red rot, whip smut, ring spot, Pokkah Boeng, grassy shoot, ratoon stunting
15. Major Diseases of Cotton: Anthracnose, vascular wilt (Fusarium & Verticillium) and black arm
16. Major Diseases of Citrus: Canker, Gummosis, Tristeza and Greening
17. Major Diseases of Mango: Anthracnose, Powdery mildew, Malformation, Bacterial blight
18. Major Diseases of Banana: Sigatoka, Panama wilt, Bacterial wilt, Bunchy top
19. Major Diseases of Grapevine: Downy mildew, Powdery mildew, Anthracnose
20. Major Diseases of Apple: Scab, Powdery mildew, Fire blight, Crown gall
21. Major Diseases of Guava: Wilt, Anthracnose, Pomegranate: Bacterial blight
22. Important Diseases of Papaya: Foot rot, Leaf curl, mosaic Peach: leaf curl Strawberry: Cercospora Leaf spot
23. Important Diseases of Coconut: Ganoderma Wilt, Bud rot, basal stem Rot, Tatipaka disease
24. Important Diseases of Tea: Blister blight, Coffee: Rust
25. Important Diseases of Potato: Early and late blight, Black scurf, Leaf roll, Mosaic
26. Important Diseases of Tomato: Damping off, Early and late blight, Bacterial Wilt, Leaf curl, Mosaic, Tomato spotted wilt virus
27. Major Diseases of Brinjal: Phomopsis blight and fruit rot, Sclerotinia blight
28. Major Diseases of Chillies: Anthracnose (die back and fruit rot), Alternaria leaf spot, Sclerotium Wilt, Choanephora blight, Leaf curl
29. Major Diseases of Cucurbits: Downy mildew, Powdery mildew, Bacterial Wilt; Crucifers: Alternaria leaf spot, Black rot, cauliflower mosaic
30. Major Diseases of Beans: Anthracnose, Bacterial blight, rust Bhendi; Powdery mildew, Cercospora leaf spot, Yellow vein mosaic virus
31. Major Diseases of Ginger: Rhizome rot, Phyllosticta leaf spot Turmeric leaf spot, leaf blotch Coriander stem gall
32. Major Diseases of Rose: Die back, Powdery mildew, Black leaf spot Marigold: Botrytis blight, Cercospora leaf spot, Septoria blotch

B) Practicals

1. Field Diagnosis, Collection, Preparation and Preservation of plant diseased specimens for herbarium.
2. Identification and Study of symptoms of rice blast, brown spot, sheath blight and bacterial blight
3. Identification and Study of symptoms of downy mildew and powdery mildew of cucurbits
4. Field Diagnosis, Collection, Preparation and Preservation of plant diseased specimens for herbarium.
5. Identification and Study of symptoms of Rhizoctonia and Cercospora leaf spot of blackgram and greengram
6. Identification and Study of symptoms of Alternaria blight and downy mildew of mustard
7. Field Diagnosis, Collection, Preparation and Preservation of plant diseased specimens for herbarium.
8. Identification and Study of symptoms of early blight and late blight of tomato and potato
9. Identification and Study of symptoms of Phomopsis blight of brinjal; Powdery mildew and rust of pea
10. Field Diagnosis, Collection, Preparation and Preservation of plant diseased specimens for herbarium.
11. Identification and Study of symptoms of stem gall of coriander; Anthracnose and fruit rot of chillies
12. Identification and Study of symptoms of leaf spot and leaf blotch of turmeric; Red rot of sugarcane
13. Acquaintance with fungicides and their use for management of diseases in field and horticultural crops
14. Acquaintance with antibiotics and biopesticides for management of diseases in field and horticultural crops
15. Identification and histopathological studies of selected diseases of field crops
16. Identification and histopathological studies of selected diseases of horticultural crops

Textbook

1. Diseases of crop plants in India by Rangaswami, G., Mahadevan, A. Prentice Hall of India pvt. Ltd, Delhi.

Suggested Readings

1. Integrated Plant Disease Management by R.C. Sharma. Scientific Publishers, Jodhpur, Rajasthan.
2. Plant Diseases by R.S. Singh. Medtech Publishers, New Delhi.
3. Plant Disease Management: Principles and Practices by Hriday Chaube. Taylor & Francis Publishers, New Delhi.
4. Plant Pathology by G.N. Agrios. Academic Press Publishers, West Bengal.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course Structure for B.Sc. (Hons.) Agriculture
Semester-VI (Third Year II Semester)

S.No.	Category	Course Number	Course Title	Hours per Week			Credits
				L	T	P	
1.	Core Course	AU-STAM-301	Basic and applied Agril Statistics	2	0	2	3(2+1)
2.	Core Course	AU-AGRO-303	Dryland Agriculture/ Rainfed agriculture and watershed management	1	0	2	2(1+1)
3.	Core Course	AU-GPBR-312	Fundamentals of Agri Biotechnology	2	0	2	3(2+1)
4.	Core Course	AU-GPBR-313	Crop Improvement (Rabi crops)-II	1	0	2	2(1+1)
5.	Core Course	AU-GPBR-314	Fundamentals of Seed Science & Technology	1	0	2	2(1+1)
6.	Core Course	AU-ENTO-332	Pest Management in Horticultural crops and stored grains	1	0	2	2(1+1)
7.	Core Course	AU-AECO-342	Agricultural Finance & Cooperation	1	0	2	2(1+1)
8.	Core Course	AU-AENG-351	Renewable energy in Agriculture and Allied Sector	1	0	2	2(1+1)
9.	Core Course	AU-PATH-372	Agricultural Microbiology and Phytoremediation	1	0	2	2(1+1)
10.			MOOC				3
						Total Credits	**23**

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-STAM 301**
Course Title	**:**	**Basic and Applied Agricultural Statistics**
Credits	**:**	**3(2+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objective

1. To provide basic knowledge of Statistics and its applications in Agriculture
2. To make students familiar with Tools of Statistics for data Analysis and interpretations.
3. To make students to draw meaningful conclusions from the experimental data.

Course Outlines

Theory

Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives. Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median -Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode-Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode. Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean,

Median and Mode for Symmetrical and Skewed Distribution. Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability- Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability. Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution- Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve. Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients. Tests of Significance. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance. ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non-assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

Practical

Diagrammatic and Graphical representation of data. Calculation of A.M., Median and Mode (Ungrouped and Grouped data). Calculation of S.D. and C.V. (Ungrouped and Grouped data). Correlation and Regression analysis. Application of t-test (one sample, two sample independent and dependent). Analysis of variance one way classification. CRD. Selection of random sample using simple random sampling.

A) Theory Lecture Outlines

Lec. No. Topics

1. Introduction and various definitions of Statistics – limitations, importance and Applications in Agriculture
2. Types of Data (primary data secondary data), types of variables (discrete and continuous), Scales of measurements of Data (nominal, ordinal, interval and ratio)
3. Classification, methods of classification (quantitative & qualitative) - Tabulation – parts of a table - frequency distribution (Construction of frequency table), types of frequency distributions (discrete and continuous).
4. Diagrammatic representation of Data - Bar Diagrams – Simple, Multiple, Sub- divided and

Percentage Bar Diagrams, Pie-diagram

5. Graphical Presentation of Data – Histogram, Frequency curve and frequency Polygon and Ogives (cumulative frequency) curves
6. Measures of Central Tendency - Requisites for an Ideal Measure of Central Tendency. Arithmetic mean, weighted mean, properties, merits, demerits and uses
7. Median, mode, geometric mean, Harmonic mean - merits & Demerit, empirical relationship between mean, median and mode; relationship between A.M., G.M. and H.M.
8. Measures of Dispersion - Characteristics for an Ideal Measure of Dispersion - list of Measures of Dispersions
9. Definition of Range, coefficient of range - Quartile Deviation – coefficient of Q.D and Mean Deviation.
10. S.D. and Variance for Grouped and Ungrouped Data – properties - Variance of Combined Series - Coefficient of dispersion, Co-efficient of Variation
11. Moments - skewness – kurtosis – different types and measures - Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution
12. Introduction to Probability - Basic Terminologies – event, set, types of events, permutations, combinations
13. Classical Probability-Definition and Limitations - Empirical Probability Definition and Limitations- Axiomatic Probability.
14. Addition and Multiplication Theorems - Conditional Probability, Baye's theorem
15. Normal Distribution- Definition, Probability density function, characteristics of normal distribution, Normal Probability Curve - importance
16. Definition of correlation, types of correlations with examples and figures (scatter diagram), properties of correlation coefficient, Testing of correlation coefficient
17. Regression – fitting of linear regression equations of Y on X and X on Y
18. Properties of regression coefficients, testing of regression coefficients, inter relationship between r, b & b^1
19. Tests of hypothesis - Null and Alternative Hypothesis. Type I and Type II Errors. Critical Region, Level of Significance, Parameter, statistic, degrees of freedom and S.E.
20. One tailed and two tailed tests, z-test for one sample and two samples
21. Small sample tests – one sample t-test and two sample t-test
22. Paired t-test and F-test
23. Chi square test – goodness of fit, applications, uses, yate's correction for continuity, 2x2 contingency table

24. Definitions of ANOVA, assumptions of ANOVA, assignable causes and random causes
25. Analysis for one way classification and two-way classification
26. Uniformity trials – maximum curvature method, Fair field smith variance law
27. Design of experiments – blocks, treatments, experimental error, critical difference and Basic principles of experimental designs
28. Completely Randomized Design (CRD) layout and analysis with equal and unequal repetitions, advantages and disadvantages, applications
29. Randomized Block Design (RBD) - layout, analysis, advantages and disadvantages, applications
30. Latin square design (LSD) – Layout, analysis, advantages and disadvantages, applications
31. Introduction to sampling – population, sample, sampling error, sampling frame, sampling Vs complete enumeration
32. Simple random sampling – SRSWR & SRSWOR – estimates of population mean, variance and its confidence limits, methods of selection of random sample

B) Practicals

1. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams, Pie-diagram
2. Graphical Presentation of Data – Histogram, Frequency curve and frequency Polygon and Ogives curves
3. Construction of Frequency Distribution table
4. Computation of Arithmetic Mean for Grouped and Un-grouped data (direct and step deviation method)
5. Computation of Median and mode for Grouped and Un-grouped data
6. Computation of Geometric mean and harmonic mean for grouped and ungrouped data
7. Computation of Q.D, M.D for grouped and ungrouped data
8. Computation of Standard Deviation, variance and CV for grouped and ungrouped data
9. Problems on addition - multiplication theorems and Baye's theorem
10. Student's t-test for single and two samples
11. Paired t-test and F-test
12. Computation of correlation coefficient and its testing
13. Fitting of simple regression equations Y on X and X on Y
14. Completely Randomized Design: Analysis with equal and unequal replications
15. Randomized Block Design: Analysis

16. Simple random sampling

Textbook

1. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor. Sultan Chand and Sons Publishers, New Delhi.

Suggested Readings

1. Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers, New Delhi.
2. Basic Statistics by B. L. Agarwal, New Age International Publishers, New Delhi.
3. A Textbook on Statistics for Agricultural Sciences by V Srinivasa Rao, V V Krishna and G. Mohan Naidu. VGS Techno Series, Hyderabad.
4. Agricultural Statistics by S.P. Singh and R.P.S. Verma. Rama Publishing House, Uttar Pradesh
5. Agriculture and Applied Statistics-I by P.K. Sahu. Kalyani Publishers, New Delhi

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	:	**AU-AGRO 303**
Course Title	:	**Dryland Agriculture and watershed management**
Credits	:	**2 (1+1)**
Year	:	**III**
Semester	:	**II**

Objectives

1. To learn about characteristics and conditions of dryland/rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management

Course Outlines

Theory

Dryland/Rainfed agriculture: Introduction, types and characteristics; History of dry land/rainfed Agriculture in India; Problems and prospects of dry land/rainfed agriculture in India; Soil and climatic conditions prevalent in dry land/rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices, Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas, Contingent crop planning for aberrant weather conditions, Watershed Concept, history, objective, principles and components of watershed management, factors affecting watershed management. Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA). Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling

of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country. Effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure. Soil moisture determination under different land situations, Importance of seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of model watershed. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops. Field demonstration on soil and moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Dryland agriculture - Introduction, definition, classification of drylands, major characteristics - historical development of dryland agriculture in India.
2. Major constraints and future opportunities of dryland agriculture in India - prevailing soil types and climatic conditions in dryland regions.
3. Soil erosion – definition - losses due to erosion - types of water and wind erosion - nature and extent - influencing factors of soil erosion - Universal Soil Loss Equation.
4. Soil and water conservation Techniques - agronomic measures and engineering-based conservation techniques
5. Analysis of long-term rainfall data using simple mathematical models and forecasting the weather abnormalities.
6. Length of Growing Period (LGP) and Soil Moisture Availability (SMA) – Concepts and their impact on crop and cropping systems in dryland agriculture.
7. Tillage practices for dryland crops - sub-soiling - set-line cultivation - modern approaches to tillage.
8. Selection of suitable crops, varieties, and cropping systems for dryland and their crop management.
9. Drought - definition, types of drought, effects of water deficit on plant physio-morphological characteristics; Crop adaptations and mitigation strategies.
10. Evapotranspiration - methods to minimize evapotranspiration - weeding, mulching, use of antitranspirants, windbreaks, and shelterbelts.
11. Water harvesting – structures of water harvesting - farm pond technology - supplemental irrigation - efficient water use through soil and crop management practices.

12. Contingent crop planning strategies to manage aberrant weather conditions (delayed monsoon onset, extended dry spells, and early monsoon withdrawal) in red and black soils.
13. Land capability classification - Alternate land use systems in dryland regions.
14. Watershed management - Definition, Concept, evolution and objectives.
15. Watershed management – principles, components and factors influencing it
16. Integrated Farming System (IFS) models for sustainable dryland agriculture.

B) Practicals

1. Classification of climate based on different criteria
2. Statistical analysis of rainfall data - mean, standard deviation, variance, and coefficient of variation.
3. Study of rainfall distribution patterns in rainfed regions of India and pattern of monsoon onset and withdrawal trends.
4. Computation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA)
5. Interpretation of meteorological data and scheduling of supplemental irrigation based on crop evapotranspiration demand.
6. Critical evaluation of rainfall and potential drought periods in India (Dry spells and wet spells)
7. Estimation of effective rainfall
8. Study of cultural, agronomic, and mechanical practices used for alleviating moisture stress.
9. Determination of soil moisture content and moisture availability index
10. Techniques and methods of seed priming
11. Assessment of meteorological drought.
12. Field visits to watershed.
13. Identification and mapping of major dryland regions of India.
14. Field demonstration of soil and moisture conservation practices
15. Demonstration of water harvesting structures and study of farm ponds as sources of supplemental irrigation.
16. Visit to a dryland research station for studying dryland crops

Textbook

1. Principles of Agronomy (6th edition) by Yellamanda reddy and Shankara reddy. Kalyani Publishers, New Delhi.

Suggested Readings

1. Agrometeorology – Principles and applications of climate studies in agriculture by H.S. Mavi and Graeme J. Tupper. International Book Publishing Co., Lucknow.
2. Principles of Agronomy by S.R. Reddy. Kalyani Publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-GPBR – 312**
Course Title	**:**	**Fundamentals of Agricultural Biotechnology**
Credits	**:**	**3(2+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objectives

To familiarize students with the basic principles of biotechnology, recent developments in the field, and its potential applications

Course outlines

Theory

Introduction to Plant Tissue Culture and Genetic Engineering: History; Cellular totipotency and cyto differentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement; Embryo rescue technique and its significance in hybrid development; Invitro fertilization, ovule culture and its significance in hybrid development; Protoplast isolation, culture and regeneration; Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement; Anther and pollen culture for haploid production; Development of disease-free (virus free) plants through apical meristem culture; Micropropagation technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants secondary metabolite production- in vitro germplasm conservation.

Introduction to Molecular Biology: DNA structure, structure and function; DNA replication, transcription and translation, RNA, types and function; Structure of prokaryotic and eukaryotic gene; Central dogma of life - DNA replication, transcription, genetic codes- translation and protein synthesis; Lac Operon concept - Nucleic acid hybridization; Polymerase chain reaction- DNA sequencing – Sanger method; PCR and its applications.

Introduction to recombinant DNA technology: DNA modifying enzymes and vectors; plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated

gene transfer methods; Transgenic and its importance in crop improvement with successful stories; biosafety. Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement

Practical

Introduction to Plant Tissue Culture Laboratory; Good Laboratory Practices; Media Preparation and sterilization; Glassware sterilization; Micropropagation; Callus induction and culture; Anther culture; Apical meristem culture; Preparation of synthetic seeds; Isolation of plasmid DNA; Quantification of DNA; Agarose Gel Electrophoresis and visualization of plasmid DNA; Restriction digestion of plasmid DNA and agarose gel electrophoresis; Isolation of Plant genomic DNA; PCR amplification of DNA; Gel electrophoresis of amplified DNA; Visit to tissue culture units /biotech labs.

A Theory Lecture outlines

Lec. No. **Topics**

1. Plant tissue culture: Introduction, definitions, origin, history, major principles and recent technologies, significance, international institutions and biotechnology in India.
2. Cellular totipotency and cyto-differentiation; morphogenesis; growth and differentiation in cultures; types of cultures—callus culture and single-cell/suspension culture and their applications.
3. Organogenesis and somatic embryogenesis: stages of somatic embryo development, general method, factors influencing somatic embryogenesis, applications and constraints.
4. Artificial (synthetic) seed production: desiccated and hydrated systems of synthetic seed production, benefits and drawbacks and Applications.
5. Embryo rescue technique: Embryo culture, objective, methods of embryo culture, protocol, importance in hybrid development, Applications and achievements.
6. In vitro pollination and in vitro fertilization: factors influencing in vitro pollination, importance in hybrid development. Ovary and ovule culture and its importance.
7. Protoplast culture: techniques of protoplast isolation, protoplast culture and regeneration.
8. Somatic hybridization: methodology, fusion of protoplasts, selection and culture of somatic hybrid cells, regeneration, symmetric hybrids, asymmetric hybrids and cybrids, advantages and disadvantages and application in crop improvement.
9. Anther/pollen culture: methodology, factors influencing androgenesis, applications of haploids in crop improvement, limitations and achievements.
10. Somaclonal variation: types, origin, advantages, limitations and applications in crop improvement.
11. Micropropagation: production of quality planting material, development of disease-free (virus-free) plants through apical meristem culture, methodology, different approaches for shoot multiplication, advantages and limitations and applications.

12. Secondary metabolite production: significance, use of cell suspension, organ, hairy root, shoot and callus cultures in metabolite production, applications and problems associated with secondary metabolite production.
13. In vitro germplasm conservation: slow-growth storage and cryopreservation, achievements, applications and limitations.
14. National certification and quality management of tissue culture plants: introduction and background of NCS–TCP, organization structure, roles and responsibilities, NCS–TCP Management Cell (NMC), Accreditation Panel and Accredited Test Laboratories (ATLs).
15. Recognized tissue culture production facility: certification of tissue culture raised plants and tissue culture certification standards.
16. Introduction to molecular biology: definition, components, three domains of life (eukaryotic, prokaryotic, and archaea), DNA structure and function; DNA replication, transcription and translation, RNA, types and function.
17. Structure of prokaryotic and eukaryotic genes: plant gene structure as a discontinuous gene, control sequences, TATA box, AGGA box and other regulatory elements.
18. Central dogma of life: post-transcriptional and post-translational modifications.
19. Nucleic acid hybridization; polymerase chain reaction (PCR); and components of the polymerase chain reaction.
20. Inverse PCR, reverse transcriptase–mediated PCR (RT-PCR), quantitative RT-PCR, advantages, limitations and applications.
21. DNA sequencing: Sanger method, next-generation sequencing (NGS) and advantages.

22&23. Introduction to markers-Morphological, biochemical and molecular markers- Advantages and disadvantages-ideal Marker system-RFLP, RAPD, SSR, SNP

24 &25. Marker-assisted breeding in crop improvement – Genome – Omics.

26&27. Recombinant DNA technology and Genetic Engineering Introduction, History, Applications in different fields, Advantages and Limitations/ Apprehensions. Strategies for resistance management. DNA modifying enzymes and Gene cloning.

28. Vectors – Ideal vector, Plasmids, cosmids, Phagemids, Bacteriophages, BAC and YAC – characteristics - advantages and disadvantages – Gene cassette.

29. Direct plant genetic transformation – physical (Gene gun method) and chemical (PEG mediated) methods.
30. Indirect gene transfer methods: Agrobacterium-mediated gene transfer, T-DNA, disarming, Vir genes, co-cultivation and selection of transformants.
31. Transgenic crops: significance, examples such as Bt cotton, herbicide-resistant crops, Flavr Savr

tomato, Golden rice and the Barnase–Barstar system for male sterility.

32. Biosafety: risks to human health and the environment, containment measures, biosafety levels, confinement, national biosafety regulatory framework in India, recombinant DNA safety guidelines, socio-economic and ethical considerations and international protocols and conventions on biosafety.

C) Practicals

1. Introduction to Plant Tissue Culture Laboratory and Good Laboratory Practices
2. Media Preparation and sterilization - Glassware and explant sterilization

3& 4. Micropropagation and Apical meristem culture

5 & 6. Callus induction and culture.

7 & 8. Anther culture.

9 & 10. Preparation of synthetic seeds.

11 &12. Isolation of plasmid DNA - Quantification of DNA – Agarose Gel Electrophoresis and visualization of plasmid DNA.

13. Restriction digestion of plasmid DNA and Agarose gel electrophoresis.
14. Isolation of Plant genomic DNA.
15. PCR amplification of DNA and confirmation of amplicons.
16. Visit to tissue culture units /biotech labs.

Textbooks

1. Biotechnology: Expanding Horiozon by Singh BD. Kalyani Publishers, New Delhi.
2. Fundamentals of Genetics by B.D.Singh. Kalyani Publishers, New Delhi.

Suggested Readings

1. Plant Tissue Culture: Theory and Practice by Bhojwani SS. Elsevier, New Delhi.
2. Handbook of Plant Biotechnology by Christou P and Klee H. John Wiley & Sons, New Delhi.
3. Gene IX by Lewin B. Peterson Publications/ Panima. W.H. Freeman & Co, New York.
4. Molecular Biotechnology by Primrose SB. Panima Publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-GPBR – 313**
Course Title	**:**	**Crop Improvement (*Rabi* crops)- II**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objectives

1. To provide knowledge on self-pollinated and cross-pollinated rabi crops.
2. To understand the origin and distribution of rabi crops.
3. To formulate breeding objectives for major rabi crops.
4. To impart information on different crop varieties suitable for the rabi season.

Course outlines

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 wheat, oat, maize, sorghum, chickpea, rapeseed and mustard etc. Ideotype concept, climate resilient crop varieties for future.

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. wheat, oat, maize, sorghum, rapeseed and mustard, pulses, potato, sugarcane, tomato, chilli, onion etc. Study of field techniques for seed production and hybrid seed production in rabi crops; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

A) Theory Lecture outlines

Lec. No. Topics

1. Concepts of breeding sexually propagated (self-pollinated and cross-pollinated) and vegetatively propagated *rabi* crops; plant genetic resources of *rabi* crops and their utilization and conservation.
2. Cereals – **Wheat, Barley and Oat**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
3. Millets – **Maize and Sorghum**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
4. Pulses – **Chickpea and Lentil**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
5. Oilseeds – **Sunflower, Safflower and Linseed**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
6. Oilseeds – **Rapeseed and Mustard**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
7. Sugars and Starches – **Potato**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
8. Sugars and Starches –**Sweet Potato**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
9. Sugars and Starches – **Sugarcane**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
10. Vegetable crops – **Tomato and Chilli**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
11. Vegetable crops – **Onion and Garlic**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
12. Vegetable crops – **Cabbage and Cauliflower**: Centre of origin, Distribution of species, Wild

relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.

13. Fruit crops – **Mango and Papaya**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
14. Fruit crops – **Pomegranate and Sapota**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
15. Flower crops – **Rose and Jasmine**: Centre of origin, Distribution of species, Wild relatives, Genetics of qualitative and quantitative characters, major breeding objectives, Breeding procedures (conventional and modern innovative approaches) and seed production technology.
16. Ideotype concept and development of climate-resilient crop varieties for multiple stresses in rabi crops—achievements.

B) Practicals

1. Floral biology, emasculation and hybridization techniques in Wheat, Oat and Barley.
2. Floral biology, emasculation and hybridization techniques in Maize and Sorghum.
3. Floral biology, emasculation and hybridization techniques in Chickpea and Lentil.
4. Floral biology, emasculation and hybridization techniques in Sunflower, Safflower and Linseed.
5. Floral biology, emasculation and hybridization techniques in Rapeseed and Mustard.
6. Floral biology, emasculation and hybridization techniques in Potato and Sweet Potato.
7. Floral biology, emasculation and hybridization techniques in Sugarcane.
8. Floral biology, emasculation and hybridization techniques in Tomato and Chilli.
9. Floral biology, emasculation and hybridization techniques in Onion and Garlic.
10. Floral biology, emasculation and hybridization techniques in Mango and Papaya.
11. Floral biology, emasculation and hybridization techniques in Pomegranate and Sapota.
12. Floral biology, emasculation and hybridization techniques in Rose and Jasmine.
13. Handling of germplasm and segregating populations by different methods- pedigree, bulk and single seed descent methods.
14. Study of field techniques for varietal and hybrid seed production in *rabi* crops.
15. Visit to seed production plots.
16. Visit to AICRP breeding plots of different crops.

Textbooks

1. Breeding Asian field Crops by J.M. Poehlman and D.N. Barthakur. Oxford and IBH Publishers, Delhi.
2. Practical Manuals on Crop Improvement II (*Rabi* crops) by Rajendra Kumar Yadav. S.K. Kataria & Sons Publishers, New Delhi

Suggested Readings

1. Breeding Field Crops -I by V.L. Chopra. Biogreen Publishers, New Delhi.
2. Genetic Improvement of Field Crops by C.B. Singh and D. Khare. Scientific publishers (India), Jodhpur, Rajasthan.
3. Genetics and Breeding of Pulse crops by D.P. Singh. Kalyani Publishers, New Delhi
4. Vegetable Breeding – Principles and Practices by Hari Har Ram. Kalyani Publishers, New Delhi.
5. Breeding Field Crops by D.A. Sleper and J.M. Poehlman. Blackwell Publishers, UK.
6. Plant Breeding –Theory and practice by S.K. Gupta. Agrobios Publishers, Jodhpur, Rajasthan, India.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-GPBR – 314**
Course Title	**:**	**Fundamentals of Seed Science & Technology**
Credits	**:**	**2 (1+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objectives

1. To provide basic and fundamental knowledge of the principles and practices of seed science and technology.
2. To develop practical skills in scientific seed production and post-harvest quality management.

Course Outlines

Theory

Introduction to seed technology, definition and importance; Seed quality -definition, characters of good quality seed; Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed. Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures; Post-harvest seed quality management; seed processing procedures, seed drying; Seed treatment, its importance, method of application and seed packing; seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage. Seed Certification and legislation; Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques.

Practical

Seed Structure, Seed sampling, Physical purity, Moisture determination, Germination test, Seed and seedling vigour test, Seed Viability, Genetic purity test: Grow out test, Field inspection, Seed health testing using blotter and agar plate method. Visit to seed production farms, seed testing laboratories and seed processing plant.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Introduction to seed and seed technology: definitions, importance, roles, and objectives of seed technology.
2. Seed quality: definition and characteristics of good quality seed.
3. Causes of deterioration of varietal purity and methods for assessment of genetic purity; safeguards for maintaining genetic purity.
4. Different classes of seed: nucleus seed, breeder seed, foundation seed, certified seed, and truthfully labeled seed.
5. Seed certification: history, procedures for seed certification, field inspection, and recognition of seed certification agencies in foreign countries.
6. Seed Act: main features of the Seed Act, 1966, Seed Act enforcement, duties and powers of seed inspectors, offences and penalties; Seeds Control Order, 1983, and New Seed Bill, 2019.
7. Basics of seed quality testing: objectives of seed testing, International Seed Testing Association (ISTA), establishment of Seed Testing Laboratory (STL), seed testing procedures for quality assessment, and seed quality enhancement techniques.
8. Foundation and certified seed production of varieties and hybrids in rice.
9. Foundation and certified seed production of varieties and hybrids in maize.
10. Foundation and certified seed production of varieties and hybrids in sorghum.
11. Foundation and certified seed production of varieties in blackgram, greengram, and Bengal gram, and varieties and hybrids in redgram.
12. Foundation and certified seed production of varieties in groundnut, sesamum, and varieties and hybrids in sunflower.
13. Seed drying: methods of seed drying including sun drying and forced-air drying, principle of forced-air drying, and moisture equilibrium between seed and air.
14. Planning, layout, and establishment of a seed processing plant: factors to consider in planning and designing, types of layouts, and sequence of operations.
15. Seed treatment: importance, types, benefits, methods of application and seed packaging.
16. Seed storage: General principles, factors affecting seed longevity and conditions required for proper storage, Seed health management.

B) Practicals

1. Seed structure
2. Seed sampling – Principles and procedures

3. Physical Purity analysis of field crops and vegetable crops
4. Seed moisture tests of field crops and vegetable crops
5. Germination test of field crops and vegetable crops
6. Seed vigour tests of field crops and vegetable crops
7. Seed viability test of field crops and vegetable crops
8. Grow Out Test (GOT)
9. Field Inspection
10. Seed health testing using blotter and agar plate method
11. Visit to seed production farm
12. Visit to Seed Testing Laboratories (STLs)
13. Visit to seed processing plant
14. Visit to Seed Certification Agency
15. Visit to public sector seed production agencies
16. Visit to seed storage godowns

Textbooks

1. Seed Technology (2nd edition) by Agarwal, R.L. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
2. Seed Science and Technology Biology, Production, Quality by Malavika Dadlani, Devendra K. Yadava. Springer Publications. New Jersey.

Suggested Readings

1. Seed Technology by Khare, D. and Bhale, M.S. (2nd revised edition), Scientific Publishers, Jodhpur, India
2. Seed Technology by Vanangamudi, K. New India Publishing Agency, New Delhi, India.
3. The Embryology of Angiosperm by Bhojwani, S.S. and Bhatnagar, S.P. Vikas Publishers, Uttar Pradesh.
4. Seed Production: Principles and Practices by McDonald, M.B. Jr and Copeland, L.O. Chapman & Hall, London.
5. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture by Tunwar, N.S. and Singh, S.N.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-ENTO 332**
Course Title	**:**	**Pest Management in Horticultural Crops and Stored Grains**
Credits	**:**	**2(1+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objectives

1. Diagnosis and management of major insect pests and non- insect pests of Horticulture crops
2. Identification and management of insect pests and non-insect pests of stored grains

Course Outlines

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 Vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments. Management of non-insect pests, mites, snails and slugs, birds, nematodes, vertebrates and rodent pests of horticultural crops. Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management.

Practical

Field visit, Identification of different types of damage symptoms of various horticultural crops. Identification and study of life cycle and seasonal history of various insect pests attacking different Horticultural crops. Identification of mites, birds, rodent and vertebrate pests of Horticultural crops. Stored grain Pests - Factors affecting losses of stored grain, Storage structures and Methods of grain storage.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. **Pests of Brinjal:** Shoot and fruit borer, stem borer, mealybug, leafhopper, lacewing bug, leaf webber, epilachna beetle and red spider mite – nature of damage and management.

2. **Pests of Bhendi and Tomato:** Bhendi: Shoot and fruit borer, leafhopper, whitefly and spider mite. Tomato: Serpentine leaf miner, tomato pinworm, fruit borer, thrips and whitefly – IPM practices.
3. **Pests of Cucurbits and Crucifers:** Cucurbits: Fruit flies, pumpkin beetles, semilooper, serpentine leaf miner and pumpkin leaf eating caterpillar. Crucifers: Diamondback moth, cabbage head borer, leaf webber, aphids, painted bug, tobacco caterpillar and cabbage butterfly – IPM practices.
4. **Pests of Tuber and Spice Vegetables:** Potato: Tuber moth. Sweet potato: Sweet potato weevil, hairy caterpillar and tortoise beetle. Chillies: Thrips, black thrips, whitefly, pod borers, aphids, blossom midge and mites. Moringa: Hairy caterpillar, budworm, leaf webber and pod fly – IPM practices.
5. **Pests of Mango:** Leafhoppers, stem borer, nut weevil, fruit fly, shoot borer, fruit borer, semilooper, mealybug, aphids, leaf webber, termites, thrips, red tree ant, leaf gall midges and red spider mite – IPM practices.
6. **Pests of Citrus and Grapevine:** Citrus: Citrus butterfly, fruit sucking moths, leaf miner, psylla, rust mite, bark eating caterpillar, blackfly and leaf mite. Grapevine: Flea beetle, thrips, mealybug, stem girdler, stem borer, leaf eating caterpillars and root grub – IPM practices.
7. **Pests of Pomegranate:** Pomegranate butterfly, thrips and fruit sucking moths – Integrated Pest Management strategies.
8. **Pests of other Fruit Crops:** Guava: Tea mosquito bug, mealybug, fruit flies and spiralling whitefly. Sapota: Leaf webber, parijatha hairy caterpillar and mealybugs. Ber: Fruit fly, fruit borer and fruit weevil. Banana: Rhizome weevil, skipper, aphid and pseudostem weevil. Papaya: Whiteflies, mealybugs and thrips. Apple: Woolly aphid and codling moth – IPM practices.
9. **Pests of Coconut and oil palm:** Black headed caterpillar, rhinoceros beetle, red palm weevil, slug caterpillar, rugose spiralling whitefly, scales, termites and eriophyid mite – IPM practices.
10. **Pests of Plantation and Spice Crops:** Arecanut: Scale insects. Cardamom: Thrips. Pepper: Pollu beetle and shoot borer. Coriander: Aphids and leaf eating caterpillar. Turmeric and Ginger: Rhizome fly and lacewing bug. Onion: Thrips and beet armyworm – IPM practices.
11. **Pests of Ornamental and Beverage Crops:** Rose: Thrips, scales, leaf eating caterpillars and chafer beetles. Jasmine: Stink bug, budworm and gall mite. Chrysanthemum: Aphids – IPM practices. Coffee: White borer, red borer, coffee berry borer, shot hole borer and green scale. Tea: Tea mosquito bug, thrips, red spider mite, pink mite, purple mite and scarlet mite – IPM practices.
12. **Non-Insect Pest on Horticultural Crops:** Important mites, nematodes, snails, slugs and other non-insect pests and their management.
13. **Vertebrate Pest in Horticulture:** Management of rodents, birds, wild boars, monkeys and other wild animals damaging horticultural crops.

14. **Pests of Stored Grains:** Rice weevil, lesser grain borer, khapra beetle, pulse beetle, groundnut bruchid, flour beetles, saw-toothed grain beetle, flat grain beetle, cigarette beetle, Angoumois grain moth, meal moth and rice moth; non-insect pests - psocids, grain mites, birds and rodents.
15. **Stored Grain Losses and Deterioration:** Factors affecting stored grain losses and the role of physical, biological, mechanical and chemical factors in grain deterioration.
16. **Stored Grain Pest Management:** Types of storage structures, fundamental principles and methods of grain storage; systems approach in stored grain pest management including prophylactic and curative measures.

B) Practicals

1. **Identification of insect pests of brinjal** and study of their characteristic damage symptoms.
2. **Identification of insect pests of bhendi and tomato** and their damage symptoms.
3. **Identification of insect pests of cucurbits and cruciferous crops** and their damage symptoms.
4. **Identification of insect pests of potato, sweet potato, chillies and moringa** with recognition of damage symptoms.
5. **Identification of insect pests of mango** and apple study of their nature of damage.
6. **Identification of insect pests of citrus and grapevine** and their characteristic damage symptoms.
7. **Identification of insect pests of banana, pomegranate** and sapota., their damage symptoms.
8. **Field visit to fruit orchards** for observation and collection of insect pest damage symptoms.
9. **Identification of insect pests of coconut and oil palm** and study of their damage symptoms.
10. **Identification of insect pests of plantation crops** – arecanut, cocoa, cardamom, pepper, and, along with their damage symptoms.
11. **Identification of insect pests of spices and condiments crops** (turmeric, ginger, onion) and pests of ornamental plants, with their damage symptoms.
12. **Field visit to horticultural and flower gardens** for observation and collection of pest damage specimens.
13. **Identification of insect and non-insect pests of stored grains** including psocids, grain mites, birds and rodents.
14. **Methods of grain sampling and determination of grain moisture content**.
15. **Methods of detection of infestation in stored grains** and assessment of quantitative losses caused by insect pests.
16. **Visit to FCI/CWC/SWC godowns** for demonstration of grain storage practices and fumigation techniques.

Textbook

1. Elements of Economic Entomology by Vasantharaj David, B. and Ramamurthy V.V., Popular Book Depot, Coimbatore.

Suggested Readings

1. Handbook of Economic Entomology for South India by Ramakrishna Ayyar, T.V Government Press, Madras.
2. Agricultural Insect Pests of tropics and their control by Dennis S Hill. Cambridge Universtiy Press, New York.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-AECO 342**
Course Title	**:**	**Agricultural Finance and Cooperation**
Credits	**:**	**2(1+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objective

To impart knowledge on issues related to lending to priority sector, credit management and financial risk management

Course Outlines

Theory

Agricultural Finance - Meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports Bank norms – SWOT analysis. Agricultural Cooperation –Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India - Credit, marketing, consumer and multipurpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3 R's, 5 C's and 7 P's of credit. Crop insurance: Its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

Practical

Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study. Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study. Appraisal of a loan proposal – A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value-added products. Seminar on selected topics. Different types of repayment plans.

A) Theory Lecture Outlines

Lec. No.	Topics
1.	Agricultural Finance – Concept, definition, scope and Importance - Micro and macro finance – credit needs and its role in Indian agriculture
2.	Credit: Meaning and Definition; Classification of Credit Based on Purpose, Time, Security, Liquidity, Contract Type, Approach, Activity Orientation, and Lender
3.	Credit Analysis – Economic Feasibility Assessment, 4 Rs (Risk, Response, Revenue, Retention), 3 Cs (Character, Capital, Capacity), and Seven Ps of Credit
4.	Agricultural Finance – Sources- Institutional and Non-Institutional; Commercial banks-Social Control and Nationalization of Commercial Banks; Objectives and Significance of Nationalization
5.	Lead Bank Scheme: Origin, Objectives, and Functions; Regional Rural Banks (RRBs) – Origin, Objectives, Features, and Functions; RRBs in Andhra Pradesh:
6.	Microfinance – Concept, Significance, Objectives, Features; Providers (Banks, NBFCs, MFIs), and Microfinance Lending and Control Act in Andhra Pradesh
7.	Crop Loan System: Objectives and Significance; Scale of Finance – Meaning and Objectives; Unit Costs, Cost of Credit, and Kisan Credit Card (KCC)
8.	Higher Financing Institutions: RBI, NABARD, World Bank Group, IMF, ADB, and DICGC – Origin, Objectives, Functions, and Their Role in Agricultural Development
9.	Recent Developments in Agricultural Credit in India; Financial Inclusion; Government of India Schemes – PM-KISAN, PM-KMY, PMJDY, PMMY,
10.	Financial Statements: Significance; Balance Sheet and Income Statement – Meaning and Key Components
11.	Project - Meaning and Definition; Phases of Project Cycle - SWOT analysis; Time value of money

12. History of Cooperative Development in India: Maxims of Cooperation
13. Cooperation: Core Principles and Types of Agricultural Cooperatives, Credit, Marketing, Consumer, Multi-Purpose, Farmers' Service, Processing, and Farming Cooperatives, and Cooperative Ware housing
14. Role of Cooperative Organisations - ICA, NCUI, NCDC, NAFED
15. Analysis of Successful Cooperative Organizations: AMUL (Gujarat), AAVIN (Tamil Nadu), Nandini (Karnataka), and Cooperatives in Maharashtra, Punjab, and Andhra Pradesh
16. Crop Insurance – Meaning, Scope, Evolution; Salient Features of Pradhan Mantri Fasal Bima Yojana (PMFBY)

B) Practicals

1. Optimum allocation of limited capital among different enterprises
2. Analysis of progress and performance of cooperatives, commercial banks and RRBs w.r.t. agricultural credit using published data
3. Visit to a Commercial bank to acquire first-hand knowledge of management, schemes and procedures for availing loan
4. Visit to a District Central Co-operative Bank (DCCB) to study its role, functions, procedures for availing loan and fixation of scale of finance
5. Estimation of credit requirement of farm business
6. Analysis of balance sheet– A case study
7. Analysis of income statement – A case study
8. Preparation of bankable projects / farm credit proposals –A case study
9. Appraisal of loan proposal – A case study
10. Techno economic parameters for preparation of projects – Undiscounted measures
11. Techno economic parameters for preparation of projects – Discounted measures
12. Preparation of repayment plans of credit
13. Visit to a co-operative society to acquire first-hand knowledge of management, schemes and procedures
14. Estimation of indemnity of crop insurance

15&16. Seminar on selected topics

Textbooks

1. Agricultural Finance and Management by Reddy S S and Ram P R. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi
2. Economic Analysis of Agricultural Projects by Gittinger, J.P. The Johns Hopkins Univ. Press, Baltimore, Maryland.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No. : **AU- AENG 351**

Course Title : **Renewable Energy in Agriculture and Allied Sectors**

Credits : **2(1+1)**

Year : **III**

Semester : **II**

Objectives

1. To gain the knowledge on different types of materials used in Renewable Energy

2. To understand the importance of Renewable Energy technology and its applications.

3. To train the students on the applications of solar thermal technology.

Course Outlines

Theory

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and bio oil production and their utilization as bio energy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photo voltaic system and their application, introduction of wind energy and their application. Availability of bio mass and their application in different places.

Practicals

Familiarization with renewable energy gadgets. To study biogas plants, To study gasifier, To study the production process of biodiesel.

To study briquetting machine, To study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photo voltaic system: solar light, solar pumping, solar fencing. To study solar cooker, To study solar drying system. To study solar distillation and solar pond. Solar Wind hybrid system. Field visit to Solar –Wind farm.

A) Theory Lecture Outlines

Lec. No. Topics

1. Classification of energy sources (conventional and non-conventional types) importance of non-conventional energy sources; advantages of renewable energy; obstacles in implementation of renewable energy systems.
2. Classification, conversion technologies (thermo-chemical and bio-chemical conversion) methods.
3. Introduction to biogas plants; anaerobic digestion; factors influencing bio-digestion
4. Biogas plants – classification - continuous and batch type, dome and drum type, different variations in dome types.
5. Biogas Plant - Advantages and limitations of floating drum and fixed dome biogas plants; KVIC, Janata and Deenabandhu biogas plant models.
6. Design considerations of biogas digesters; estimation of digester volume for biogas production using cattle dung; numerical problems related to biogas plant design.
7. Definition and importance of gasifiers; construction and working principles of different types of gasifiers; advantages of gasifiers.
8. Biomass densification; briquetting machines; biomass combustion process; types of furnaces used for biomass combustion.
9. Biodiesel principles- preparation; transesterification process; process of biodiesel production from Jatropha, waste oil and other feedstocks.
10. Fermentation process of biomass; production of ethanol from agricultural produce such as sugarcane and grains.
11. Solar energy- Introduction; types of solar radiation; flat-plate and concentrated type solar collectors.
12. Solar thermal applications - box-type and dish-type solar cookers, solar water heating systems, solar stills, space heating and solar ponds.
13. Solar grain dryers; solar cabinet dryers, solar convective dryers and solar greenhouse dryers.
14. Solar cell, solar photovoltaic applications, solar water pumping system, solar street lights, solar refrigeration system.
15. Wind energy; nature of wind, wind energy collectors - classification (horizontal-axis and vertical-axis)
16. Wind Energy Conversion Systems (WECS)-Components; applications of wind energy

B) Practicals

1. Demonstration of KVIC model biogas plant.
2. Demonstration of Janata &Deenabandhu biogas plants
3. Demonstration of different types of gasifiers
4. Demonstration of different types of gasifiers

5. Demonstration of briquetting machines
6. Demonstration of different types of furnaces
7. Demonstration of box type solar cooker
8. Demonstration of parabola type solar
9. Demonstration of solar water heater
10. Demonstration of solar grain dryers
11. Visit to Biogas plants/ Briquetting machinery
12. Demonstration of solar Water pumping unit
13. Demonstration of grid type domestic SPV system
14. Demonstration of non-grid type SPV system
15. Visit to solar park
16. Final practical examination

Textbooks

1. Non – conventional Energy Sources by Rai. G.D. Khanna Publishers, New Delhi.
2. Alternate Sources of Energy by Rathore N. S, Mathur and Kothari.S. ICAR publications, New Delhi

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No	**:**	**AU-PATH 372**
Course Title	**:**	**Agricultural Microbiology and Phyto- remediation**
Credits	**:**	**2(1+1)**
Year	**:**	**III**
Semester	**:**	**II**

Objectives

1. To get an introduction to microbiology with specific focus on its significance in agriculture science.
2. To get acquainted with the bacterial structure and the function of the different components.
3. To get highlights on different fields of microbiology
4. To get highlights on bioremediation of polluted soils using microbial mediators and phytoremediation
5. To get a concept of biological control and the role of biopesticides in plant disease management.

Course Outlines

Theory

Introduction to Microbiology: Definition, applied areas of Microbiology and Importance of Microbiology. History of Microbiology: Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination-transformation, conjugation and transduction Genetic Engineering: Plasmids, episomes, and genetically modified organisms Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management. Concepts of rhizosphere microbiology- Rhizodeposits - biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome-residents and their roles Potential of plant growth promoting rhizobacteria

(PGPR) and endophytes on soil health and sustainability Bioremediation of polluted soils using microbial mediators Phytoremediation of polluted soils

Practicals

Study of the microscope, Acquaintance with laboratory material and equipments, Microscopic observation of different groups of microorganisms: moulds (Fungi), Direct staining of bacteria by crystal violet, Negative or indirect staining of bacteria by nigrosin, Gram staining of bacteria, Study of phyllosphere and rhizosphere microflora, Measurement of microorganisms, Preparation of culture media, Isolation and purification of rhizospheric microbes, Isolation and purification of N-fixers, Isolation and purification of Nutrient solubilizers, Isolation and purification of Endophytes.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Introduction to Microbiology: Definition, Applied areas of Microbiology and importance of Microbiology in Food & Dairy, Industrial products, Genetic engineering & Biotechnology, Environmental Microbiology, Medical Microbiology, Agriculture, Climate change and Computer applications.
2. History of Microbiology: Discovery of microorganisms; spontaneous generation theory, Germ theory of diseases, Immunization, fermentation and the origin of life.
3. Bacteria: Cell structure – external and internal structures of bacteria.
4. Photo autotrophy: Oxygenic photosynthesis (Cyclic photophosphorylation & Noncyclic photophosphorylation)-anoxygenic photosynthesis.
5. Chemoautotrophy: Nitrifying bacteria, Sulphur-oxidizing bacteria, iron-oxidizing bacteria, and hydrogen-oxidizing bacteria.
6. Growth: Bacterial growth cycle; synchronous growth, diauxic growth; generation time, growth rate, and growth yield.
7. Principles of Bacterial Genetics: Genetic recombination through transformation, conjugation, and transduction; fundamentals of genetic engineering; role of plasmids and vectors, with reference to Ti plasmid and Escherichia coli.
8. Soil Microbiology: Nutrient mineralization and transformation- Nitrogen cycle, Phosphorous and Sulphur cycle.
9. Concepts of rhizosphere Microbiology- Rhizodeposits –biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome residents and their roles in Agriculture (VAM, BNF, PSB)
10. Air Microbiology: Phyllosphere microflora, Phylloplane microflora, Microflora of floral parts etc.

11. Mechanisms of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sus tainability.
12. Food Microbiology: Microbial spoilage – Principles of food preservations, Food poisoning- Food borne infection (*E. coli, Salmonella sp., Listeria sp.,*), *Bacillus cereus, Clostridium perfringens, Clostridium botulinum*)- Food born intoxication (*Staphylococcus aureus, Bacillus cereus, Clostridium perfringens, Clostridium botulinum*).
13. Water Microbiology: Types of water, water microorganisms, and microbial analysis of water (coliform test), Purification of water.
14. Industrial Microbiology: Microbial products (organic acids, amino acids, vitamins, solvents, alcohol & alcoholic beverages, enzymes, steroid transformation, Single cell protein, antibiotics, biofertilizers, bioinsecticides) Biodegradation (Biogas production), Biodegradable plastics etc.
15. Biological control: Microbial biopesticides for plant disease management. Mode of action of EPF, NPV, *Bacillus*, EPNs, Mechanisms of *Trichoderma, Pseudomonas, Bacillus subtilis*
16. Bioremediation of polluted soils using microbial mediators: Types of Bioremediation- Phytoremediation of polluted soils - Mechanism of phytoremediation- Advantages and Disadvantages.

B) Practicals

1. Demonstration of simple staining of bacteria using Crystal Violet and negative staining techniques employing Nigrosin.
2. Performance of Gram's staining technique for differentiation of bacterial cells.
3. Microscopic examination of major microbial groups, including bacteria, fungi, and yeasts.
4. Determination of microbial size using a stage micrometer and haemocytometer.
5. Formulation and sterilization of various microbiological culture media.
6. Application of in vitro techniques for obtaining pure microbial cultures.
7. Quantitative estimation of soil microorganisms.
8. Isolation and characterization of microorganisms associated with the rhizosphere.
9. Isolation and purification of mineral-solubilizing microorganisms, namely phosphate-, potassium and zinc-solubilizing bacteria.
10. Isolation and purification of nitrogen-fixing microorganisms, including *Rhizobium*, *Azotobacter*, and *Azospirillum*.
11. Isolation and analysis of microorganisms inhabiting the phyllosphere.
12. Recovery and study of endophytic microorganisms from plant tissues.
13. Techniques for long-term maintenance and preservation of microbial cultures.

14. Isolation of vesicular–arbuscular mycorrhizal (VAM) fungi using the wet sieving and decantation method.
15. Enumeration of microbial load in food samples.
16. Estimation of microbial populations present in water samples

Textbooks

1. Agricultural Microbiology by Rangaswami, G. & Bagyaraj, D. J. Prentice-Hall of India Pvt. Ltd, New Delhi.
2. A Textbook of Fungi, Bacteria and Viruses by Dubey, H.C. Vikas Publishing House Ltd. New Delhi

Suggested Readings

1. Microbiology by Pelczar, M.J., Chan, E.C.S. &Kreig, N.R. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Agricultural Microbiology by Mukherjee, N. & Ghosh, T. Kalyani Publishers, Calcutta
3. Microbiology: diversity, disease, and the environment by Salyers, A. A., & Whitt, D. D. Fitzgerald Science Press, Inc, China.
4. Microbiology by Prescott, L. M. 5th Edition. McGraw-Hill Inc., US

COLLEGE OF AGRICULTURE
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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course Structure for B.Sc. (Hons.) Agriculture
Semester-VII (Fourth Year I Semester)

S.No.	Course Number	Course Title	Hours Per Week			Credits
			L	T	P	
1.	AU- ELCT 401	System Simulation and Agro Advisory	3	0	2	4 (3+1)
2.	AU- ELCT402	Climate Resilient Agriculture	3	0	2	4 (3+1)
3.	AU- ELCT 403	Principles and Practices of Conservation Agriculture	3	0	2	4 (3+1)
4.	AU-ELCT 411	Commercial Plant Breeding	3	0	2	4 (3+1)
5.	AU-ELCT 412	Biotechnology of Crop Improvement	3	0	2	4 (3+1)
6.	AU-ELCT- 413	Commercial Seed Production	3	0	2	4 (3+1)
7.	AU- ELCT 421	Management of Natural Resources	3	0	2	4 (3+1)
8.	AU-ELCT 422	Food Safety and Standards	3	0	2	4 (3+1)
9.	AU-ELCT- 423	Bio pesticides and Bio fertilizers	3	0	2	4 (3+1)
10.	AU-ELCT- 424	Geo informatics and Remote Sensing, Precision Farming	3	0	2	4 (3+1)
11.	AU- ELCT 425	Food Science and Nutrition	3	0	2	4 (3+1)
12.	AU- ELCT 431	Bio formulation and Nano formulation	3	0	2	4 (3+1)
13.	AU- ELCT 441	Agri-Business Management	3	0	2	4 (3+1)
14.	AU- ELCT 451	Soil and Water Conservation Engineering	3	0	2	4 (3+1)
15.	AU- ELCT 461	Micro-Propagation Technologies	3	0	2	4 (3+1)
16.	AU- ELCT 471	Agrochemicals	3	0	2	4 (3+1)
17.	AU- ELCT 481	Landscaping	3	0	2	4 (3+1)
18.	AU-ELCT 482	Hi-Tech Horticulture	3	0	2	4 (3+1)
19.	AU-ELCT 483	Protected Cultivation	3	0	2	4 (3+1)

20.	AU-ELCT 484	Post-Harvest Management and Value Addition	3	0	2	4 (3+1)
21.	AU-ELCT- 485	Ornamental Crops, Maps & Landscaping	3	0	2	4 (3+1)
22.	AU-ELCT- 491	Agricultural Journalism	3	0	2	4 (3+1)
23.		MOOC				4
					Total credits	**24**

Note: 5 Courses will be selected from the list each with 4 credits totalling to 20 credits

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 401**
Course Title	**:**	**System Simulation and Agro Advisory**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To impart the knowledge of statistical and simulation modelling in crop yield estimation
2. To get acquainted with different weather forecasting techniques and their usability analysis
3. To study about the preparation and dissemination of agro-advisory bulletin

Course Outlines

Theory

System approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams. Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis. Potential and achievable crop production- concept and modelling, techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance. Weather forecasting, types methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity; Crop- Weather Calendars; Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro- advisory and its effective dissemination.

Practical

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential and achievable production; yield forecasting, insect and disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro- advisory

A) Theory Lecture Outlines

Lec. No. **Topics**

1. Crop simulation modelling - Categories of crop models - empirical and mechanistic models - Introduction to Systems and Modelling
2. Computer simulation of different dynamic crop models - DSSAT, APSIM, and INFOCROP.
3. Crop Modelling - History of agricultural system modelling- agricultural system models in spatial and temporal scales - state variables and model development.
4. Modelling plant growth and development, and crop yield formation.
5. Modelling dry matter production processes - photosynthesis, respiration, light use efficiency (LUE), and dry matter partitioning.
6. Parameterization of crop growth models
7. Modelling soil nitrogen - mineralization, immobilization, leaching, plant uptake processes.
8. Modelling carbon balance and soil carbon sequestration.
9. Modelling emissions of carbon dioxide, methane and nitrous oxide from agricultural systems.
10. Simulation of crop–environment interactions (soil, weather) factors.
11. Modelling for soil-water balance
12. Model initialization, data standards, and concepts of potential, attainable, and actual crop yield.
13. Data requirements for operating of crop simulation models - data collection and minimum datasets.
14. &15. Steps in Crop model application - model calibration, model evaluation, validation, and sensitivity analysis
16. Cropping rotation - Simulation of crop rotations –Use of computer simulation models for soil organic carbon dynamics in crop rotation simulations
17. Artificial intelligence - machine learning - hybrid modelling - Latest developments in simulation modelling – Use of AI and ML techniques in crop modelling.
18. Elementary crop growth models - verification and sensitivity analysis.
19. Climate change – Climate variability- Use of simulation models in assessing climate change and climate variability impacts on agriculture.
20. Geo spatial tools - GIS - remote sensing- GPS and its uses in spatial agricultural modelling.
21. Climate change scenarios - introduction to IPCC scenarios, concepts - simulation-based climate impact studies - Data utilization methods
22. Adaptation – mitigation - simulation of climate change impacts, adaptive strategies, potential gains, and vulnerability.
23. Greenhouse gas emissions – scenario in India, GHG emissions from Indian agriculture – modelling GHG emission from agriculture and mitigation strategies for climate change.
24. Ecological niche modelling in agriculture- Concepts, principles, and applications

25. Application of simulation models for crop selection and agricultural management (fertilizer and water management).
26. Yield forecasting- Yield forecasting techniques using crop simulation models and integrated with remote sensing technology.
27. Application of crop simulation models for environmental risk analysis.
28. Cropping system models and their uses in agriculture.
29. Pest and disease modelling and its application in early forewarning.
30. Use of simulation models for crop production in moisture and nutrients limited conditions by using simulation models.
31. Optimization mode to solve for crop and genetic traits using crop simulation models.
32. Evaluation of weather risks to crop yield and farm profitability using simulation models.
33. Development and evaluation of best management practices (BMPs) to reduce nitrate leaching or irrigation water use.
34. Use of models for foresight analysis.
35. Concept of Soil Test Crop Response (STCR) and its role in precision agriculture.
36. Crop insurance - weather index-based crop insurance- Cropping system models for decision-making for crop insurance
37. weather forecasting-History and development of weather forecasting in India
38. Crop–weather calendar, crop–weather–pest–disease calendar and forewarning models - crop weather diagram.
39. Value-added weather forecasts, indigenous technical knowledge (ITK) for weather forecast and its validity and Aerospace science and weather forecast.
40. Weather forecasting -Types and their uses.
41. Importance and role of medium-range weather forecasting in agriculture
42. weather-based Agro-advisory services- Concept and development
43. weather-based Agro advisories- Steps in preparation of Agro advisories
44. Dissemination of Agro-advisories to farming communities.
45. Role of information and communication technologies (ICTs) in dissemination of Agro advisories
46. Agro-advisories – its Economic impact
47. Role of Agricultural field monitoring units (AFMUs) in preparation and communication of Agro advisories.
48. Use of artificial intelligence and machine learning tools for efficient and seamless delivery of Agro-advisories.

B) Practicals

1. Handling weather datasets and preparation of climate analytics using R and Python tools.

2. Preparation of Data and input files for crop simulation models.
3. Working with Statistics in Simulation modelling (Random Sampling, Monte Carlo Methods, Bayesian Statistics etc).
4. Climate scenario data generation methods or steps.
5. Simulation of nitrogen balance using crop models.
6. Simulation of soil water balance using crop simulation models.
7. Simulation of crop growth and development using crop simulation models.
8. &9. Hands-on training on crop model calibration
10. Simulation of environmental modifications using models.
11. Uncertainty and sensitivity analysis in crop simulation studies.
12. Use of simulation models in Yield forecast.
13. Understanding and Interpretation of weather forecast data.
14. Preparation of weather-based agro advisories using medium-range weather forecast data.
15. Use of ICT tools for effective dissemination of agro-advisories.
16. Case study on economic impact assessment of agrometeorological advisory services.

Textbook

1. Introductory Agrometeorology and Climate change by S. R. Reddy - Kalyani publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT402**
Course Title	**:**	**Climate Resilient Agriculture**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To impart the concept of climate resilient agriculture under the present context of climate change
2. To study the integrated role of different sectors in building resilience to climate change in agriculture.

Course Outlines

Theory

Climate change and impacts of climate change on agriculture and food security; Crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc. Basics of adaption and mitigation in the agricultural sectors; Analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; Assessing biophysical and socioeconomic impacts on agricultural sector; Risk assessment strategies, preparedness for weather and climate risks in agriculture; Application of geospatial tools and techniques for sustainable agriculture. Climate Resilient Agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather and climatic information, agroadvisories, ICTs and simulation models; Climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management, organic/natural farming, integrated farming systems (IFS); Site specific nutrient management (SSNM), Conservation agriculture technologies to build soil organic carbon, harnessing microbial 31 biodiversity, biomass recycling; Use of renewable sources of energy; Climate resilient pest-disease management strategies. Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.

Practical

Acquaintance with meteorological instruments including AWS, Statistical techniques to study trend of climatic parameters, Analysis of extreme weather events using non-parametric tests, Building climate change scenarios under different futuristic emission of GHGs, Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars, Climate resilient technologies and manipulation of cropping patterns, Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories, Analysing carbon sequestration potential of different agro-ecosystems; Designing climate smart village model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.

A) Theory Lecture Outlines

Lec.No. Topics

1. Introduction to the concepts of weather, climate, climate variability, and climate change Greenhouse effect, greenhouse gases, global warming, and global warming potential.
2. Trends and variability of major climatic parameters and associated climate changes; Influence of climate change in agriculture sector - global, national, state, and regional levels.
3. Crop productivity under various climate change scenarios.
4. Concept of extreme weather events - drought, flood, pest and disease outbreaks, and their effects on crop production.
5. Concepts of climate change adaptation and mitigation in agriculture – climate vulnerability analysis and assessment to identify susceptible sectors and adaptation options in agriculture and allied sectors.
6. Evaluation of biophysical and socio-economic impacts of climate change on agriculture, Agro-industry, and Forestry.
7. Strategies of Risk assessment - preparedness for weather and climate-related risks in agriculture.
8. Definition and fundamentals of adaptation and mitigation strategies in the agricultural sector.
9. Definition of Climate Resilient Agriculture (CRA) and greenhouse gases- need for adopting CRA practices - strategies for reducing greenhouse gas emissions from agriculture.
10. Assessment of biophysical and socio-economic impacts on agricultural sector.
11. Weather and climate risks – Strategies for risk assessment and preparedness for weather and climate risks in agriculture
12. Climate Resilient Agriculture (CRA): concept, scope and importance – history in India and Andhra Pradesh.
13. Climate resilient technologies – It’s role for enhancing crop productivity and sustainability.

14. Contingency planning – Development of Crop contingency planning based on Agro-climatic conditions.
15. Crop contingency planning based on rainfall patterns, dry spells, soil types, and real-time weather conditions.
16. Agrometeorology - weather forecasting- role of weather forecasting in intelligent farming to help farmers anticipate and adapt to climate change.
17. Role of Agro-advisories and Information and communication technologies (ICTs) in promoting climate resilient technologies.
18. Definition of crop modelling - types of crop models - empirical and mechanistic models.
19. Role of simulation models for developing climate resilient agricultural technologies.
20. Various climate resilient agronomic practices – 1. crop/cultivar selection, crop diversification/crop mixtures.
21. 2. Water management practices - rainwater harvesting techniques.
22. 3. Micro-irrigation, deficit irrigation and drainage management.
23. 4. Organic/natural farming, Integrated farming systems (IFS); site-specific nutrient management (SSNM).
24. 5. Conservation agriculture technologies to build soil organic carbon
25. 6. Harnessing microbial biodiversity and biomass recycling
26. 7. Utilization of renewable energy sources.
27. 8. Climate resilient pest management strategies.
28. 9. Climate resilient disease management strategies.
29. Physiological and morphological strategies for development of climate change resilient crops and varieties.
30. Development of biotic and abiotic stress tolerant and resistant cultivars under changing climatic scenarios.
31. Development of crop varieties tolerant to biotic and abiotic stresses under extreme weather events.
32. Geospatial tools - GIS, GPS, and remote sensing and it's role in sustainable and climate resilient agriculture.
33. Climate change adaptation and mitigation strategies and technologies for climate change adaptation
34. Climate smart crop development: concept and development of climate smart crops- strategies adopted for their development.
35. Climate resilient crop management strategies - Rice.
36. Climate resilient crop management strategies - Wheat.
37. Climate resilient crop management strategies - Maize.
38. Climate resilient crop management strategies - Sorghum.
39. Climate resilient crop management strategies - Major and minor millets.
40. Climate resilient crop management strategies - Sugarcane.

41. Climate resilient crop management strategies - Cotton.
42. Climate resilient crop management strategies - Pigeon pea - chickpea.
43. Climate resilient crop management strategies - Black gram, green gram.
44. Climate resilient crop management strategies - oilseed crops.
45. Climate resilient management strategies - livestock.
46. Climate resilient management strategies - major horticultural orchard crops.
47. & 48. Climate resilient management strategies - major horticultural vegetable crops.

B) Practicals

1. Acquaintance with meteorological instruments including AWS
2. Statistical techniques to study trends and fluctuations of climatic parameters
3. Analysis of extreme weather events using non-parametric tests
4. Building climate change scenarios under different futuristic emission of GHGs
5. Climate change laboratory and simulation experiments using crop simulation models
6. Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars
7. Climate resilient technologies and manipulation of cropping patterns
8. Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories
9. Analysing carbon sequestration potential of different agro-ecosystems;
10. Designing of a 'climate smart village' model considering the availability of resources.
11. Awareness programme on climate change and climate resilient agriculture among farming community.
12. Economic analysis of climate smart interventions-a cost benefit analysis
13. Field visit - Research station/Cyclone warning station
14. Field visit - Research station- Climate smart trials
15. Field visit - Farmers field- Climate smart villages
16. Field visit - Farmers field- Climate smart villages

Textbook

1. Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish. New India Publishing Agency

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 403**
Course Title	**:**	**Principles and Practices of Conservation Agriculture**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To teach students the principles of crop production under organic and conservation agriculture situation
2. To impart practical knowledge of organic and conservation agriculture practices

Course Outlines

Theory

Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming; Nutrient management in organic farming and their sources; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture. Conservation agriculture: definition, origin, principles, advantages, challenges; Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture vis a vis Climate Smart Agriculture; Organic manures- Recommended doses and application in comparison to inorganic fertilizers for major crops

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost and their quality analysis; Method of application of bio-fertilizers; Indigenous technology knowledge (ITK) for nutrient, insect-pest and disease management; Studies in green manuring in-situ and green leaf manuring, Studies on different type of botanicals for insect pest management; Weed management in organic farming; Cost of organic production system; Practices of conservation agriculture.

A) Theory Lecture Outlines

Lec. No. Topics

1. Organic farming: definition, need, concept, scope, characteristics - relevance to modern agriculture.
2. History and evolution of organic farming - milestones in early ages.
3. Principles of organic farming - crop and variety selection, crop rotations, multiple cropping, and their importance.
4. Various eco-friendly farming systems- biological farming, natural farming, regenerative agriculture, permaculture, biodynamic farming with their merits and limitations.
5. Relevance of organic farming to India, Andhra Pradesh, and global agriculture, future prospects, advantages, and constraints.
6. Initiatives of central and state governments, NGOs, and other organizations in promoting organic agriculture.
7. Organic nutrient sources and their enrichment, organic manures, and composting methods.
8. Green manures and biofertilizers: types, methods of application, benefits, and limitations.
9. Nutrient use efficiency in organic farming with scope and limitations.
10. 11& 12. Nutrient management in organic farming- Preparation and use of liquid organic manures- & Recommended package practices in organic farming for major crops-Rice/Maize/Pulses/Millets/ Cotton/Sugarcane
13. Organic farming ecosystems - Concept.
14. &15. Basics of insect and disease management in organic farming – cultural - biological approaches - Non-chemical pest and disease management in organic crop production.
16. Weed management practices in organic farming.
17. Use of botanicals - pyrethrum, neem seed kernel extract, neem oil, and other neem formulations in pest management.
18. Operational structure of the National Programme for Organic Production (NPOP) - other supporting agencies for organic farming.
19. &20. Certification process for organic products - inspection and certification – Labelling and accreditation – processing - economic consideration and viability of organic products.
21. Marketing and export potential of organic products in national economy.
22. Importance of organic farming in maintaining soil health and soil quality.
23. Role of organic farming in sustaining crop yield and improving quality.
24. Impact of organic farming on climate change mitigation.
25. Organic crops & foods and their influence on human health.
26. Organic seed production - success stories and case studies - Indigenous technical knowledge (ITKs) in organic farming.

27. Conservation agriculture: definition, concept, objectives, and difference between conventional and conservation agriculture.
28. Conservation agriculture - History, global developments, opportunities, and present status.
29. Principles of conservation agriculture - minimum soil disturbance, permanent soil cover, and cover crop diversification.
30. Benefits and constraints of conservation agriculture - operational, technical, and socio-economic aspects.
31. &32. Types of conservation agriculture practices - no-till farming, conservation tillage, crop rotation, cover cropping - stubble mulching, crop residue management, legume farming, agroforestry, precision farming, carbon farming.
33. Conservation Agriculture - Modern tillage concepts - zero, minimum, and conservation tillage – difference between conventional tillage & conservation tillage and their effects on soil properties.
34. Crop residue management- generation in India, utilization, and reasons for on-farm burning of crop residues.
35. Competing uses of crop residues – energy source, livestock feed, compost making, biofuels, bio-oil, biochar production – gasification - bio methanation.
36. Crop residue management strategies in different countries – Managing crop residues with conservation agriculture.
37. Crop diversification: definition, concept, types (horizontal and vertical), advantages, challenges - constraints.
38. Characteristics/functions and management of cover crops in conservation agriculture systems.
39. & 40. Crop establishment under conservation agriculture – machinery, tools and implements used for crop establishment in conservation agriculture.
41. Conservation agriculture in relation to climate smart agriculture.
42. Greenhouse gas emissions in conventional agriculture - conservation agriculture and carbon sequestration.
43. Diversification of crop rotations using nitrogen-fixing legumes.
44. Strategies for improving carbon-nitrogen dynamics for climate resilient farming in conservation agriculture.
45. Conservation agriculture- agroforestry systems - complementary benefits - sustainable development principles.
46. Conservation agriculture - major cropping systems in India - rainfed and irrigated conditions.
47. conservation agriculture: Mulches – advantages - disadvantages and management practices.
48. Conservation Agriculture – Challenges – policies - adoption- research strategies in India.

B) Practicals

1. Visit to organic farms to study components of organic farming systems and utilization of organic inputs.
2. Preparation of vermicompost.
3. Compost preparation- aerobic and anaerobic methods.
4. Preparation of enriched farmyard manure.
5. Preparation and application of organic formulations such as panchagavya, beejamrutam, jeevamrutam, ghanajeevamrutam, and dravajeevamrutam.
6. Methods of application of bio-pesticides (Tricho cards, *Bacillus thuringiensis* (Bt), NPV)/Biofertilizers.
7. Different weed management practices in organic farming – mulching - stale seedbed technique.
8. Quality standards of biofertilizers, bio-inoculants, and compost.
9. Study of post-harvest management practices in organic farming.
10. Preparation and application of Neemastra.
11. Field visits to organic farms to study various components and their utilization.
12. Economic analysis of organic production system.
13. Estimation of weed seed bank in conservation agriculture conditions.
14. Study of direct seeding equipment methods under conservation agriculture - Broadcasting, Planting stick, Hand jab planter, Motorized or tractor drawn seed drill, Happy seeder, Roto till drill, multi crop raised bed planter, slit till drill, Animal drawn planter.
15. Study of cover crops and their role in conservation agriculture.
16. Case studies on conservation agriculture practices in rainfed areas

Textbook

1. Conservation Agriculture Technologies by Singh, Abhinandan, Pankaj Kumar Ojha and Rahul Kumar. Biotech Books

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-ELCT 411**
Course Title	**:**	**Commercial Plant Breeding**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To discuss about hybrid development and various crop improvement aspects of field crops viz., rice, wheat, maize, pearlmillet, sorghum, pigeonpea, chickpea, greengram, blackgram, lentil, soybean, groundnut, rapeseed-mustard, cotton etc.
2. To provide understanding on tissue culture and biotechnological approaches as alternatives strategies for development of line and cultivars
3. To impart knowledge on seed production, release and notification of varieties and PPV&FR Act, 2001

Course Outlines

Theory

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self-and cross-pollinated crops (A/B/Rand two-line system) for development of hybrids and seed production. Genetics test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Speed Breeding, Breeding Management systems, High-through put phenotyping and genotyping platforms, Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of verities under PPV and FR Act. Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self- and cross- pollinated crops.

Practical

Floral biology in self- and cross- pollinated species, selfing and crossing techniques. Techniques of seed production in self- and cross- pollinated crops using A/B/R and two-line system. Learning

techniques in hybrid seed production using male-sterility in field crops. Understanding the difficulties in hybrid seed production. Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing, viz. grading and packaging. Visit to public private seed production and processing plants.

A) Theory Lecture Outlines

Lec. No. Topics

1. Types of crops and modes of reproduction in plants.
2. Different types of seeds – Classification.
3. Line development.
4. Development of hybrids in self and cross pollinated crops using three line (A/B/R lines).
5. Development of hybrids in self and cross pollinated crops using two line system.
6. Principles and techniques of seed production.
7. Seed production in self-pollinated crops.
8. Seed production in cross pollinated crops.
9. Seed production in often-cross pollinated crops.
10. Maintenance breeding in self-pollinated crops.
11. Maintenance breeding in cross pollinated crops.
12. Genetic purity test of commercial hybrid.
13. Advances in hybrid seed production of rice.
14. Advances in hybrid seed production of maize.
15. Advances in hybrid seed production of sorghum.
16. Advances in hybrid seed production of pearl millet.
17. Advances in hybrid seed production of castor.
18. Advances in hybrid seed production of sunflower.
19. Advances in hybrid seed production of cotton.
20. Advances in hybrid seed production of pigeonpea.
21. Advances in hybrid seed production of brassica sps.
22. Quality seed production of vegetable crops under open and protected environment.

23-26. Alternative strategies for the development of the line cultivars – Cytological, haploid inducer, tissue culture technique and biotechnological tools.

27. Variety testing, release and notification systems in India – SVRC.
28. Variety testing, release and notification systems in India – CVRC.

29. IPR issues in commercial plant breeding.
30. DUS testing & Registration of varieties under PPV and FR Act.
31. DUS Descriptors and testing – in rice
32. DUS Descriptors and testing – in groundnut
33. DUS Descriptors and testing – in maize.
34. DUS Descriptors and testing – in sorghum
35. DUS Descriptors and testing – in pearl millet
36. DUS Descriptors and testing – in castor.
37. DUS Descriptors and testing – in sunflower
38. DUS Descriptors and testing – in cotton
39. DUS Descriptors and testing – in pigeonpea.
40. DUS Descriptors and testing – in rapeseed and mustard.
41. DUS Descriptors and testing – in brinjal.
42. DUS Descriptors and testing – in tomato.
43. Quality testing in self- pollinated crops.
44. Quality testing in cross- pollinated crops.
45. Speed Breeding.
46. Breeding Management Systems.
47. High-throughput phenotyping platforms.
48. High-throughput genotyping platforms

B) Practicals

1. Floral biology, selfing and crossing techniques in self- pollinated species – rice, groundnut
2. Floral biology, selfing and crossing techniques in cross- pollinated species – maize/castor
3. Floral biology, selfing and crossing techniques in often cross-pollinated species redgram/cotton.
4. Techniques of seed production in self pollinated crops using three line (A/B/R lines) and two line systems in self and cross pollinated crops.
5. Understanding the difficulties in hybrid seed production.
6. Tools and techniques for optimizing hybrid seed production
7. Concept of rouging in seed production plot.
8. Concept of line, its multiplication and purification in hybrid seed production.
9. Role of pollinators in hybrid seed production.
10. Hybrid seed production techniques in rice, sorghum, pearl millet and sunflower crops.
11. Hybrid seed production techniques in maize, castor, pigeon pea and cotton crops.
12. Hybrid seed production techniques in rapeseed-mustard and vegetable crops.
13. Sampling and analytical procedures for purity testing and detection of spurious seed.
14. Seed drying and storage structure in quality seed management.
15. Screening techniques during seed processing, viz., grading and packaging.

16. Visit to public private seed production and processing plants.

Textbooks

1. Plant Breeding: Principles and Methods by B. D. Singh. Kalyani Publishers, New Delhi.
2. Breeding Field Crops by J.M. Poehlman. Springer publishers.

Suggested Readings

1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. Daya Publishing House.
2. Principles of Plant Breeding (1st & 2nd Edition) by R.W. Allard. Wiley publishers.
3. Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh. Astral Publishing, 160pp.
4. Biotechnology for Agricultural Breeding by Mangal, S. K. GeneTech Books.

COLLEGE OF AGRICULTURE
ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-ELCT 412**
Course Title	**:**	**Biotechnology of Crop Improvement**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To acquaint with biotechnological tools of crop improvement
2. To know about direct and indirect methods of gene transfer
3. To introduce about gene editing in plants
4. To provide knowledge about marker assisted breeding and genomic selection

Course Outlines

Theory

Impact of Biotechnology on crop improvement and the perspective of society; Various biotechnological techniques available for crop improvement – Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection. Biosafety regulations and their application in Agricultural Biotechnology. Somaclonal variation and its use in crop improvement; embryo culture; anther/pollen culture; somatic embryogenesis; artificial seeds; techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants. Direct and Indirect methods of gene transferin plants - Agrobacterium- Mediated gene transfer in dicots and monocots; Direct DNA delivery methods (microinjection, particle gun method, electroporation); gene targeting; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems. Introduction to genome editing – Various tools of genome editing; CRISPR - Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into CRISPR/Cas9 plasmids; electroporation of Cas9 plasmids into cells; purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing; in vitro synthesis of single guide RNA (sgRNA); using Cas9/sgRNA complexes to test for activity on DNA substrates; evaluate Cas9 activity by T7E1 assays and DNA sequence analysis; Applications of CRISPR/cas9 technology in crop plants. Marker Assisted Breeding and Genomic Selection: Introduction to various DNA-based markers and their use in marker-assisted breeding; Foreground

Selection, Recombinant Selection and background Selection; Marker-assisted backcross breeding, marker-assisted selection–success stories; Introduction to Genomic Selection.

Practicals

Agrobacterium-mediated transformation in Tobacco – preparation of construct, transfer to binary vector, transform Agrobacterium, prepare explant, Inoculation and Co-cultivation, antibiotic based selection of putative transformants, validation using PCR; Genome editing-preparation of CRISPR/CAS construct, direct transfer to plant, analysis of the targets; Planning of a MABB programme–selection of parents, crossing strategies, marker analysis.

A) Theory Lecture Outlines

Lec. No. Topics

1. Biotechnology – Impact on crop improvement – Nutrient and Food security – the perspective of society – Political stability and market restructuring.
2. Biotechnological techniques available for crop improvement – Plant tissue culture – Genetic engineering – Genome editing - Molecular marker technology (MAS) – Genomic selection - Scope and importance.
3. Plant tissue culture - Somaclonal variation – types – origin – applications – advantages – limitations – use in crop improvement.
4. Plant tissue culture - Embryo culture – Embryo rescue technique - purpose - applications – achievements.
5. Anther / pollen culture – brief procedure – factors affecting androgenesis - Applications of haploids in crop improvement – limitations – achievements.
6. Organogenesis and somatic embryogenesis – stages of somatic embryo development – general procedure – factors affecting somatic embryogenesis – applications – limitations.
7. Protoplast culture – methods of protoplast isolation – culture of protoplasts – regeneration.
8. Somatic hybridization – procedure – fusion of protoplasts - selection and culture of somatic hybrid cells - regeneration of hybrid plants – symmetric hybrids, asymmetric hybrids and cybrids – advantages and limitations of somatic hybridization - Application in crop improvement.
9. Artificial/ synthetic seed production – Desiccated systems and hydrated systems of synthetic seed production – advantages and limitations – Applications.
10. Genetic engineering - Creation of transgenic plants – Gene cloning - Steps in transgenic development.
11. Transgenic crops – Applications - Advantages and disadvantages – Ethical issues – IPRs – World scenario on GM Crops.
12. Genetic engineering - Gene transfer - Direct methods in plants - Microinjection, particle gun method and electroporation – advantages and disadvantages

13. Gene transfer - Agrobacterium-mediated gene transfer in dicots and monocots – Advantages and disadvantages.

14. Transgenic crops – importance – Bt Cotton, herbicide resistance, Flavr-savr tomato, Golden rice, Barnase – Barstar system of male sterility.

15 Biosafety – risks with genetically modified organisms – International convention –International regulations – Indian regulatory mechanism - Application in Agricultural Biotechnology.

16&17 Gene targeting – Steps – Construct preparation – Targeting the gene – Generation – Types of disruption - Applications

18,19&20 Gene silencing – Types – Transcriptional – Post transcriptional – Role in plants – Advantages and disadvantages.

21&22 siRNA - importance - Classes – biogenesis - Functions of plant siRNAs.

23 &24 miRNA – Importance -Techniques for Determining miRNA Functions in Plants – Applications – Differences between siRNA and miRNA.

25&26 RNAi – Importance – Molecular cloning - Construction of negative control vectors - Construction of shRNA/miRNA expression vectors - Construction of miRNA expression vectors – Western blotting.

27&28 Genome editing – Importance - Targeted nucleases - Restriction enzymes – ZFN - TALENs - CRISPRCas9 -Base editing - Prime editing.

29&30 CRISPR/Cas9 - Construction of donor and destination vectors - Construction of expression clones - Plant transformation – Genotype analysis.

31&32 CRISPR- Cas9 – CRISPR sgRNA design and DNA constructs - Cell culture and electroporation - Viability and albumin assays - Measuring allele alterations using Tracking of Indels – Confirmation.

33. In vitro synthesis of single guide RNA (sgRNA) – Steps – Factors affecting synthesis.

34. Cas9/sgRNA complexes to test for activity on DNA substrates – Features of complexes – Methods to know the activity.

35. CRISPR-Cas9 - Validating CRISPR/Cas9- Mediated Gene Editing - T7 endonuclease 1 (T7E1) assay – Steps – Advantages and disadvantages.

36&37 Crispr-Cas9 - Validating Crispr/Cas9-Mediated Gene Editing - Sequencing-Based Methods for CRISPR Validation - Sanger Sequencing and Tracking of Indels By Decomposition (TIDE)- Next Generation Sequencing (NGS) - Confirming Loss of Expression.

38. CRISPR- Cas9 – Applications in crop plants.

39. Regulation of Genome edited crops in India – Regulatory mechanism.

40. Markers- Morphological and Biochemical Markers.

41&42 Molecular markers – PCR based – Non-PCR based – Advantages and disadvantages.

43. Molecular markers – Applications.

44 & 45 Molecular markers – Marker assisted selection – Marker assisted backcross breeding - Steps – Applications – Examples.

46, 47 & 48 Genomic selection – Importance – Different populations – Procedure - Advantages and disadvantages.

B) Practicals

1. Plant DNA extraction by CTAB method.
2. Plasmid extraction from bacteria
3. Polymerase chain reaction.
4. Gel electrophoresis.
5. Poly acrylamide gel electrophoresis.
6. Agrobacterium-mediated transformation in Tobacco – Preparation of construct.
7. Agrobacterium-mediated transformation in Tobacco – Transfer to binary vector.
8. Agrobacterium-mediated transformation in Tobacco – Transformation of Agrobacterium
9. Agrobacterium-mediated transformation in Tobacco – Prepare explants - Inoculation and Cocultivation.
10. Agrobacterium-mediated transformation in Tobacco – Antibiotic based selection of putative transformants.
11. Agrobacterium-mediated transformation in Tobacco – Validation using PCR.
12. Genome editing-preparation of CRISPR/Cas construct.
13. Genome editing-Direct transfer to plant.
14. Genome editing-analysis of the targets.
15. Planning of a Marker Assisted Backcross Breeding programme– Selection of parents, crossing strategy.
16. Foreground, background and recombinant selection using markers.

Textbooks

1. Biotechnology: Principles and Applications by S.C. Rastogi. Narosa Publishers
2. Agricultural Biotechnology at a Glance by K.H. Singh, Ajay Kumar and Nehanjali Parmar. Sharma Publications & Distributors.

Suggested Readings

1. Principles of Gene Manipulation and Genomics by Old, R.W., Primrose, S.B & Twyman, R.M. 7th Edition. Oxford & Black Well Scientific Publications.
2. Genomes by Brown, T.A. (3rd ed.). Garland Science Pub., New York
3. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes by Sander JD and Joung JK.
4. Biotechnology: A Problem Approach by Pranav Kumar and Usha Mina. Pathfinder Publication
5. Crop Breeding and Biotechnology by Hari Har Ram. Kalyani Publications

Course No.	**:**	**AU-ELCT- 413**
Course Title	**:**	**Commercial Seed Production**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objective

1. To introduce the basic principles of planting material production at commercial scale and seed quality evaluation.

Course Outlines

Theory

General Principles of Seed Production: Raising the seed crop, Introduction, Procurement of a class of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops, Concept of apomixes, male sterility and self- incompatibility and its application in hybrid seed production of horticultural crops, Farmers participatory seed production.

General Principles of Seed Processing: Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling.

General Principles of Seed Testing: Seed testing-Introduction, Procedure of Seed testing, components of seed quality testing genetic, physical, physiological and seed health testing, Seed sampling, Types of seed sampling, Requirements of sampling, Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed, Principles of seed Germination, types of germination, biochemical and genetic basis.

Seed Industry and Seed Marketing: Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing

intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labelling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and / packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand, Role of WTO in seed marketing.

Biotechnology in Seed Technology: History of plant tissue culture, Laboratory organization, Composition of nutrient medium, Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation, Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds, Components of nutrient media for synthetic seed development, Storage of synthetic seeds, Advantages and limitations of synthetic seed production.

Practical

Planning of Seed Production, requirements for different classes of seeds in field crops – unit area and rate, Operation and handling of mechanical drying equipment; effect of drying temperature and duration on seed germination and storability seed processing equipment; seed treating equipment. Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc., Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurships visit to nearby areas, Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed-borne fungi, bacteria and viruses, identification of storage fungi, control of seed-borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micropropagation and Callus induction, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro-propagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation.

A) Theory Lecture Outlines

Lec. No. **Topics**

1. General Principles of Seed Production: Introduction to seed and seed technology – Definition of variety –Type of variety (Pureline variety, Line variety, Multiline variety, Varietal blend, Inbred line, Hybrid, Population and Clonal Crops) and their genetic constitution.
2. Seed quality - Definition, Characters of good quality seed/improved seed - Different classes of seed–Nucleus seed, Breeder seed, Foundation seed, Certified seed and Truthfully labelled seed.
3. Deterioration of crop varietal purity – Factors responsible for loss of genetic purity - Assessment of genetic purity - Safeguards for maintenance of genetic purity.
4. Agronomic principles of seed production - Selection of a suitable agro-climatic region, land and variety - Raising of crops.
5. Importance of isolation distance and rogueing- Space isolation, time isolation and barrier isolation, Roguing.
6. Apomixis – Classification – Applications - Advantages and disadvantages.
7. Male sterility - Classification – Applications - Advantages and disadvantages.
8. Self-incompatibility - Classification – Applications - Advantages and disadvantages.
9. Seed certification: History, Concept, Objectives and Procedure of seed certification – Procurement of a class of improved seeds - Reporting to monitoring or certification Agency.
10. Seed certification agency/organization and staff requirement - Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field and seed Standards
11. Principles and practices of seed production of field crops – Rice.
12. Principles and practices of seed production of field crops – Wheat.
13. Principles and practices of seed production of field crops – Maize.
14. Principles and practices of seed production of field crops – Sorghum.
15. Principles and practices of seed production of field crops – Bajra.
16. Principles and practices of seed production of field crops – Redgram& Bengal Gram.
17. Principles and practices of seed production of field crops – Groundnut.
18. Principles and practices of seed production of field crops – Sunflower.
19. Principles and practices of seed production of field crops – Castor.
20. Principles and practices of seed production of field crops – Cotton
21. Principles and practices of seed production of horticultural crops – Tomato.
22. Principles and practices of seed production of horticultural crops – Brinjal
23. Principles and practices of seed production of horticultural crops - Hot & Sweet Pepper.
24. Principles and practices of seed production of horticultural crops – Okra.
25. Principles and practices of seed production of horticultural crops – Onion.

26. Principles and practices of seed production of horticultural crops – Cucumber.
27. Principles and practices of seed production of horticultural crops - Cabbage & Cauliflower.
28. Principles and practices of seed production of horticultural crops – Carrot.
29. Principles and practices of seed production of horticultural crops – Potato.
30. Farmers participatory seed production- Concept- Advantages-Challenges.
31. General Principles of Seed Processing: Introduction- Objectives of Seed Processing, Planning, layout and establishment of seed processing plant – Factors to be considered in planning and designing a seed processing plant.
32. Seed Drying- Principle - Water vapour equilibrium - Methods of drying seeds- Sun drying – Forced air drying.
33. Seed cleaning – Pre cleaning and preconditioning equipments, Principle and method of seed cleaning –Air screen machine – Principle of cleaning – Parts of air screen cleaner.
34. Upgrading the quality of cleaned seeds - Different upgrading machines - Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids - Their principles of operation and uses.
35. Seed treatment - Temperature treatment, Chemical treatment - method of application –Equipments used for seed treatment - Bagging of seed and labelling.
36. General Principles of Seed Testing: Seed testing-Introduction- Procedure of Seed testing-Components of seed quality testing - Genetic, physical, physiological and seed health testing.
37. Seed sampling- Types of seed sampling- Requirements of sampling- Sampling Procedures.
38. Seed viability and vigour – Concepts- Tests.
39. Seed Dormancy-Types - Principles - Physiological quality of seed- Methods to overcome seed dormancy.
40. Seed Germination - Types of germination - Biochemical and genetic basis.
41. Seed Industry and Seed Marketing: Introduction - Evolution of the seed industry - Development of the vegetable and Flower seed industry.
42. Seed marketing – Concept - Definition and purpose - Importance and promotion of quality seed - formal and informal seed supply systems.
43. Seed marketing intelligence and product mix - Sales promotion-Distribution channels – Marketing costs and margins - Packaging and labelling- Seed Associations.
44. Factors influencing seed marketing - Seed marketing programs - Seed industry organizations - Marketing of public versus private players - Demand and supply of seed - Role of seed replacement rate (SRR) and seed multiplication ratio (SMR).
45. Economics of seed production- Determining seed needs - Seed pricing and price policy – seed processing and packaging - Demand forecasting and factors affecting demand for seeds - Effect of price and farm income on seed demand - Role of WTO in seed marketing.

46. Biotechnology in Seed Technology: History of plant tissue culture - Laboratory organization - Composition of nutrient medium.
47. Micro-propagation, Axillary bud proliferation approach - Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation.
48. Synthetic seed production - Types of synthetic seeds - Methods of development of synthetic seeds - Components of nutrient media for synthetic seed development - Storage of synthetic seeds – Advantages and limitations of synthetic seed production.

B) Practicals

1. Planning of seed production of different seed classes in field crops.
2. Operation and handling of seed drying, seed processing and seed treating equipment.
3. Hybrid seed production in Rice
4. Hybrid seed production in Maize and Bajra.
5. Hybrid seed production in Tomato, Chilli and Okra.
6. Visit to seed production plots.
7. Visit to seed processing plant/Commercial controlled and uncontrolled seed stores.
8. Visit to seed industries and local entrepreneurships.
9. Seed health testing of field crops and vegetable crops.
10. Seed treatment methods.
11. Maintenance of aseptic conditions and sterilization techniques.
12. Preparation of nutrient stocks for synthetic media.
13. Preparation of MS medium for micro-propagation and callus induction.
14. Selection and inoculation of explant for micro-propagation and callus induction.
15. Hardening and Acclimatization procedures for field and horticultural crops.
16. Synthetic seed preparation.

Textbook

1. Seed Technology by Agarwal, R.L. 2nd edn. Oxford & IBH Publishers.

Suggested Readings

1. Seed Production: Principles and Practices by McDonald, M.B. Jr and Copeland, L.O. Chapman & Hall Publishers.
2. An Introduction to Seed Technology by Thompson, J.R. Leonard Hill.
3. Hybrid Seed Production in Field Crops by Singhal, N.C. Kalyani Publishers.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 421**
Course Title	**:**	**Management of Natural Resources**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To Strengthen students about available natural resources and their relationship with crop production
2. To impart the knowledge of principles and practices of natural resource management

Course Outlines

Theory

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Inter relationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification. Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Introduction to soil and water conservation and causes of soil erosion., Definition and agents of soil erosion, water erosion - Forms of water erosion, Gully classification and control measures. Soil loss estimation by universal soil loss equation - Soil loss measurement techniques. Principles of erosion control- Introduction to contouring, strip cropping. Contour bund - Graded bund and bench terracing. Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures, Water harvesting techniques - Lining of ponds, tanks and canal systems.

Practical

Identifying natural resources and their utility Practicing survey - Principles and educating to use pacing technique for measurement. Area calculations through chain survey - GPS demo for tracking and area measurement. Estimation of soil loss and calculation of erosion index. Levelling concepts and practical utility in agriculture. Preparation of contour maps. Concept of vegetative water ways and design of grassed water ways. Wind erosion and estimation process. Different irrigation pumps and their constructional differences. Farm pond construction and its design aspects. Visit to nearby farm pond. Visit to an erosion site. Exposure to strip cropping/contour bunding.

A) Theory Lecture Outlines

Lec. No. Topics

1. Natural resource bases – Introduction, Concept, Classification of natural resources, Carrying capacity and ecological foot print and sustainability, sustainable development goals and sustainable portfolios
2. Natural resources of India – Types, Examples, distribution and uses - Problems associated with Natural resources
3. Factors influencing resource availability - Interrelationships among types of natural resources - Concern on Productivity issues
4. Resource management of sustainable development – Ecological dimension, social dimensions; economic dimension and integration of all dimensions

5 & 6. Land resources: Land as a resource. Types - Land Use Categories- Land-use Changes in India- Land use classification nine

7. Land resource management – Importance, Techniques, and Applications; key components - Strategies and Challenges.
8. Land degradation – man induced landslides, soil erosion and desertification - Types, factors and causes of land degradation
9. Land degradation- GLASOD classification application of GIS and remote sensing in monitoring, diagnosis and mapping of land degradation
10. Soil erosion - History, distribution, identification and description of soil erosion problems in India
11. Soil erosion- forms; impact; on-site and off-site effects; strategies for erosion control and conservation of soil
12. Water erosion - Types, forms and classification
13. Gullies and their classification stages of gully development and control measures
14. Soil loss estimation- USLE- Rainfall Erosivity factor (R)- Soil erodibility factor(K)- Topographic factor (LS)- Crop Management factor(C) – Support practice factor (P).
15. Measurement of soil erosion – Runoff plots, soil samplers – Multi slot devisor and Coshocton wheel sampler
16. Rainfall Erosivity, methods of measurement and prediction of runoff losses

17. Uses of USLE- Limitations of Universal soil loss equation- Revised Universal soil loss Equation (RUSLE) – Modified Universal soil loss equation (MUSLE)
18. soil erosion - Causes and agents - factors affecting soil erosion
19. Soil conservation in different lands (hilly, arid, semiarid, coastal and diary lands) - Impacts and activities to be taken up in soil conservation
20. Management of forest, peat and muck soils - Impacts and steps to be taken up in soil conservation
21. Landscape impact analysis, Landscape Character Assessment Criteria – Landscape quality.
22. Wetland ecology – meaning, types and management, Hydrological conditions Biological functions Site-specific conditions
23. Water resources- Use and over-utilization of surface and ground water; Natural disasters- Floods, drought, conflicts over water – dams-benefits and problems.
24. Water ecology and management - Water quality management- Water Quality Objectives and Standards- Physical Parameters- River water quality model and lake water quality model
25. Energy resources: Growing energy needs, renewable and nonrenewable sources, use and benefits of alternative energy sources- Global variations in energy use- Scenario of India.
26. Field residues- Uses of Agro-Residues as Biomass (second generation biofuel) Energy- Benefits of using agro-residue as a source of energy
27. Nuclear energy -different methods– Applications, Advantages and Disadvantages of Nuclear Energy
28. Wind erosion- forms; Factors affecting wind erosion - wind erosion equation management practices
29. Wind erosion - Mechanics of wind erosion, types of soil movement
30. Principles of wind erosion control and its control measures– Vegetative and mechanical measures
31. Soil conservation planning; land capability classification
32. Soil conservation in special problem areas - Hilly, arid and semi-arid regions water logged and wetlands
33. & 34. Resource Management Paradigms: evolution and history; paradigms- India's resource management problems- review paradigm concept, analyze, evolution and application of identified paradigms and sub-paradigms and compare global and Indian experiences.
35. Resource conflicts: Resource extraction, access and control system, The Role of Natural Resources - Environment in Fueling Conflict, The Conflicts - Efforts for Resolutions - Factors Leading to Resource Conflict and Resolving Resource Conflicts
36. Approaches in Resource Management: Ecological approach; Institutional Approach economic approach, Integrated Approach, Behavioural Approach, , , Community Based Approach and Technological Approach
37. Ethnological approach - implications; integrated resource management strategies
38. Land restoration and conservation techniques-erosion control
39. Reclamation of salt affected soils – saline soils- Alkali/ sodic soils- saline sodic or Saline – alkali soils- Management practices

40. Reclamation of saline soils - their characteristic features and Management practices
41. Reclamation of alkali /Sodic soils and their management practices
42. Reclamation of saline- sodic or Saline- alkali soils and their management
43. Reclamation of Mine land, afforestation, organic products, soil fauna and biodegradation, Mechanical methods and agronomic practices of erosion control
44. Soil and water conservation, Research centres in India and soil conservation problems in India
45. Land Use classification, principles of erosion control - Introduction to contouring, strip cropping
46. Classification of bunding system, Contour bund, graded bund and types of bench terracing
47. Water harvesting – principles, merits and demerits water harvesting, significance and issues
48. Water harvesting techniques - Lining of ponds, tanks and canal systems

B) Practical

1. Identifying natural resources and their utility.
2. Study of survey instruments, folding, unfolding of the chain and pacing technique for measurement.
3. Estimation of area through chain survey.
4. Study of GPS and DGPS.
5. Levelling concepts and practical utility in agriculture.
6. Methods of contour, direct method for locating contour, Location of contours by direct method using radial lines indirect method for locating contours – Grid method.
7. Preparation of contour map
8. Estimation of soil loss by USLE and calculation of EI.
9. Study of vegetative water ways and design of grassed water ways.
10. Estimation of Wind erosion
11. Different irrigation pumps and their constructional differences.
12. Farm Pond construction and Design.
13. Visit to farmer's farm pond.
14. Visit to a degraded land.
15. Exposure to strip cropping/contour bunding
16. Final practical exam

Textbooks

1. Sustainable Natural Resource Management by Danill R. Lynch. Cambridge University Press.
2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and B S Rathor, Daya Publishing House.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-ELCT 422**
Course Title	**:**	**Food Safety and Standards**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To develop the skills to convert raw materials into safe, attractive food products
2. To manage the production of food products
3. To use scientific knowledge to develop new products

Course Outlines

Theory

Food safety – Definition, Importance, Scope and Factors affecting Food Safety. Hazards and Risks, Type of Hazards - Biological, Chemical Physical hazards. Management of hazards – Need. Control of Parameters. Temperature Control. Food Storage. Production Design. Hygiene and Sanitation in Food Service Establishments Introduction. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control. Personnel Hygiene. Food safety Measures. Food Safety Management Tool- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc. HACCP.ISO series. TQM-concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygiene. Food laws and Standards Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food. Recent concerns - New and Emerging Pathogens. Packaging, Product labelling and Nutritional labelling. Genetically modified food/transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

Practical

Water quality analysis physico – chemical and microbiological. Preparation of different types of media. Microbiological examination of different food samples. Assessment of surface sanitation by swab/rinse method. 54 Assessment of personal hygiene. Biochemical tests for identification of bacteria. Scheme for the detection of food borne pathogens. Preparation of plants for Implementation of FSMS-HACCP, ISO: 22000.

A) Theory Lecture Outlines

Lec. No. Topics

1. Food Safety – Introduction, Importance of Food Safety in Public Health, Scope in the Food Industry
2. Factors Affecting Food Safety - Factors influencing food safety (biological, environmental and handling) – Food borne Illnesses: examples and impact
3. Food Hazards and Risks - Definition, Difference between hazards and risks
4. Types of Hazards in Food Safety – Biological Hazards (Bacteria, viruses, fungi, parasites) - Potential risks of foodborne bioterrorism, Bioterrorism protection - The role of pest management in biosecurity
5. Chemical Hazards in Food Safety (Food additives, toxins, allergens, Pesticides, heavy metals, and environmental contaminants) - True Food Allergy - Food Intolerance - Regulatory requirement - Allergen Management, Ingredients, Production, Packaging and Labelling, Sanitation and Allergen Control, Disposition/Liability
6. Physical Hazards in Food Safety - Foreign materials - Detection and prevention methods – Role of Sanitation in Physical Hazard Prevention
7. Hazard Management in Food Safety - Importance - Overview of Hazard Control Strategies
8. Control Parameters in Food Safety - Critical control points (CCPs) in the food production process, Control parameters: Temperature, time, pH, etc.
9. Temperature Control in Food Safety - Importance, Refrigeration, freezing, cooking, and hot holding standards
10. Food Storage Guidelines - Principles, Types of storage (Dry, cold, and frozen, FIFO (First In, First Out) method, Low- Moisture Food Manufacturing and Storage Sanitation) Receipt and storage of raw materials, Sanitary construction considerations, Cleaning of low- moisture food manufacturing plants
11. Production Design for Food Safety - Plant layout and design considerations, Prevention of cross contamination; Principles of sanitary facility design
12. Hygiene and Sanitation in Food Service Establishments - Introduction and Importance in maintaining food safety
13. Sources of Contamination and Control - Common sources of contamination (air, water, equipment), Transfer of contamination, Protection against contamination.
14. Waste Disposal in Food Safety - Safe disposal of food waste, Impact of waste on food safety and environment; Waste disposal Strategy. Planning and survey of waste disposal (Solid and Liquid).
15. Pest and Rodent Control in Food Establishments - Types of pests and impact on food safety, strategies of Integrated pest management (IPM)
16. Personnel Hygiene in Food Safety - Role of food handlers in preventing contamination, - practices and regulations

17. Food Safety Measures - Overview, Preventative practices in food establishments
18. Introduction to Food Safety Management Tools - Overview - Key terms: PRPs, GHPs, GMPs, SSOPs
19. Good Hygiene Practices (GHPs) - GHPs in food service establishments, Specific practices like personal and facility hygiene
20. Good Manufacturing Practices (GMPs) - Guidelines, Importance in maintaining product quality- Employee GMPs
21. Sanitation Standard Operating Procedures (SSOPs) - Importance of SSOPs in food safety, components of effective SSOPs
22. Hazard Analysis and Critical Control Point (HACCP)- Introduction to HACCP principles, HACCP as a food safety management tool
23. Steps for implementing HACCP in food production, Development of HACCP plan
24. ISO Series and Food Safety Management - Overview and Role of ISO 22000 in food safety management
25. Total Quality Management (TQM) in Food Safety – Introduction, Role, Concept of continuous improvement (Kaizen) in food safety, Quality assurance for effective sanitation; Quality assurance program
26. Components of TQM in food production - Employee involvement Importance in TQM
27. Risk Analysis in Food Safety - Risk assessment, Role, Communication and management of risk analysis in food safety decision-making
28. Accreditation and Auditing in Food Safety - Importance of food safety accreditation and certification, Conducting internal and external food safety audits
29. Water Analysis in Food Safety - Importance of water quality in food safety, Water testing methods and standards
30. Surface Sanitation and Personal Hygiene – Importance, Methods, Effects of on soil deposition, Soil attachment characteristics, Cleaning compound characteristics, Classification of cleaning compounds Cleaning auxiliaries, Scouring compounds,
31. Food Laws and Standards: Introduction - Overview Role; Sanitation Regulatory Requirements, FDA, Food Safety Modernization Act of 2011, USDA, Sanitation Standard Operating Procedures (SSOPs), Sanitation Performance Standards (SPSs), European Food Safety Authority.
32. Indian Food Regulatory Regime: FSSA - Introduction guidelines and regulations
33. Global Scenario- Codex Alimentarius Commission (CAC) - Role in food safety, International food standards set by CAC
34. Other Food Laws and Standards - Overview, Food safety standards in different countries
35. Emerging Concerns: New Pathogens - Identification of new and emerging pathogens, Recent foodborne outbreaks caused by pathogens, Control of Listeria in food manufacturing, Biofilm formation and its Removal

36. Packaging and Food Safety - Role, Types and their safety concerns
37. Product and Nutritional Labelling - Importance and nutritional labelling requirements
38. Genetically Modified Foods (GMOs) and Food Safety - GM foods, Safety, labelling and regulations
39. Organic Foods and Food Safety - Defination - safety concerns, Organic certification standards.
40. New Approaches to Food Safety - Introduction to innovative technologies viz., nanotechnology and block chain technology, Role of emerging technologies for improving food safety
41. Recent foodborne illness outbreaks - Case studies, Causes and preventive measures
42. Food Safety Standards for Dairy and Meat Products - Specific food safety standards for animal derived products, - Veterinary controls in food safety - Role
43. Food Safety Standards for Plant- Based and Fermented Products - Food safety concerns for plant based foods, Food safety management for fermented foods
44. Food Safety in Marine Products - Hazards associated with marine and seafood products, International standards for seafood safety
45. Food Safety and Public Health - Role of food safety in preventing public health crisis, Impact of food safety measures on population health
46. Recent Concerns in Food Safety: Nanotechnology and Food Safety - Nanotechnology applications, Regulatory concerns and potential risks
47. Food Safety and the Global Trade - Importance in international trade,
48. Challenges faced by exporting and importing countries.

B) Practicals

1. Analyze the basic physico-chemical & microbiological properties of water samples.
2. Assess the microbiological quality of water by detecting coliforms.
3. Preparation of different types of culture media
4. Microbiological examination of milk.
5. Microbiological examination of fruits and vegetables.
6. Microbiological examination of processed food samples.
7. Assessment of surface sanitation by swab method.
8. Assessment of surface sanitation by rinse method.
9. Assessment of personal hygiene
10. Biochemical tests for identification of bacteria (Iodine test, Citrate test, Urease test).
11. Biochemical tests for identification of bacteria (Catalase test, Coagulase test, Oxidase test).
12. Isolation of Salmonella from poultry products using selective enrichment.
13. Isolation of Escherichia coli from raw meat products.
14. Scheme for the detection of food borne pathogens
15. Identification of critical control points in food processing
16. Preparation of plans for implementation of FSMS – HACCP, ISO: 22000

Textbook

1. Text book of Food Science and Technology: Avantina Sharma. CBS Publishers and Distributors Pvt. Ltd.

Suggested Readings

1. Handbook of Food Safety: D.S.L. Khatekar and N. Sarkate. Step Up Academy, 576p.
2. Food and Beverage Management: Bernard Davis. Andrew Lockwood, Ioannis Pantelidis, Peter Alcott Routledge
3. Food safety and Quality Control: Pulkit Mathur. The Orient Blackswan.332p.
4. Safe Food Handling: HACCP booklet for Food Handlers. Cletus Fernandes, Notion Press.

Course No.	**:**	**AU-ELCT- 423**
Course Title	**:**	**Biopesticides and Biofertilizers**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases

2. To provide knowledge on principles, methods, and mechanism of bio fertilizers and their use in agriculture

Course Outlines

Theory

History and concept of bio pesticides. Importance, scope and potential of bio pesticides. Definitions, concepts and classification of bio pesticides viz. Pathogen, botanical pesticides, and bio rationales. Botanicals and their uses. Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of bio pesticides. Methods of quality control and Techniques of bio pesticides. Impediments and limitation in production and use of bio pesticides. Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers –Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cynobacterial bio fertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers – AM mycorrhiza and ectomycorhiza. Nitrogen fixation –Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertiizers. FCO specifications and quality control of biofertilizers . Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.

Practical

Isolation and purification of important biopestisides: trichoderma Pseudomonas, Bacillus, Metarhyziumetc. and its production. Identification of important botanicals. Visit to biopesticide

laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides. Isolation and purification of Azospirillum, Azotobactor, Rhizobium, P-solubilizers and cyanobacteria. Mass multiplication and inoculums production of biofertilizers. Isolation of AM fungi- Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

A) **Theory Lecture outlines**

Lec. No. **Topics**

1. History and evolution of bio-pesticides
2. Concept – importance - scope and potential of bio-pesticides in sustainable agriculture
3. Bio-pesticides - Definitions, concepts and classification
4. Categories of bio-pesticides: Pathogens, botanicals and bio rationales
5. Botanical pesticides: Sources, properties and uses
6. Important botanicals: Neem, pyrethrum, tobacco, pongamia, custard apple, etc.
7. Mode of action of botanical pesticides
8. Advantages and limitations of botanical pesticides
9. Microbial bio-pesticides: Bacteria, fungi, viruses and nematodes
10. Entomo pathogenic bacteria: *Bacillus Thuringiensis* and others
11. Entomo pathogenic fungi: *Beauveria*, *Metarhizium*, *Verticillium*
12. Entomo pathogenic viruses: NPV and GV
13. Entomo pathogenic nematodes: Characteristics and role in pest control
14. Concepts of virulence and pathogenicity in entomo pathogens
15. Symptoms of infection caused by entomo pathogens and nematodes
16. Environmental factors influencing efficacy of bio-pesticides
17. Mass production technology of bacterial bio-pesticides
18. Mass production technology of fungal bio-pesticides
19. Mass production technology of viral bio-pesticides
20. Mass production of entomo pathogenic nematodes
21. Formulation of bio-pesticides and carriers used
22. Methods of application of bio-pesticides (seed, soil, foliar, baiting)
23. Methods of quality control and standards of bio-pesticides
24. Storage, shelf life and packaging of bio-pesticides
25. Constraints, impediments and limitations in production and use of bio-pesticides
26. Role of bio-pesticides in IPM and organic farming
27. Introduction, history, status and scope of bio-fertilizers
28. Classification and types of bio-fertilizers
29. Structure and characteristic features of bacterial bio-fertilizers

30. *Azospirillum*: Characteristics and role in agriculture
31. *Azotobacter*: Characteristics and role in agriculture
32. *Bacillus* and *Pseudomonas* as bio-fertilizers
33. *Rhizobium*: Symbiotic association and nitrogen fixation
34. *Frankia*: Actinorhizal symbiosis and importance
35. Cyanobacterial bio-fertilizers: *Anabaena*, *Nostoc*, *Hapalosiphon*
36. Fungal bio-fertilizers: AM mycorrhiza and ectomycorrhiza
37. Nitrogen fixation: Free-living nitrogen fixation
38. Nitrogen fixation: Symbiotic nitrogen fixation mechanism
39. Mechanism of phosphate solubilisation by microorganisms
40. Phosphate mobilization and potassium solubilisation
41. Strain selection for bio-fertilizer production
42. Sterilization, growth and fermentation techniques
43. Mass production of carrier-based bio-fertilizers
44. Mass production of liquid bio-fertilizers
45. FCO specifications and quality control of bio-fertilizers
46. Application technologies: Seed, seedling, tuber, sett treatments, soil application
47. Storage, shelf life, marketing and distribution of bio-fertilizers
48. Factors influencing the efficiency and field performance of bio-fertilizers

B) **Practicals**

1. Isolation and purification of Trichoderma from soil on selective media; mother culture maintenance and small-scale production
2. Isolation and purification of Pseudomonas fluorescens; colony characterization and mass multiplication
3. Isolation and purification of Bacillus spp. (including *B. thuringiensis*); spore staining and culture production
4. Isolation and purification of Metarhizium anisopliae from infected insects/soil and its multiplication
5. Identification of important botanical pesticides
6. Visit to a bio-pesticide production laboratory/unit to study commercial production procedures
7. Field visit to collect and observe naturally infected insect cadavers
8. Identification of entomopathogenic fungi, bacteria, viruses and nematodes under field/lab conditions
9. Quality control tests of bio-pesticides (CFU count, spore count, viability test, contamination check)
10. Isolation and purification of Azospirillum, Rhizobium, Azotobacter from soil/root nodule samples
11. Isolation of phosphate-solubilizing microorganisms

12. Isolation of cyanobacteria (*Anabaena, Nostoc*) from paddy fields
13. Mass multiplication and inoculum production of carrier-based bio-fertilizers
14. Preparation of liquid bio-fertilizer formulations
15. Isolation of AM fungi spores by wet sieving and decanting method and by sucrose gradient centrifugation method
16. Mass production of AM fungal inoculants using pot culture technique

Textbook

1. Beneficial Microbes as Biofertilizers and its Production Technology by Borkar,S.G.

Suggested Readings

Biopesticides

1. Biological Control of Plant Pathogens by Baker, E.F. and James, R.C. American Phytopathological Society
2. Plant microbe interactions and Biological Control by Boland, G.J. and David, L. Kuykendall Marel Dekker, INC.
3. General Concepts of Integrated Pest and Disease Management by Ciancia, A. and Mukerji, K.J. Edited Published by Springer.
4. Biological Control of Plant Diseases by Cincholkar, S.B. and Mukherji, K.G. Hawarth Food and Agricultural products.
5. Biological control of crop Disease by Gnanamanickam, S.S. Kuykendall Marel Dekker, INC.
6. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India by Ramanujam, B. and Rabindra, R.J. Precision Fototype Services Bangalore.
7. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds by Singh, S.P. and Hussanini, S.S. Precision Fototype Services Bangalore.

Biofertilizers

1. Handbook of Microbial Biofertilizers- Dr. Awani Kr. Singh, Agrotech Press, Jaipur, India
2. Biofertilizers for Sustainable Agriculture- Sampat Nehra, Aavishkar Publishers, Jaipur, India
3. Organic Farming- A.K. Singh, New India Publishing Agency, New Delhi
4. Earthworm Vermiculture and Vermicomposting, R.K. Bhatnagar, R.K. Palta, Kalyani Publishers

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-ELCT- 424**
Course Title	**:**	**Geoinformatics and Remote Sensing, Precision Farming**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. Enabling students acquire knowledge on basics of remote sensing technique for precision farming applications.
2. To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management.

Course Outlines

Theory

Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in atmosphere; Interaction with matter, Application of remote sensing techniques land use soil surveys, crop stress and yield forecasting, Advantages and disadvantages of remote sensing, Remote sensing institutes in India, Basic Concepts about geo informatics. What is artificial intelligence; History of artificial intelligence, Fundamentals of big data & machine learning (ML), Use of artificial intelligence in autonomous systems: agricultural robots and drone monitoring systems, driverless tractors, automated sprinklers and self-harvesting machines etc.; Use of AI in crop analysis: monitoring soil quality, promoting organic crops, monitoring weeds, precision agriculture, using drones for crop analysis; Role of AI for sustainability and climate change, yield and demand forecasting, food tech/wider value chain including impact of block chain, AI use for in the emerging markets; Technology deployment like sensors , AI and agricultural technologies and How to scale AI for agricultural technologies applications, Responsible AI in agriculture, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents.

Practical

Familiarization with different remote sensing equipments and data products, Interpretation of aerial photographs and satellite data for mapping of land resources, Global positioning system

(GPS), Basics of Geographic Information System (GIS), Georeferencing of toposheets, 50 Live examples and case study of AI use in Agriculture, Search and Control strategies: Blind search, Breadth -first search, Depth First search, Hill climbing method, Best First search, Branch and Bound search, Programming in Prolog Syntax and meaning of Prolog Programs. Using Data Structures. Controlling Back tracking. Input and Output. Built-in Predicates, Using Prolog Grammar Rules. Higher level assignments/exercises for implementation using Prolog.

A) Theory Lecture Outlines

Lec. No. Topics

1. Precision Farming: Overview, Concepts, principles; historical development and components (RS, GPS, GIS, aerial systems)
2. Precision Farming - trends and Government initiatives (central and state); advantages and limitations at central and state level in Indian context
3. Geoinformatics: Definition, concepts, usage and techniques (Remote Sensing, GIS, GPS) in precision farming
4. Global Positioning System (GPS): Components, advances and applications
5. Data sources for precision farming: Satellite, aerial and UAV platforms; Remote sensing – Definition, Introduction, Historical Development and platforms
6. Remote sensing; Types and major remote sensing institutes in India (NRSC, IIRS, ISRO)
7. Remote sensing of: Principles, components; Electromagnetic spectrum, energy interaction with atmospheric, spectral reflectance
8. Radiation propagation in the atmosphere: Scattering, absorption and reflection
9. Interaction of radiation with matter-reflection, transmission, and absorbtion in soil, vegetation and water; remote sensing sensors
10. Spectral signatures ; concept and types of resolution: Spatial, spectral, temporal and radiometric
11. Hyperspectral and thermal remote sensing; thermal imaging for precision agriculture
12. Aerial photographs: Types, characteristics and interpretation
13. Unmanned Aerial Vehicles (UAVs): Components, types, sensors, uses, advantages and limitations
14. Advantages and disadvantages of remote sensing in agriculture
15. Pre-processing of satellite images: Geometric, atmospheric and radiometric correction
16. Image processing: Enhancement, feature extraction, segmentation and fusion
17. Geodesy: basic principles; laser leveling for precision farming; spatial data concepts
18. GIS in agriculture: Spatial data management, mapping techniques and data analysis
19. Variable Rate Technology (VRT): Components, sensors, GPS/geospatial data, software and machinery
20. Crop discrimination and yield monitoring techniques
21. Crop modeling: Types, advantages and disadvantages

22. Interpretation of remote sensing data: Basics of Machine Learning: Random forest, SVM, ensemble methods; Basics of Deep learning; Classification and change detection Data sharing in precision agriculture: Open data, cloud computing, interoperability and standards
23. Introduction to Expert Systems: introduction, Definition, components and rule-based systems; Characteristics and features of Expert Systems- Knowledge base, inference engine and learning capability
24. Features of Expert Systems-Performance improvement over time, reasoning and decision making capabilities
25. Applications of Expert Systems in disease diagnosis, scheduling irrigation and fertilizer management
26. Importance of Expert Systems in Precision Farming-Decision Support, Efficiency Improvement, and Resource Optimization, Automation in decision-making, increasing efficiency and reducing human error,
27. Rule-Based System- Architecture- Structure and function, forward and backward chaining
28. Software agents in agriculture: Definition, Role, Autonomous agents, intelligent behavior and applications
29. Block chain concepts in agriculture: Definition, Overview, Application, Traceability, data security impact and smart contracts, Secure Data Transactions, and Farm-to-Market Transparency
30. Introduction to Probability and Statistics- Definitions, Overview of probability, random variables, probability distributions Role in Data Analysis, and Application in Precision Agriculture, Bayes Theorem and its Application in Precision Farming-Conditional Probability, Decision- Making, and Risk Assessment in Crop Management Correlation and covariance in agricultural data analysis
31. Precision Farming Data Analysis: Correlation and Covariance - Relationships between Data Patterns, Variables, and Precision Insights
32. Probability Distribution Functions and Continuous Random Variables-Probability Distributions (Normal and Poisson) and Relevance in Agriculture
33. Central Limit Theorems -Importance- Explanation, Predictive Modelling and Applications in Data Aggregation
34. Machine Learning in Precision Farming- Introduction to Machine Learning Algorithms, Applications, Random Forest Algorithm for Agricultural Data Analysis Concepts, Feature Importance, Prediction and Application in Crop Classification.
35. Support Vector Machines (SVM) in Precision Agriculture-Explanation, Applications in Disease Detection and Crop Monitoring Ensemble Methods in Machine Learning for Agriculture-Bagging, Boosting, Stacking, and their Applications in Precision Agriculture

36. Deep Learning in Precision Farming- Introduction to Neural Networks, CNN, RNN, and Deep Learning Applications in Agriculture
37. Deep Learning Models in Agriculture- Model Training, Data Preparation, Hyper parameters and under fitting/over fitting.
38. Application of remote sensing in various fields- Agriculture, forestry, weather monitoring, crop area estimation, flood mapping etc.
39. Site-specific crop management: Precision nutrition, irrigation, weed and vegetation indices, crop health management;
40. Use of Remote sensing applications in soil and fertility variability mapping; land use/land cover
41. Use of Remote sensing for soil surveys: Texture, moisture, erosion and salinity mapping
42. Use of Remote sensing for crop stress detection and yield forecasting
43. Hyper spectral remote sensing for soil nutrient mapping Definition and importance Crop Monitoring, and Soil Nutrient Mapping
44. Thermal remote sensing for irrigation management and crop stress Monitoring
45. Proximal soil and plant sensors: Types and applications in nutrient and canopy monitoring and Applications; Plant Canopy Sensors, Nutrient Deficiency Monitoring, and Canopy Cover Analysis
46. Future trends in precision farming: IoT, robotics, big data and automation; AI applications
47. Introduction to Artificial intelligence, Robotics in precision farming and its applications
48. Nanotechnology in precision agriculture: Nano fertilizers, Nano herbicides, Nano sensors and applications

B) Practicals

1. Familiarization with remote sensing equipment: Optical, thermal and microwave sensors; operation and data acquisition
2. Remote sensing data products: Multispectral, hyperspectral, LiDAR and radar data; spatial, spectral and temporal resolution; data formats (GeoTIFF, HDF)
3. Interpretation of aerial photographs: Scale, distortions, relief displacement and identification of land features
4. Satellite data interpretation for land resource mapping: LULC mapping, NDVI, SAVI, supervised and unsupervised classification
5. Introduction to Global Positioning System (GPS): Principles, receiver operation, ground control points (GCPs), differential GPS and accuracy
6. Fieldwork using GPS: Collection of waypoints, tracks and routes; integration of GPS data into GIS
7. Basics of Geographic Information System (GIS): Spatial and attribute data, raster and vector models, GIS software (QGIS/ArcGIS)
8. Georeferencing using toposheets: Coordinate systems, projections, transformation methods and error rectification

9. Digital soil mapping using remote sensing and GIS: Mapping soil texture, moisture and salinity
10. Digital soil mapping using soil variables: pH, organic matter, nutrients and soil health assessment
11. Fertilizer recommendations using Variable Rate Technology (VRT) and Soil Test Crop Response (STCR) approaches
12. Crop stress monitoring using geospatial technologies and UAVs for crop damage assessment
13. Conduct of agricultural surveys and watershed mapping using GPS
14. Use of GPS for crop yield estimation and field data collection
15. Geostatistics in agriculture: Spatial interpolation (IDW, Kriging) and analysis of soil and crop variability; practical use of PCA, regression and clustering with software tools
16. Creation of productivity zones and management zones using GIS and geostatistical tools

Textbook

1. Advances in Geo informatics Remote Sensing and GIS by Bhunia, Gouri Sankar, Uday Chatterjee and Gopal Krishna Panda. BIOGREEN.

Suggested Readings

1. Data Analytics in Bio informatics: A Machine Learning Perspective. Editor(s): Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy and Sachi Nandan.
2. Machine Learning Approaches to Bioinformatics by Zheng Rong Yang.
3. Text Book of Remote Sensing and Geographical Information Systems by M. Anji Reddy.
4. Principles and Theory of Geoinformatics by P.K. Garg. Khanna Publishers. 296p
5. Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes by John Adamssen. Efalon Acies.
6. Remote Sensing and Image Interpretation, Lilisand, 6th edn (WSE) Paperback–1 January 2011, Willey Student Edition.
7. Remote Sensing and Geographic Information by A.M. Chandra and S.K. Ghosh. Narosa.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 425**
Course Title	**:**	**Food Science and Nutrition**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives:

To impart knowledge on the biochemical aspects of various nutrients and their interactions in foods during processing, storage and deterioration

Course Outlines

Theory

Introduction on fundamentals of foods and human nutrition; Basic food groups; Concept of balanced diets; Recommended Daily Allowances (RDA) for various age groups; Biochemical composition, energy and food value of various food grains, fruits and vegetables; Carbohydrates, proteins, fats as nutrients and their interactions; Physiochemical, functional and nutritional characteristics of essential nutrients - sources and functions, Nutritional requirements, malnutrition, inborn errors of metabolism, deficiency diseases; Digestion, absorption, transport and metabolism of nutrients in human system; Protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinutritional factors and biochemistry of post - harvest storage, losses during processing. Effect of cooking, processing and preservation on nutrients of different food products, biochemical aspects of food spoilage; Food fads, food safety and quality standards. Enzymes in food industry, food additives, nutritional quality of plant, animal, dairy, marine and fermented products.

Practical

Proximate analysis of foods; calorific value of foods; Estimation of vitamins, phenols and flavonoids, carotenoids, antinutrients like Phytate/ Oxalate, Trypsin and Chymotrypsin inhibitor activities, limiting amino acids in food stuff.

A) Theory Lecture Outlines

Lec. No. Topics

1. Fundamentals of foods and human nutrition – Introduction, Definition of food, nutrients, nutrition and health, specific nutrients in foods and functions
2. Basic food groups - Types (grains, vegetables, fruits, proteins, dairy products) and nutritional facts.
3. Balanced diets – Definition, Concept, Importance, health benefits and risks of imbalanced diets.
4. Recommended Daily Allowances (RDA) – Definition, calculation, significance for different age groups based on sex, age, activity level and physiological state.

5&6. Biochemical composition of grains and pulses - Energy and food value of various food grains, fruits and vegetables - Nutritional contribution to diet.

7&8. Carbohydrates, Carbohydrates as nutrients - Definition, types of carbohydrates. proteins, fats as nutrients and their interactions -

9. Proteins as nutrients - Definition, and Types.
10. Fats and Lipids - Definition, types of fats (saturated, unsaturated, trans fats) - Relation between the metabolism of carbohydrates, proteins and fats.
11. Characteristics of essential nutrients (Physiochemical, functional and nutritional), sources and functions - Physiochemical characteristics of carbohydrates, dietary sources and biological functions of carbohydrates viz., energy storage, glycemic index and glycemic load).
12. Physiochemical characteristics of proteins, dietary sources and biological functions of proteins viz., emulsification, gelation, foaming, importance in muscle, enzyme, and hormone synthesis.
13. Physiochemical characteristics of fats, dietary sources and biological functions of fats viz., emulsification, lipid solubility and energy storage.
14. Nutritional requirements – for different ages, impact of age on metabolism and nutrient absorption

15&16. Malnutrition - Definition, causes and symptoms of kwashiorkor and marasmus - Differences between kwashiorkor and marasmus, prevention and strategies for treatment.

17. Inborn errors of metabolism - Definition, common Examples like Phenylketonuria, Lactose Intolerance.
18. Deficiency diseases - Vitamin deficiencies, Micro nutrient deficiencies (Iron, Iodine), prevention strategies (fortification, supplementation).
19. Digestion, absorption, transport of nutrients - Digestion of carbohydrates, enzymes in carbohydrate digestion, simple sugars absorption in the small intestine.
20. Digestion of proteins, enzymes in protein digestion like gastric and pancreatic enzymes amino acid absorption and transport.
21. Digestion of fats - enzymes involved (Lipase activity) and fat absorption in the small intestine, transport of lipids (Chylomicrons, Lipoproteins).

22 &.23. Metabolism of nutrients – Overview, Inter conversion of nutrients (Gluconeogenesis, Lipogenesis).

24. Protein quality evaluation - Methods and importance - Biological value and Net protein utilization.

25. Biochemical and nutritional aspects of water - soluble vitamins - Sources and functions and their deficiency symptoms.

26. Biochemical and nutritional aspects of fat - soluble vitamins - and their deficiency diseases.

27&28. Minerals - Macro and micro minerals in foods sources, functions and deficiency diseases.

29. Nutraceuticals - Definition, food sources, importance in diet, health benefits of nutraceuticals.

30&31. Antioxidants in foods - Definition, food sources, role in preventing oxidative stress, importance in diet - Antinutritional factors - Definition, food sources, types (Phytates, Oxalates).

32&33. Biochemistry of post - harvest storage of food grains - Nutritional losses during processing (milling, peeling and cooking on nutrients) - Strategies to minimize nutritional losses.

34. Effects of cooking on nutrient composition of foods - Impact of heat, water and light on nutrients.

35. Effects of Cooking on carbohydrates, proteins, and fats - Nutrient preservation in cooking methods - Energy density and caloric value.

36. Processing and preservation of nutrients - Causes of spoilage of food - Factors contributing to spoilage (temperature, moisture), impact of food preservation on nutrient retention.

37. Effect of preservation on vitamins, minerals and antioxidants - Methods of Food preservation (canning, freezing, drying).

38 & 39 Food Fads and Myths - importance of evidence - based nutrition - Food safety standards - National and International Perspectives - food safety regulations overview (FSSAI, FDA, Codex).

40 & 41 Strategies for Foodborne Illnesses and prevention - Importance of food safety for public health - Food quality control and certification systems Role of quality standards in nutrition security - Food quality Measures.

42. Food industry enzymes - Role, its applications in food processing (amylases, proteases), role of enzymes in fermentation and preservation.

43. Food additives - Definition, types of food additives viz., preservatives, colorants, emulsifiers.

44. Nutritional quality of plant - based foods - grains and vegetables - Role of vegetables in disease prevention.

45. Nutritional quality of animal - based foods - meat, poultry and dairy - Nutritional benefits of meat and dairy in diet.

46. Nutritional quality of marine products - fish and seafood, omega - 3 fatty acids and heart health benefits - Comparison of Nutrients different seafood types.

47& 48 Nutritional quality of fermented foods - Overview (Yogurt, Sauerkraut, Kimchi) - Future directions, current trends in food science and nutrition research.

B) Practicals

1. Determine the moisture content of a food sample using oven drying or moisture analyzer

2. Determination of the total ash content in food.
3. Determination of crude fat content in food using Soxhlet extraction.
4. Determine the crude protein content of food using the Kjeldahl method.
5. Estimate the crude fiber in food by acid and alkaline digestion.
6. Measure the calorific (energy) value of a food sample using a bomb calorimeter.
7. Estimate the vitamin C (ascorbic acid) content in food using iodine titration.
8. Measure the total phenolic content in a food sample.
9. Measure the total flavonoid content in food using a colorimetric method.
10. Estimate the total carotenoid content in food using solvent extraction.
11. Estimate the phytate (antinutrient) content in a food sample using the Wade reagent.
12. Estimate oxalate content in food using titration.
13. Measure trypsin inhibitor activity in a food sample using enzyme inhibition assay.
14. Measure chymotrypsin inhibitor activity in a food sample.
15. Determine the limiting amino acid (e.g., lysine) in a food sample using chromatography or chemical methods.
16. Estimate methionine content in food using a chemical method (e.g., performic acid oxidation).

Textbook

1. Food Science and Nutrition by Dharmesh Kumar.

Suggested Readings

1. Fennema's Food Chemistry by Damodaran, S. and Parkin, K.L. CRC Press
2. Introduction to Human Nutrition by Gibney, M.J., Lanham - New, S.A., Cassidy, A. and Voster, H.H. Wiley - Blackwell.
3. Nutritional Biochemistry by Trueman, P. MJP Publishers
4. Fundamentals of Food and Nutrition by Rekhi, Tejmeet and Yadav, Heena. Elite Publishing House. 257p.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 431**
Course Title	**:**	**Bioformulation and Nanoformulation**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To enable students to acquire expertise and skill to develop bioformulation and nanoformulation
2. To know the importance of biopesticides and biofertilizers
3. To make the students know about various techniques involved in biofertilizers and biopesticides production
4. To get knowledge on essential oils, botanicals, predators, parasitoids, pheromones, and parapheromone and their application in insect pest management
5. To get concepts on agrochemical formulations with nanoparticles and acquaint them with nanotechnology.

Course Outlines

Theory

Introduction and history of biological control of pests and diseases; Microbial biopesticides: the global and Indian market scenario; biopesticides for organic agriculture; Different phytopathogenic biocontrol agents: Mode of action; Different entomopathogenic biocontrol agents: Mode of action; Microbial inoculants as biofertilizer candidates, Production, quality assessment and methods of application of biopesticides and biofertilizers; Regulatory system of biopesticides in India; Formulations of plant essential oils, botanicals, pheromone, and parapheromone and their application in insect pest management; Use of predators and parasitoids for insect pest management; Nanotechnology: its applications in pest and disease diagnosis and management; Nano biopesticides: Concept and importance, different techniques of producing nano biopesticides; Nano Fertilizers: Concept and importance, Types of nano fertilizers; Different techniques of producing nano fertilizers; Green synthesis of nano fertilizers; green slow-release fertilizer composition based on urea-modified hydroxyapatite nanoparticles

Practical

Introduction and acquaintance with biopesticide laboratory; Preparation of culture media; Isolation and purification of bioagent from soil and infected insects; Microscopic study of different microbial bioagents; In vitro assay of microbial bioagents against plant pathogens. In vitro compatibility study among different microbial bioagents; Mass multiplication of biopesticides; Population enumeration of biocontrol agents in different biopesticides; Preparation of plant extracts and their efficacy test against insect pests; Use of pheromone parapheromone for monitoring and management of insect pests; Bioassay of Entomopathogenic biocontrol agents on insect pests; Preparation of microbial inoculants of biofertilizer microbes; Compatibility of biofertilizer microbes; Preparation of solid and liquid consortia of biofertilizer microbes

A) Theory Course Outlines

Lec. No. Topics

1. Introduction and history of biological control of pests and diseases; evolution of bioformulations and nanoformulations.
2. Microbial biopesticides – fungi, bacteria, actinomycetes, viruses, bacteriophages and nematodes; comparison with biorational pesticides and biostimulants such as chitosan.
3. Global and Indian market scenario of biopesticides; Global and Indian Scenario. No of biopesticides countrywise, bacterial and other microbial based bioformulations.
4. Role of biopesticides in organic agriculture; harmful effects of chemo-intensive agriculture and Importance, scope and potential of biopesticides and benefits of biopesticides.
5. Principles of organic farming and implications of bioformulations and nanoformulations in organic production systems.
6. Organic farming certification systems and organizations involved in certification processes.
7. Phytopathogenic biocontrol agents – classification and mode of action with reference to *Trichoderma* spp. and *Pseudomonas* spp.
8. Entomopathogenic biocontrol agents – classification and mode of action of entomopathogenic fungi (EPFs).
9. Production protocols for entomopathogenic fungi – *Beauveria bassiana*, *Metarhizium anisopliae* and *Lecanicillium lecanii*.
10. Entomopathogenic bacteria – classification and mode of action with special reference to *Bacillus thuringiensis* (Bt).
11. Biology and applications of *Bacillus thuringiensis* formulations and Bt Plant Incorporated Protectants (Bt-PIPs).
12. Production protocols for Bt toxins; classification of Bt toxins and delta-endotoxin production.
13. Entomopathogenic viruses – mode of action of NPV, GV and CPV.
14. Production protocols for Nuclear Polyhedrosis Virus (NPV) and Granulosis Virus (GV).

15. Entomopathogenic nematodes – biology and mode of action of *Steinernema carpocapsae* and *Heterorhabditis* spp.
16. Mass production of entomopathogenic nematodes – in vivo and in vitro techniques (solid and liquid culture systems).
17. Production and quality assessment of biopesticides; role of pesticide testing laboratories.
18. Microbial inoculants as biofertilizers – *Azolla*, *Azotobacter* and phosphate solubilizing bacteria (PSB).
19. Plant growth promoting microorganisms – mycorrhiza, VAM fungi and mycorrhiza-associated bacteria (MAB).
20. Concepts of Plant Growth Promoting Microorganisms (PGPM) and Plant Growth Promoting Rhizobacteria (PGPR) in plant health and growth promotion.
21. Role of PGPR in production of phytohormones, siderophores, enzymes (chitinase, lignocellulolytic enzymes), HCN and ammonia.
22. Management of virus vectors with PGPM metabolites (Foul odours and metabolites from fungal and bacterial PGPMs prevent virus vector colonization).
23. Production, quality control and storage of biofertilizers; FCO specifications and quality control of biofertilizers, Storage, shelf life, Plant infection test and marketing of Biofertilizers, Factors influencing the efficacy of biofertilizers.
24. Methods of application of biopesticides and biofertilizers – seed treatment, biopriming, seedling dip, foliar and soil application.
25. Soil inoculation and seed treatment protocols; order of seed treatment with fertilizers and biopesticides (FIR principle).
26. Role of adjuvants in enhancing biopesticide efficiency – Surfactants, transporters, protective agents and nutritional adjuvants.
27. Novel tensio-active microbial compounds such as rhamnolipids in biological control.
28. Formulation and use of botanicals and plant essential oils as biopesticides.
29. Pheromones and parapheromones – formulations and their applications in insect pest management.
30. Specialized Pheromone and Lure Application Technology (SPLAT) – formulation, application techniques and advantages over conventional lures.
31. Use of parasitoids in insect pest management – *Trichogramma*, *Bracon*, *Goniozus*, *Chelonus*, *Tetrastichus* etc.
32. Use of predators in pest management – *Chrysoperla zastrowii*, *Cryptolaemus montrouzieri*.
33. Regulatory system of biopesticides in India – role of CIBRC and accredited laboratories.
34. Introduction to nanotechnology – history, concepts and scope in agriculture.
35. Nano mission projects at the national level: Nano Mission (Nano Science and Technology Mission – NSTM), Nanotechnology initiative, GOI.

36. Classification of Nanomaterials- based on dimension and origin; 1) Inorganic-based, solid, and non-biodegradable nanoparticles (gold-, silver-, copper-, iron-, aluminium oxide, zinc oxide, titanium dioxide, cadmium sulphide and silica-based nanoparticles)
37. Classification of Nanomaterials 2) organic-based biodegradable nanoparticles (liposomes, solid lipid, and polymeric nanoparticles) and 3) hybrid nanoparticles (combination of both inorganic and organic components).
38. Engineered nanoparticles (metals and metaloxides): Engineered Metal Oxide Nanoparticles as Fungicides for Plant Disease Control- Antifungal Properties of Mono-Metal Oxide Nanoparticles - Zinc oxide nanoparticles (ZnO-NPs), Copper oxide nanoparticles (CuO-NPs), Magnesium oxide nanoparticles (MgO-NPs), etc.,
39. Applications of nanotechnology in agriculture – merits, demerits, non-target effects and safety issues.
40. Nano-biopesticides – concept, importance and types of nanoformulations for pesticide delivery (Nanocapsules, nanoparticles, nanogels, nanoemulsions, nanosuspensions, nanospheres, micelles, dendrimers).
41. Mode of action of nanopesticides in management of mosquitoes, caterpillars and stored grain pests.
42. Techniques for production of nano-biopesticides – top-down and bottom-up approaches.
43. Nano fertilizers – concept, importance and classification based on action and nutrients.
44. Types of nano fertilizers – (nano urea, nano DAP).
45. Techniques for production of nano fertilizers.
46. Green synthesis of nano fertilizers and pesticides (from leaves of *Azadirachta indica*, *Acalypha indica, Phyllanthus amarus, Calotropis gigantea* and bark extract of *Terminalia Arjuna*)
47. Slow-release fertilizer systems based on urea-modified hydroxyapatite nanoparticles.
48. Nano-pheromones – production techniques and field applications in pest management.

B) Practicals

1. Introduction and acquaintance with the biopesticide laboratory.
2. Preparation of commonly used culture media for microbial bioagents.
3. Isolation and purification of bioagents from soil and infected insect samples.
4. Microscopic study and identification of important microbial biocontrol agents.
5. In vitro evaluation of microbial bioagents against plant pathogens and compatibility studies among different bioagents.
6. Techniques for mass multiplication of important biopesticides.
7. Enumeration of biocontrol agent populations in different commercial biopesticide formulations.
8. Preparation of botanical plant extracts and evaluation of their efficacy against insect pests.
9. Use of pheromone and parapheromone traps for monitoring and management of insect pests.

10. Bioassay techniques for testing entomopathogenic biocontrol agents on target insect pests.
11. Preparation of microbial inoculants, biofertilizers and plant growth promoting microorganisms.
12. Compatibility studies of bioformulations involving biofertilizers and biopesticides.
13. Preparation of solid and liquid consortia of biofertilizer microorganisms.
14. Formulation and characterization of nanomaterials for agricultural use.
15. Synthesis of nanopesticides and nanofertilizers.
16. Applications of nanoparticles in agriculture and their practical utility.

Textbooks

1. Biological Suppression of Plant Diseases, Phytoparasitic Nematodes and Weeds by Singh, S. P and Hussanini, S. S. Precision Fototype Services, Bengaluru.
2. Nano-biopesticides Today and Future Perspectives by Koul, O. Academic Press.

Suggested Readings

1. Biological Control of Plant Pathogens by Baker, E. F and James, R. C. American Phytopathological Society, St. Paul, Minnesota, USA.
2. Microbes as Bio-Fertilizers and their Production Technology by Borkar, S. G. Woodhead Publishing India, New Delhi, India.
3. Plant microbe interactions and Biological Control by Boland, G. J and Kuykendall, L.D. Basel Marcel Dekker, Inc. Switzerland.
4. General Concepts of Integrated Pest and Disease Management by Ciancia, A and Mukerji, K. J. Springer, Dordrecht, The Netherlands.
5. Biological Control of Plant Diseases by Cincholkar, S. B and Mukherji, K. G. Hawarth Food and Agricultural products Press, New York, USA.
6. Biological Control of Crop Diseases by Gnanamanickam, S. S. Marcel Dekker, New York, USA.
7. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India by Ramanujam, B and Rabindra, R. J. Precision Fototype Services, Bengaluru.
8. Nanotechnology and Society- Current and Emerging Ethical Issues by Allhoff, F and Lin, P. Springer, UK.
9. Nanobiotechnology in Bioformulations (Nanotechnology in the Life Sciences) by Prasad, R., Kumar, V., Kumar, M and Choudhary, D. Springer, UK.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 441**
Course Title	**:**	**Agri-Business Management**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objective

To impart knowledge on understanding the concepts processes, significance, and role of management and organizational behaviour

Course Outlines

Theory

Transformation of agriculture into agribusiness, various stake holders and components of agribusiness systems, Importance of agribusiness in the Indian economy and New Undergraduate Degree Program in Natural Farming. Agricultural Policy, Distinctive features of Agribusiness Management: Importance and needs of Agro-based industries, Classification of industries and types of Agro-based industries, Institutional arrangement, procedures to set up Agro-based industries, Constraints in establishing Agro-based industries, Agri-value chain: Understanding primary and support activities and their linkages, Business environment: PEST and SWOT analysis, Management functions: Roles and activities, Organization culture, Planning, meaning, definition, types of plans, Purpose or mission, goals or objectives, strategies, polices procedures, rules, programs and budget, Components of a business plan, Steps in planning and implementation, Organization staffing, directing and motivation, Ordering, leading, supervision, communications, control, Capital management and Financial management of Agribusiness, Financial statements and their importance, Marketing Management: Segmentation, targeting and positioning, Marketing mix and marketing strategies, Consumer behavior analysis, Product Life Cycle (PLC), Sales and Distribution management, Pricing policy, various pricing methods, Project management: Definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation, Project appraisal and evaluation techniques.

Practical

Study of agri–input markets: Seed, fertilizers pesticides, Study of output markets: grains, fruits, vegetables, flowers, Study of product market, retails trade commodity trading, and value added products, Study of financing institutions- Cooperative, Commercial Bank, RRBs, Agribusiness Finance Limited, NABARD, Preparations of projects and Feasibility reports for agribusiness entrepreneur, Appraisal/ evaluation techniques of identifying viable project- Non-discounting techniques, Case study of agro- based industries, Trend and growth rate of price of agricultural commodities, Net present worth technique for selection of viable project, Internal rate of return.

A) Theory Lecture Outlines

Lec. No. Topics

1 Agribusiness – Meaning, scope, framework and dimensions

2&3 Agribusiness systems- Components: Agricultural input sector - Agricultural production sector - Agricultural processing sector - Marketing and trade sector

4 Significance of agribusiness in Indian economy and Features of agribusiness management

5 Agriculture to agribusiness – Transformation and Various stakeholders in agribusiness sector

6 Agricultural Policy of India 2000 - Objectives and Components

7 Agro based industries – Significance, Need and Types of Agro based industries

8&9 Institutional Arrangement for promotion of agro-based industries – Procedure to establish agro-based industries – Challenges in establishing Agro-based industries

10 Agri-value chain: Primary and support activities and their linkages

11 Strategic Formulation for Business Environment: PEST Analysis

12 Strategic Formulation for Business Environment: SWOT Analysis

13 Management – Definitions and concepts - Pipeline diagram & Wheel diagram

14 Management functions – Role and activities

15&16 Planning: Importance, Levels of planning, Steps in planning and Implementation, Types, and Characteristics of effective Plan

17 Components of Business Planning: Goals and objectives, Strategies, Policies, Procedures, Rules, Programmes and Budget

18 Organization function – Meaning, Definition and Purpose; Staffing – Meaning, Definition; Procedure of Staffing

19&20 Directing, Motivation, Ordering, Leading, Supervision, Coordination, Communication and Control –Concepts, Meaning and Definitions

21&22 Organization culture: Meaning, Importance and types; Conflict Management; Change Management - Group dynamics

23 Decision making and Leadership styles

24 Human Resource Management in agribusiness – Functions of HR and Role of HR Managers

25 Human resource training and development, Participative management, Labour management relations

26 Production management – Meaning and Production process, plant layout, material handling, operations planning and control

27&28 Inventory – Meaning, definition, objectives and types of inventory; Inventory management – Meaning, Definition and types of Inventory

29 Marketing management in agribusiness – Meaning and definitions: Market segmentation - types of market segmentation, Targeting and Positioning

30 Marketing Mix- The Four P's and Marketing Strategies

31 Product concept, Product line and product mix - Branding of agricultural commodities

32 Product Life Cycle (PLC) - Stages of new product development

33 Pricing policy - Types of product pricing

34 Packaging- functions and Physical distribution

35&36 Sales and distribution management - Selling, advertising, marketing research, marketing extension and supply chain management

37 Consumer Behaviour Analysis and the buying process

38&39 Capital management- Fixed capital and working capital – Meaning; Types and Significance of working capital

40,41,42 Financial management- Importance, Financial statements– Balance sheet, Cash flow statement, Profit and Loss statement, and Break Even Analysis - Meaning, components and formats of financial statements

43&44 Analysis of financial statements: Ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Turnover ratios and Profitability ratios

45 Project – Meaning and definition, Project cycle, Guidelines for project report preparation

46 Project management techniques - PERT and CPM

47 Project appraisal and evaluation techniques – Undiscounted measures and decision rules – PBP, ROR

48 Project appraisal and evaluation techniques – Discounted measures and decision rules – BCR, IRR, NPW, N/K ratio, Sensitivity analysis

B) Practicals

1 Visit to input based industries: Seed / Fertilizer / Pesticide / Machinery

2 Visit to study output market / product market: Grains / Fruits / Vegetables / Flowers

3 Study of financing institutions - Commercial Bank / Cooperative Bank / RRBs / AFL / NABARD

4&5 Financial statements – Balance sheet, Profit & loss statement – Financial ratio analysis

6 Development of business performance tracking system

7 Break even analysis / Cost volume profit analysis

8 Trend filling and growth rate analysis of prices of agricultural commodities

9&10 Time value of money: Compounding and Discounting techniques; Project appraisal techniques: Undiscounted measures - PBP, ROR; Discounted measures - NPW, BCR, IRR

11 Networking techniques in project management - PERT and CPM

12 Assessing the economic viability and financial feasibility of Agri-input firm - Case study

13 Assessing the economic viability and financial feasibility of Agri-output firm - Case study

14&15 Preparation and presentation of Business plan

16 Preparation of project feasibility report for an agribusiness entrepreneur

Textbooks

1. Textbook of Agri-business Management by Broadway A C. Kalyani Publishers, New Delhi

2. Objective on Fundamentals of Agri-business Management by Bairwa S L. Kalyani Publishers, New Delhi

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 451**
Course Title	**:**	**Soil and Water Conservation Engineering**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objective

To make the students acquainted with the different causes of soil erosion and water loss and the different measures for soil and water conservation.

Course Outlines

Theory

Soil erosion: Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion. Water erosion: Mechanics and forms- splash, sheet, rill, gully, ravine and stream bank erosion; Gullies: classification, stages of development; Soil loss estimation - Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity- estimation by KE>25 and EI30 methods; Soil erodibility- topography, crop management and conservation practice factors; Measurement of soil erosion- Runoff plots, soil samples.

Water erosion control measures: Agronomical measures, contour farming, strip cropping, conservation tillage and mulching; Engineering measures- bunds and terraces, bunds: contour and bench terraces - planning, design and layout procedure, contour stone wall and trenching; Gully and ravine reclamation- principles of gully control, vegetative measures, temporary structures and diversion drains. Grassed waterways and design. Energy and momentum principles in open channels; specific energy and specific force, hydraulic jump and its application, types of hydraulic jump, energy dissipation due to the jump.

Soil erosion control structures- Introduction, classification and functional requirements. Permanent structures for soil conservation and gully control- check dams, drop, chute and drop inlet spillways- design requirements, planning for design, design procedures- hydrologic, hydraulic and structural design and stability analysis.

Wind erosion: Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes. Land capability classification, dryland farming; Rate of sedimentation, silt monitoring and storage loss in tanks, control of sedimentation in reservoirs.

Water harvesting techniques: Classification based on source, storage and use, runoff harvesting short term and long-term techniques; Structures- farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes; Farm pond- components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction; Percolation pond - site selection, design and construction details. Design considerations of nala bunds.

Practical

Estimation of soil loss by USLE, computation of rainfall erosivity index, computation of soil erodibility index in soil loss estimation; Determination of length of slope (LS) and cropping practice (CP) factors; Estimation/ measuring techniques of soil loss; Study of rainfall simulator for erosion assessment, estimation of sediment rate using Coshocton wheel sampler and multi-slot devisor; Determination of sediment concentration through oven drying method. Calculation of rate of sedimentation and storage loss in tanks; Study on sedimentation of reservoirs; Design and layout of contour bunds and graded bunds; Design and layout of broad base terraces and bench terraces; Design of vegetative waterways; Design of shelter belts and wind breaks for wind erosion control; Farm pond- design, capacity and estimation; Hydraulic design of drop spillway; Determination of uplift

force and construction of uplift pressure diagram, structural design and stability analysis of drop spillway; Hydraulic and structural design of chute spillway, design of SAF energy dissipater; Design of drop inlet spillway; Study on components of earth embankments and its design; Design of water harvesting structures; Study on prioritization of watershed; Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures; Visit to a watershed.

A) Theory Lecture Outlines

Lec.No. Topics

1. Surveying – definition and objectives of survey, primary divisions of surveying, geodetic and plane surveys, classifications, uses of surveys.
2. Instruments used in chain survey -constructional details of metric chain, metallic and steel tapes, ranging rods, arrows, cross-staff, optical square, plumb bob and pegs.
3. Errors in length measurement due to incorrect chains, numerical problems on distance and area corrections.
4. Ranging - definition and methods of ranging, procedure for direct and indirect ranging.
5. Chain triangulation – principle, survey stations, location of survey stations, baseline, check line, tie line, offsets.

6. Plotting procedure of chain survey, conventional symbols
7. Areas of irregularly bounded fields - different methods.
8. Numerical problems on Simpson's, trapezoidal rules.
9. Leveling - definition, description of dumpy level and leveling staff. Terminology connected with leveling - datum, elevation, station, back sight, fore sight, intermediate sight, height of instrument, bench mark and its types, change point.
10. Leveling procedure - temporary adjustments in dumpy level, level field note book, recording procedure in level field note book.
11. Reduction of levels - height of collimation method, rise and fall method, and numerical problems connected with these two methods.
12. Types of leveling - simple, leveling, differential leveling and profile leveling.
13. Contour survey - definition, characteristics and uses of contours.
14. Introduction to Soil and Water Conservation and causes of Soil Erosion.
15. Design of contour bund, height of contour bund
16. Earth work computation by using contour bunding and terracing
17. Graded bunds, design of graded bunds Construction and alignment of bunds.
18. Terracing –classification, introduction to bench terraces and broad based terracing
19. Bench terraces -types planning and design
20. Design of graded terraces, runoff from terrace, and channel capacity.
21. Layout procedure of bench terracing alignment and area lost for cultivation.
22. Grassed water ways and their design.
23. Introduction to trenches and types of trenches
24. Farm pond, introduction types, selection site for farm pond.
25. Water harvesting techniques, lining of ponds, tanks and canal systems.
26. Irrigation - definition, classification of irrigation projects, benefits and ill effects of irrigation, flow irrigation and lift irrigation.
27. Wells and classification of wells, aquifers
28. Water lifting devices - classification of pumps, centrifugal pump, principle of operation.
29. Pump characteristics - pump efficiencies, capacity calculation based on irrigation scheduling, power calculations of centrifugal pump.
30. Deep well pumps – Turbine and submersible pumps, installation and working principles of these pumps.
31. Measurement of irrigation water – Importance. Methods of measuring water – volumetric and area, velocity method.
32. Direct discharge methods - water meter, weirs, orifices.
33. Parshall flume - installation of these devices, conditions for weir installation

34. Discharge calculation of rectangular and triangular weirs, advantages of parshall flume over the weirs.
35. Water conveyance systems - open channel, definitions of wetted perimeter, hydraulic radius, hydraulic slope, area of cross section and free board. Manning s formula for estimating mean velocity, side slopes of channels for different soils
36. Underground pipeline, advantages of earthen channels, disadvantages, type of pipes recommended for underground pipeline.
37. Components of underground pipe line, installation procedure, discharge calculation of underground pipe line.
38. Temporary Gulley control structures – Types brushwood dams and wiremesh dames etc.
39. Permanent Gulley control structures - Components of permanent structures and design.
40. Watershed –Introduction concept and characteristics Watershed development and identification of watersheds.
41. Indigenous micro irrigation devices.
42. Irrigation methods - sprinkler irrigation, scope, functional components of sprinkler system and their working.
43. Types of sprinkler irrigation, operation and maintenance of the system, cost economics.
44. Historical development of Drip irrigation systems advantages and limitations
45. Functional components of drip system and their working principles.
46. Water distribution system of Drip irrigation system
47. Operation and maintenance of the drip system, cost economics.
48. Rainport irrigation and Laser Irrigation system

B) Practicals

1. Study of different Components of Drip Irrigation systems
2. Study of different Components of Sprinkler Irrigation systems
3. Study of different Components of Laser Irrigation systems
4 Study of different Components of Rain Port Irrigation systems
5 Study of different filters of Drip Irrigation systems
6 Determination of Precipitation pattern, discharge and uniform coefficient
7 Evaluation of Cost Economics of Drip Irrigation system
8 Evaluation of Cost Economics of Sprinkler Irrigation system
9 Field visits of near by places of Drip Irrigation system
10 Field visits of near by places of Sprinkler Irrigation system
11 Computation of water discharge by different methods
12 Capacity calculations of open channels.
13 Design calculations of under ground pipe line systems.

14 Numerical Calculations of Irrigation efficiencies

15 Visit to Farmpond

16 Final Practical Examination

Textbooks

1. Land and water management -VVN Murthy, Kalyani Publications, New Delhi
2. Principles of Agricultural Engineering, AM Michael and TP Ojha, Jain brothers, New Delhi

Suggested Readings

1. Principles of Drip Irrigation, Mane M.S and Ayare B.L.Jain brothers, New Delhi
2. Principles of Sprinkler Irrigation, Mane M.S and Ayare B.L Jain brothers, New Delhi
3. Irrigation theory and practice, AM Michael,Vikas Publications, New Delhi

COLLEGE OF AGRICULTURE
ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 461**
Course Title	**:**	**Micro-Propagation Technologies**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objective

To educate the students in detail about the sterilization techniques for explants, preparation of stocks and working solution, culturing of explants, regeneration of whole plants from different explants and hardening procedures and hardening procedures.

Course Outlines

Theory

Introduction, History, Advantages and limitations. Types of cultures (seed, embryo, organ, callus, cell), Stages of micro propagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture), Organogenesis (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures, production of secondary metabolites, Somaclonal variation, Cryopreservation.

Practical

Identification and use of equipment's in tissue culture Laboratory, Nutrition media composition, sterilization techniques for media, containers and small instruments, sterilization techniques for explants, Preparation of stocks and working solution, Preparation of working medium, Culturing of explants: Seeds, shoot tip and single node, Callus induction, Induction of somatic embryos regeneration of whole plants from different explants, Hardening procedures.

A) Theory Lecture Outlines

Lec. No. Topics

1. Plant tissue culture: Introduction – terminology; Micro propagation – Definition, significance, meaning; Invitro culture- concept, overview, applications in agriculture and conservation history - historical milestones
2. Plant tissue culture – Procedure and General techniques
3. Plant tissue culture unit: Physical, laboratory and environmental requirement
4. Plant tissue culture: Sterilization Techniques followed in laboratory

5. Tissue culture media: Components (macro and micro nutrients, organic additions, osmotic and p^H effects, plant growth regulators, inhibitors, miscellaneous products and support systems)
6. Tissue culture media – steps in preparation, -media selection types of media- advantages and disadvantages
7. Regeneration: Genetic control -pathways of regeneration in plants
8. Micro propagation: Overview-culture types - cultures of unorganized tissues (callus cultures, suspension (or cell) cultures, protoplast cultures and anther cultures)
9. Organ culture, Meristem cultures, Shoot tip, or shoot cultures, Node cultures, Isolated root cultures, zygotic embryo cultures) patterns of growth and differentiation
10. Micropropagation- stages of micropropagation - advantages of vegetative propagation over sexual reproduction
11. Micropropagation - Factors affecting invitro stages - applications and limitations
12. Auxiliary bud proliferation - shoot tip-bud culture – meristem tip culture-production of virus free plants - virus elimination by heat treatment
13. Factors affecting virus eradication by meristem tip-virus elimination through-shoot tip grafting-callus culture-virus indexing
14. Microbial contamination- bacteria- fungus- identification- characterization– eradication methods
15. Organ culture applications techniques - shoot and root cultures: methods and applications
16. Callus culture-induction techniques-applications-significance
17. Organogenic differentiation-induction of organogenic differentiation-factors affecting shoot-bud differentiation
18. Ontogeny of shoot buds-totipotency of epidermal cells - totipotency of crown gall cells
19. Triploid production through endosperm culture and its applications
20. Factors affecting shoot-bud differentiation in endosperm culture-ontogeny of shoot buds applications of endosperm culture
21. Zygotic embryo culture-techniques-culture requirements-role of the suspensor in embryo culture morphogenesis in the cultures of seeds with partially differentiated embryos-applications
22. Pathways of pollen development
23. Haploid production-anther culture-techniques- -factors affecting androgenesis
24. Pre-treatment of cultured anthers / pollen grains-culture medium-culture density-ontogeny of androgenic haploids-plant regeneration from pollen embryos
25. Gynogenesis- production of haploids and distant hybridization-diploidization to raise homozygous diploids-applications and limitations
26. Somatic embryogenesis-factors affecting somatic embryogenesis-induction and development of somatic embryos
27. Maturation of somatic embryos- comparison between somatic and zygotic embryos-synchronization of embryo development-large scale production of somatic embryos

28. Synthetic seeds-types-desiccated synthetic seeds-hydrated synthetic seeds-applications-advantages and limitations
29. Invitro pollination-techniques- factors effecting seed set in invitro pollination and applications
30. Invitro fertilization-steps in invitro fertilization and applications; embryo rescue in wider hybridization; techniques and applications of embryo rescue
31. Invitro mutagenesis and its applications-genetic variability in the invitro system-mutagens application in invitro system-choice of mutagens in mutation breeding
32. Cell culture-isolation of single cells-from cultured tissues-suspension cultures-types-techniques culture medium for suspensions
33. Cell culture-agitation and synchronization of medium-assessment of growth in suspension cultures assessment of viability of cultured cells
34. Single cell culture-techniques and factors affecting it
35. Plant cell reactors-selection of a bioreactor -bioreactor designs-applications of cell culture
36. Cytodifferentiation-factors affecting vascular tissue differentiation-cell cycle and dedifferentiation
37. Production of secondary metabolites-natural plant products of industrial importance-strategies used to enhance the production of secondary metabolites
38. Case studies in Commercial aspects of secondary metabolite production–
39. Somaclonal variation-introduction-selection of somaclonal variants at various levels
40. Origin of somaclonal variation-mechanisms underlying genetic variation
41. Strategy to produce somaclonal and gametoclonal variants-assessment of somaclonal variation applications
42. Protoplast isolation-protoplast purification and protoplast culture techniques
43. Plant regeneration from protoplast-factors affecting yield and viability of protoplasts
44. Somatic hybridization and cybridization-protoplast fusion-methods to produce cybrids
45. Selection of hybrid cells regeneration of hybrid plants-verification of hybridity-genetic consequences of protoplast fusion
46. Invitro germplasm conservation-role of tissue culture in germplasm conservation and biotechnology
47. Cryo preservation-germplasm storage-short/medium and long-term storage
48. Agrobacterium mediated gene transfer and its applications

B) Practicals

1. Tissue culture laboratory Organization of -identification of various equipment-sterilization technique of tissue culture laboratory-glassware, plastic and metal ware
2. Preparation of stocks and working solutions
3. Preparation of different types of media
4. Sterilization of explants and establishment of a primary culture from explants
5. Preparation and inoculation of explants for callus production
6. Preparation and inoculation of explants for direct organo genesis

7. Determination of optimum concentration of growth hormones/plant growth regulators for direct organogenesis-shoot and root
8. Preparation and inoculation of explant (single node & shoot tip)
9. Subculturing techniques in plant tissue culture
10. Plant regeneration and hardening techniques in micropropagation
11. Liquid culture techniques in plant tissue culture

12 & 13. Identifying the sources of contamination in plant tissue culture and strategies to reduce contamination rates

14. Induction and development of somatic embryos
15. Preparation of synthetic seeds and encapsulation
16. Visit to commercial tissue culture laboratories

Textbooks

1. Plant tissue culture: Theory and practice, a revised edition by Bojwani, S.S and Razdan, M.K. Elsevier science.
2. Plant Propagation by Tissue Culture by Edwin F. George, E.F., Hall, M.A and Klerk, G.J., 3rd Edition. Springer

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 471**
Course Title	**:**	**Agrochemicals**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

To impart knowledge on different classes of agrochemicals

Course Outlines

Theory

An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture. Herbicides - Major classes, properties and important herbicides. Fate of herbicides. Fungicides classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxy chloride. Organic fungicides – Mode of action –Dithiocarbamates-Characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification and insecticides: inorganic and organic insecticides organochlorine, Organophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses. Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow-release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility preparation of major, secondary and micro nutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistic and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available k in market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Murate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide.

A) Theory Lecture Outlines

Lec. No. Topics

1. Introduction to agrochemicals, their types and significance in agriculture
2. Impact of agrochemicals on the environment, soil, human and animal health; advantages and disadvantages of agrochemical use and their management for sustainable agriculture
3. Herbicides – Definitions, benefits and limitations of herbicide use in India and Andhra Pradesh
4. Classification of herbicides based on chemical nature, timing and methods of application
5. Herbicides – Major groups and characteristics of important herbicides
6. Fate of herbicides applied on foliage and soil
7. Classification of fungicides based on method of application and usage
8. Classification of fungicides according to mode of action and chemical composition
9. Features and uses of copper-based fungicides – preparatory and proprietary types
10. Characteristics and uses of sulphur fungicides – inorganic sulphur fungicides (preparatory and proprietary)
11. Characteristics and uses of organic sulphur fungicides (dithiocarbamates) – monoalkyl and dialkyl dithiocarbamates and other contact fungicides
12. Characteristics and applications of heterocyclic nitrogen-containing fungicides
13. Features and uses of miscellaneous groups of fungicides
14. Characteristics and uses of systemic fungicides – acylalanines, benzimidazoles, thiophanates, carboxamides and triazoles with their mode of action
15. Characteristics and uses of systemic fungicides – strobilurins, morpholines, organophosphates and oxathins with their mode of action
16. Characteristics and uses of antibiotics – antifungal and antibacterial antibiotics
17. Methods of foliar application such as spraying (high, low and ultra-low volume) and dusting – their merits and demerits; seed treatment methods (dry, wet and slurry) and chemicals used; soil treatment methods including fumigation, broadcasting, furrow application and drenching

18. Post-harvest disease management – use of fumigants, smokes, dusts, solutions, barriers and insulators; chemicals, oils and botanicals used; tree wound dressing procedures and chemicals for disease control
19. Disinfection and sanitation of warehouses using different chemicals
20. Development of resistance in plant pathogens to chemicals – concepts of resistance, tolerance and cross-resistance; mechanisms of resistance development and management strategies such as gene pyramiding, gene deployment and multilines
21. Study of various fungicide formulations available in the market
22. Role and functions of the Fungicide Resistance Action Committee (FRAC)
23. Introduction and classification of insecticides – inorganic and organic groups; Inorganic insecticides - Arsenic Compounds - Fluorine and sulphur; organic insecticides - plant-derived insecticides such as neem products, nicotine, rotenone, plumbagin and pyrethrum – sources, properties and uses
24. Organochlorine insecticides – Synthetic organic insecticides - chlorinated hydrocarbons such as DDT, dicofol, HCH and cyclodienes (aldrin, dieldrin, heptachlor, endosulfan) – toxicity and mode of action
25. Organo phosphates - Systemic, non-systemic and translaminar action of insecticides with examples- Brief mode of action – Toxicity, formulations and uses of malathion, dichlorvos, quinalphos, phosalone, chlorpyriphos, monocrotophos, methyl demeton, dimethoate, ethion, triazophos, profenophos, acephate and phorate
26. Carbamates - Mode of action – Toxicity, formulations and uses of carbaryl, propoxur, carbofuran, fenobucarb, thiodicarb and methomyl
27. Synthetic pyrethroids - Brief mode of action – Toxicity, formulations and uses of allethrin, resmethrin, bioresmethrin, bioallethrin, fenvalerate, permethrin, deltamethrin, cypermethrin, lambda cyhalothrin, cyfluthrin, fenpropathrin, flucythrinate, fluvalinate and fenfluthrin.
28. Insecticides of other groups - Nicotinoid insecticides - Brief mode of action – Toxicity, formulations and uses of imidacloprid, acetamiprid, thiamethoxam, Thiacloprid, dinotefuran and clothianidin.
29. Biorationals - Brief mode of action, toxicity, formulations and use - Phenyl pyrazoles, fipronil - Macro cyclic lactones –Spinosyns - Spinosad; Avermectins –Abamectin and emamectin benzoate; Oxadaizines – indoxacarb; Thioureas - Diafenthiuron; Pyridine azomethines - Pymetrozine; Pyrroles-Chlorfenapyr. Formamidines – Chlordimeform and Amitraz; Ketoenols - Spirotetramat, Spiromesifen and Spirodiclofen. Diamides - Chlorantraniliprole, Cyantraniliprole and Flubendiamide
30. IGRs- Brief mode of action - Toxicity, formulations and use- Chitin synthesis inhibitors - Diflubenzuron, Flufenoxuron, Triflumuron, Teflubenzuron, Lufenuron, Novaluron, and Buprofezin; Juvenile hormone (JH) mimics – Juvabione, Methoprene, Hydroprene, Kinoprene, Pyriproxyfen and Fenoxycarb- Anti JH or Precocenes, Ecdysone agonists – Methoxyfenozide , Halofenozide and Tebufenozide.

31. Biopesticides and reduced-risk insecticides – role of plant-based biopesticides in ecological agriculture
32. Repellents and antifeedants – physical and chemical repellents, importance and limitations of antifeedants
33. Recent advances in pest control- Attractants-Sex pheromones-List of synthetic sex pheromones-Use in IPM-Insect hormones-Gamma irradiation-Genetic control-Sterile male technique.
34. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil and plant - Botanicals, plant and animal systemic insecticides their characteristics and uses.
35. Fertilizers and their importance – classification with examples; nitrogenous fertilizers – raw materials, manufacturing process and properties of ammonium sulphate, ammonium nitrate and CAN
36. Manufacturing process and properties of ammonium chloride and urea; slow-release nitrogen fertilizers
37. Phosphatic fertilizers – types, uses and properties; manufacturing process of SSP, TSP, bone meal and basic slag
38. Potassic fertilizers – natural sources, manufacturing process and properties of MOP, SOP and potassium nitrate; reactions of N, P and K fertilizers in soil
39. Secondary and micronutrient fertilizers – sources, nutrient contents and conditions leading to deficiencies
40. Nano-fertilizers, water-soluble fertilizers, customized fertilizers; concepts of fertilizer grade, ratio and unit value
41. Soil amendments – types and role of important organic, inorganic and synthetic soil conditioners as amendments.
42. Mixed and complex fertilizers – sources, advantages and disadvantages over straight fertilizers; compatibility issues and problems in bulk blending and mixture formulation
43. Manufacturing process and properties of ammonium phosphate, UAP, ammonium sulphate nitrate, ammonium polyphosphates, nitrate phosphates and NPK complexes
44. Fertilizer storage – introduction - common problems such as caking, dust formation, chemical incompatibility and corrosiveness
45. Changes in physical and chemical properties of fertilizers during storage – CRH, particle size, moisture content, free acidity, bulk density, hardness and hygroscopicity
46. Fertilizer Control Order (FCO) – importance, regulations and storage standards of major fertilizers
47. Fertilizer logistics and marketing – introduction - organizational structure, functions, growth of fertilizer industry and distribution of major fertilizers
48. Support measures for the fertilizer sector – public sector undertakings, fertilizer monitoring system and vigilance activities

B) Practicals

1. Methods of sampling fertilizers and pesticides (insecticides, fungicides and herbicides)
2. Study and identification of different fertilizers and herbicide formulations available in the market and calculation of required doses
3. Preparation of Bordeaux mixture, Bordeaux paste, Burgundy mixture and Cheshunt compound
4. Preparation procedure of Lime Sulphur formulation
5. Familiarization with contact fungicides and calculation of their required dosages
6. Familiarization with systemic fungicides and calculation of their required dosages
7. Study and identification of different insecticide formulations available in the market
8. Calculation of recommended doses of insecticides
9. Study of pesticide application technology and various pesticide application equipment
10. Conducting rapid tests for identification of common fertilizers
11. Identification of anions and cations present in unknown fertilizer samples
12. Estimation of nitrogen content in urea fertilizer
13. Estimation of water-soluble and citrate-soluble P_2O_5 in Single Super Phosphate using Pemberton's method
14. Estimation of potassium content in Muriate of Potash (MOP) and Sulphate of Potash (SOP) using flame photometer
15. Determination of copper content in Copper Oxychloride formulation
16. Determination of sulphur content in sulphur fungicide (elemental sulphur formulation)

Textbook

1. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details by Panda, H. 2nd Revised Edition. NPCS

Suggested Readings

1. Basics of Agrochemical Formulations by Singh, A. Brillion Publishing, 176p.
2. Toxicity and Hazard of Agrochemicals by Larramendy, M.L. INTECH, 170p.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 481**
Course Title	**:**	**Landscaping**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To educate the students on designing different styles and types of gardens
2. To enable the students to identify different ornamental plants and their utilization in landscaping design
3. To enable students to design landscapes in software's like AUTOCAD, ARCHCADE etc.

Course Outlines:

Theory

Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery water garden, walk-paths, bridges, other constructed features etc. Gardens for special purposes. Trees: selection, propagation, planting schemes, canopy management. Shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers importance, selection, propagation, planting. Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio aesthetic planning: definition, need, planning. Landscaping of urban and rural areas, Periurban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions, Bonsai principles and management. Lawn: establishment and maintenance. CAD application.

Practical

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals;Care and maintenance of plants, potting and repotting; Identification of tools and implements used in landscape design. Training and pruning of plants for special effects. Lawn establishment and maintenance. Layout of formal gardens, informal gardens, special type of gardens (sunken garden,

terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software. Visit to important gardens /parks /institutes.

B) Theory Lecture Outlines

Lec. No. Topics

1. Importance and Scope of Landscaping – Significance of landscaping – Objectives of landscaping – Classification of landscaping: Domestic, public, commercial and specialized landscaping.

2. Principles of Landscaping – Fundamental principles of landscaping: Preliminary approach, central axis, focal emphasis, mass planting, unity, spatial arrangement, dividing lines, proportion and scale, surface texture, time and light effects, tone and colour, movement, rhythm, equilibrium, variation, harmony, vista and design style.

3. Types of Gardens – Categories of gardens: Formal gardens, informal gardens and natural (wild) gardens.

4. Styles of Gardens – Mughal garden style: Site selection and layout – boundary walls and entrances – terracing – flowing water channels – baradari – trees and flowering plants.

5. Other Garden Styles – Features of ENGLISH, PERSIAN, ITALIAN, FRENCH JAPANESE GARDEN – TYPES OF JAPANESE GARDEN - Japanese garden – Types: Hill garden, flat garden, tea garden, promenade (passage) garden and sand (Zen) garden.

6. Japanese Garden – Features, pagodas, fountains, islands, bridges, water basins, Ponds, streams, cascades, stone lanterns, rocks, fences and gateways, vegetation comprising evergreen, deciduous and flowering plants.

7. Famous Gardens of India – Brindavan Garden (Mysuru), Lal Bagh (Bengaluru), Pinjore Mughal Garden, Government Botanical Garden (Ootacamund), and Chandigarh Rose Garden.

8. Terrace Gardening – Roof-top gardening – Characteristics – Suitable plant species – Layout and planning – maintainance.

9. Vertical Gardening - systems – Structural elements and components.

10 & 11. Garden Components / Features – Structural and decorative components of gardens – Garden walls, retaining walls, fences and gates, hedges, edging, flower beds, borders, carpet bedding, topiary work, lily pools, steps, garden drives (gravel and asphalt) and pathways (gravel, brick, turf, stone and crazy paving).

12. Garden Components / Features – Garden structures – Arches, pergolas, screens, bridges, outdoor garden spaces (gazebos, garden pavilions, bandstands, bowers and thatched shelters) and walk paths.

13 & 14. Garden Adornments – Seating arrangements, ornamental tubs, plant containers, urns and vases, sundials, floral clocks, decorative stones, fountains, statues, bird baths, Japanese lanterns, wells, and plant stands.

15 & 16. Lawn Establishment –Selection of Grass: Bermuda grass, Korean grass, Poa grass, Fescue grass and Kentucky blue grass - Grasses for shady areas; Site Selection: Soil, Preparation of soil, drainage,

digging, manuring and grading; Methods of planting: Sowing of Seeds, Dibbling, Turfing, turf plastering, Bricking and Planting on Polythene.

17. Lawn Maintenance – Maintenance practices of lawns including mowing, rolling, sweeping, scraping, raking, weeding, irrigation and top dressing with compost and fertilizers. Common lawn disorders and problems -fairy ring and pale yellow lawn.

18 & 19. Rock Garden (Rockery) – Concept of rock gardens -types of rock gardens, selection of suitable site, construction techniques, planting methods and management practices. Plants suited for rock gardens-cacti and succulents, ferns, shrubs, herbaceous plants, bulbs and flowering annuals.

20 & 21. Water Garden – Water gardening -types of water bodies such as formal pools and Informal pools. Construction methods, planting techniques, filling of pools including waterfalls, water courses and maintenance practices. Aquatic plants suitable for water gardens, including surface flowering aquatics, floaters, oxygenators and marginal plants.

22 & 23. Gardens for Special Purposes – Specialized gardens - bog garden, sunken garden, herb garden, moon garden, topiary garden, paved garden, kitchen garden, gardening in hanging baskets, mini zoos, window gardens, conservatories, ferneries, miniature gardens, greenhouses and lath houses.

24 & 25. Trees – Definition and classification of trees with suitable examples. Classification based on climatic conditions, soil, availability and cost factors. Avenue planting schemes, including single species planting, mixed flowering species flowering simultaneously or at different times, and shade trees along roads. Classification based on purpose, including specimen, shade, ornamental, flowering, avenue, roadside, screening, windbreak, fragrant flowering and pollution-tolerant trees. Tree cultivation practices covering propagation, planting methods, time of planting, manuring, care, maintenance and canopy management.

26 & 27. Shrubs – Definition, utility and aesthetic importance of shrubs. Classification with examples based on ornamental plant parts, sunlight requirement, height and purpose of planting such as specimen shrubs, standards, rock gardens, edging, hedging, screening, ground covers, topiary, pot plants and shrubbery. Arrangement of shrubbery based on height and colour. Cultural practices including soil preparation, planting, propagation through seeds, cuttings and layering, irrigation, weeding and pruning.

28. Herbaceous Perennials – Definition and introduction to herbaceous perennials. Classification with examples for plains and hills. Cultivation practices - propagation methods, planting techniques and manuring.

29 & 30. Climbers and Creepers – Utility and aesthetic value of climbers and creepers. Classification with examples based on growing conditions, ornamental value, growth rate and life span. Cultural practices including soil preparation, pit digging, planting, aftercare, manuring and maintenance.

31 & 32. Annuals – Definition and classification of annuals based on season, flower colour, height, commercial importance and usage. Situational uses such as carpet bedding, climbers, fragrance, dry flower arrangements, edging, hanging baskets, pots, rockeries, screening, shade and window sills.

Cultivation practices including soil management, nursery raising, manures and fertilizers, annual borders, herbaceous borders, colour schemes, grouping and aftercare.

33. Palms – Definition, introduction and ornamental importance of palms. Classification with examples into feather-leaved and fan-leaved palms. Propagation methods, pot culture practices -potting, repotting, potting media, manuring and aftercare.

34 & 35. Ferns and Selaginellas – Introduction and ornamental value of ferns. Methods of propagation such as spores, clump division, suckers and bulbils. Cultural practices including site selection, soil media, pot culture, repotting, irrigation and indoor cultivation, with important examples. Introduction, propagation, cultural requirements and examples of selaginellas.

36. Ornamental Grasses –Introduction to ornamental grasses including bamboos and reeds. Cultivation practices covering propagation, soil and climatic requirements, site selection and planting, with important examples.

37. Cacti – Introduction – Characteristics of Cactaceae – Site of growing – Natural habitat – Domestication (Housing of cacti) – growing of cacti: Propagation: Seeds, Offsets and Grafting, soil, Climate, Containers, Time and method of planting, Potting, Re-potting, Irrigation and Staking.

38. Succulents – Characteristics – Difference between cacti and succulents – Utility (aesthetic values) – growing of succulents: Climate, Soil, Housing, Propagation: Seeds and Cuttings, Watering, Re-potting and Summer protection.

39. Pot Plants – Introduction to pot plants, types of pots, potting methods, potting compost, repotting, arrangement and management practices.

40. Bio-aesthetic Planning – Definition, aim, Concept and objectives and Importance of bio-aesthetic planning need - air pollution control and human well-being.

41 & 42. Urban and Rural Landscaping – Landscaping of urban, rural and peri-urban areas, roadside planting, tree planting in residential colonies and landscaping of city parks including small, medium and large parks and pleasure grounds. Suitable ornamental shade and flowering trees for urban roads.

43 & 44. Landscaping of Public and Institutional Areas – Landscaping of public places and schools such as railway stations, townships, bus stations, riverbanks, hospitals, airports, industries, playgrounds and institutions, emphasizing importance, necessity and suitable planting materials for different locations.

45 & 46. Bonsai –Definition and criteria for selection of plants for bonsai. Examples, classification of bonsai styles. Bonsai cultivation techniques -containers and media, potting and repotting, training, pruning, pinching, watering, manuring, defoliation and mame bonsai.

47 & 48. Computer Aided Design (CAD) – Introduction, historical development, objectives and components of computer aided design and its applications in landscaping.

B) Practicals

1. Identification of trees
2. Identification of shrubs

3. Identification of annuals
4. Identification of pot plants
5. Propagation of trees
6. Propagation of shrubs
7. Propagation of annuals
8. Identification of tools and implements used in landscape design
9. Training and pruning of plants for special effects
10. Lawn establishment and maintenance 70
11. Care and maintenance of plants, potting and repotting
12. Layout of formal gardens and informal gardens
13. Layout of special type of gardens (sunken garden, terrace garden, rock garden)
14. Designing of conservatory and lath house.
15. Use of computer software in landscaping
16. Visit to important gardens/parks/institutes.

Textbook

1. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia

Suggested Readings

1. Principles of Landscape Gardening: Y. Chandrasekhar and Hemla Naik B. 2020. ICAR.
2. Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh. 2020, Bio-Green Books.

COLLEGE OF AGRICULTURE
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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 482**
Course Title	**:**	**Hi-Tech Horticulture**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To educate the students on the latest technology of hi-tech horticulture
2. To educate students on the concepts and prospects of hi-tech horticulture

Course outlines

Theory

Introduction and importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods; Protected cultivation: advantages, controlled conditions, method and techniques; Micro irrigation systems and its components; EC, pH based fertilizer scheduling; canopy management; high density orcharding; Components of precision farming: Remote sensing; Geographical Information System (GIS); Differential Geo-positioning System (DGPS); Variable Rate Applicator (VRA); application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment identification and application, Micro propagation, Nursery- portrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

A Theory Lecture Outlines

Lec. No. **Topics**

1. Hi-tech horticulture: Concept, scope, importance, constraints and future prospects of hi-tech horticulture in India.
2. Hi-tech nursery management: Quality standards of planting material and advantages of cultivating plants in greenhouse-propagation under green houses.

3. Micropropagation of horticultural crops: Tissue culture procedures and micropropogation applications including meristem, anther, embryo and ovule culture and somatic hybridization.
4. Micropropagation constraints: Problems, advantages, limitations and role of micro-grafting.
5. Modern field preparation: Advanced land preparation techniques with special reference to raised bed formation.
6. Soilless cultivation: Principles and practices of hydroponics and aeroponics.
7. Mechanization in hi-tech horticulture: Importance, advantages and limitations of mechanization.
8. Mechanized horticultural operations: Mechanization in nursery management, sowing, transplanting, plastic mulching, irrigation, fertigation, pest, disease and weed management and harvesting.
9. Plastics in hi-tech horticulture: Role and applications of plastics in modern horticulture.
10. Plastic mulching: Types, advantages and disadvantages of plastic mulches.
11. Protected cultivation: Concept, advantages and disadvantages of protected cultivation systems.
12. Protected structures: Types of protected structures - glasshouse, polyhouse, rain shelter, poly tunnel, hot bed, cold frame and shade net house.
13. Greenhouses: Definition, history, greenhouse effect and advantages.
14. Classification of greenhouses: Greenhouses based on shape, utility, construction and cladding materials.
15. Greenhouse environmental control: Regulation of light, temperature, humidity and carbon dioxide.
16. Greenhouse ventilation and cooling: Natural ventilation, fan-and-pad system and forced air cooling methods.
17. Greenhouses: regulation of relative humidity and carbon dioxide concentration.
18. Greenhouse soil sterilization: Physical and chemical methods of soil sterilization.
19. Off-season crop production: Techniques of off-season flower production and vegetable forcing.
20. Off-season vegetable production: Forcing techniques for off-season vegetable cultivation.
21. Insect pests of greenhouse crops: Major insect pests - sawflies, aphids, thrips, Springtails, beetles, red spider mites, slugs and snails, symphilids, millipedes etc. and their management through IPM.
22. Greenhouse nematodes: Nematode problems and their management
23. Greenhouse disease management: Management of bacterial diseases- Bacterial blight, bacterial canker, bacterial leaf spots- viral diseases - Fungal Diseases - Downy Mildew, Powdery mildew, Sclerotinia rot, Damping off in greenhouses.
24. Micro-irrigation systems: Advantages, limitations, components and methods including surface and subsurface drip irrigation.
25. Micro-irrigation components: Bubblers, micro-sprinklers and maintenance of micro-irrigation systems.
26. Fertigation: Concept, advantages, limitations and methods of fertilizer injection. (Fertilizer injection system, Pressure differential injection system, Venturi injection system)
27. fertigation: Selection of Fertilizers and use of solid and liquid fertilizers.

28. Site-specific nutrient management: Concept, advantages and disadvantages.
29. Canopy management: Importance and principles of canopy management.
30. Canopy management tools: Role of rootstocks, plant density, training and pruning, nutrient management and growth retardants.
31. Canopy management in fruit crops: Canopy management practices in mango and guava.
32. High density planting (HDP): Concept and systems of high density orcharding.
33. Components of HDP: Dwarf scions, dwarf rootstocks, pruning and training, growth retardants and other HDP components.
34. Impact of HDP: Advantages and constraints of high density planting.
35. Precision farming: Definition, scope and present status of precision farming in India.
36. Precision farming technologies: Prospects, potential and components of precision farming.
37. Remote sensing: Role of remote sensing in precision agriculture.
38. Remote sensing applications: Applications of remote sensing in horticulture.
39. Geographic Information System (GIS): Role of GIS in precision farming.
40. Differential Global Positioning System (DGPS): Introduction, principles and types of GPS and DGPS.
41. DGPS applications: Yield monitoring, field mapping and precision input application.
42. Variable rate application (VRA): Concepts and methods including map-based and sensor-based VRA.
43. VRA management zones: VRA in seeding, weed control, lime and fertilizer application.
44. Precision approaches for fruit production: Strategic use of precision technologies for improving fruit yield and quality.
45. Mechanized harvesting: Principles, advantages and limitations of mechanical harvesting.
46. Harvesting machinery and robotics: Mechanical harvesters for horticultural crops and use of robotics in harvesting.
47. Green food production: Concepts and approaches of green food production.
48. Biodynamic farming: Biodynamic preparations, cosmic integration, biodynamic calendar and strategies for sustainable green food production.

B) Practical

1. Types of polyhouses
2. Shade net houses
3. Identification and application of tools and equipment's
4. Intercultural operations for horticultural crops
5. Micro propagation
6. Nursery raising in protrays
7. Study of Micro-irrigation system and its components
8. Problems of micro irrigation systems

9. Study of mechanical harvesters
10. Study on bio dynamic preparations
11. Fertilizer scheduling
12. Canopy management in mango
13. Canopy management in Guava
14. Canopy management in Grapes
15. Visit to Hi-Tech orchard
16. Visit to Hi-Tech nursery

Textbook

1. Glimpses of Hi Tech Horticulture by Durga Hemanth Kumar Ch., Ratna Kumari N., Naram Naidu L and Srilatha V. Bhavya Books, New Delhi.

Suggested Readings

2. Hi Tech Horticulture by S. Prasad, Dharam Singh and R.L. Bharadwaj. Agrobios
3. Instant Horticulture by S.N. Gupta. Jain Brothers.
4. Greenhouse Management of Horticultural Crops by Prasad, S. And Kumar, U. 2nd edition, Agribios publishers, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 483**
Course Title	**:**	**Protected Cultivation**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

To educate students on the scientific and commercial cultivation of important commercial crops under protected conditions

Course Outlines

Theory

Protected cultivation- importance and scope, status of protected cultivation in India and World, Types of protected structure based on site and climate. Cladding material involved in greenhouse/poly house. Greenhouse design, environment control, artificial lights, Temperature control Automation. Soil preparation and management, Substrate management. Types of benches and containers, Irrigation and Fertigation management. Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops- rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc. Cultivation of economically important medicinal and aromatic plants. Off- season production of flowers and vegetables. Insect pest and disease management.

Practical

Raising of seedlings and saplings under protected conditions, Use of portrays in quality planting material production, Bed preparation and planting of crop for production. Inter cultural operations, Soil EC and pH measurement. Regulation of irrigation and fertilizers through drip, fogging and misting.

A) Theory Lecture Outlines

Lec. No.	Topics
1.	Protected cultivation: importance, scope, and present status of protected cultivation in India.

2. Types of protected structures in the world based on site and climate, including glasshouse, polyhouse, rain shelters, poly tunnels, hotbeds, cold frames, and shade net houses.
3. Greenhouses: definition, historical development, greenhouse effect, and advantages of greenhouse cultivation.
4. Classification of greenhouses based on shape, utility, construction, and cladding materials.
5. Greenhouse design aspects including site selection, orientation, layout, material requirements, and erection procedures.
6. Cladding materials for greenhouse and polyhouse structures such as glass, flexible plastic films, polyethylene, ethylene vinyl acetate, polyvinyl fluoride, and polyvinyl chloride.
7. Other cladding and covering materials including acrylic sheets, Tefzel T2 film, reinforced plastics, rigid plastic sheets, and saran plastic mesh.
8. Environmental control in greenhouses with emphasis on light management and supplemental lighting using incandescent, fluorescent, and high-intensity discharge lamps.
9. Temperature control methods in greenhouses including ventilation and cooling systems such as naturally ventilated structures, fan and pad cooling, and forced air cooling.
10. Relative humidity management and carbon dioxide fertilization, including optimum CO_2 levels in greenhouse cultivation.
11. Soil preparation and management in greenhouses, including physical and chemical methods of soil sterilization.
12. Soil and soilless growing media such as coco peat, vermicompost, perlite, vermiculite, charcoal, pumice, and rock wool, and their substrate management.
13. Types of benches and containers used in greenhouses, including no-bench systems, raised benches, ground benches, and bench arrangements such as longitudinal, cross, and peninsula systems.
14. Movable benches and pyramid benches, along with types of containers used in greenhouse cultivation.
15. Irrigation management in greenhouses, including hand watering and automatic watering systems such as tube watering, capillary mats, overhead sprinklers, perimeter watering, drip irrigation, and misting.
16. Fertigation in greenhouse crops using dry and liquid fertilizers, and methods of liquid fertilizer application such as constant feed and intermittent feed systems.
17. Automation in greenhouse cultivation, parameters to be controlled, types of greenhouse control systems, and sensors for temperature, light, CO_2, humidity, and irrigation.
18. Propagation and production of quality planting material of horticultural crops under greenhouse conditions through sexual and asexual methods.
19. Greenhouse cultivation of rose: introduction, varieties suitable for greenhouse cultivation, climatic requirements, planting methods, spacing, and planting density.

20. Fertilizer requirement and fertigation in rose, training and pruning practices, special intercultural operations, use of growth regulators, physiological disorders, harvesting, grading, packing, and yield.
21. Carnation cultivation under greenhouse conditions: introduction, suitable varieties, climatic requirements, planting, spacing, planting density, fertilizer requirement, and fertigation.
22. Training and pruning in carnation, special intercultural operations such as netting and pinching, use of growth regulators, harvesting, grading, packing, and yield.
23. Chrysanthemum cultivation under greenhouse conditions: introduction, suitable varieties, climatic requirements, planting, spacing, and planting density.
24. Fertilizer requirement and fertigation in chrysanthemum, training and pruning, special intercultural operations, use of growth regulators, harvesting, grading, packing, and yield.
25. Gerbera cultivation in greenhouses: introduction, suitable varieties, climatic requirements, planting, spacing, planting density, fertilizer requirement, and fertigation.
26. Special intercultural operations in gerbera such as defoliation, soil loosening, and shading, use of growth regulators, harvesting, grading, packing, and yield.
27. Orchid cultivation in greenhouses: varieties suitable for greenhouse production, climatic and substrate requirements, and propagation methods.
28. Planting, fertilizer requirement, use of growth regulators, physiological disorders, harvesting, grading, packing, and yield in orchids.
29. Anthurium cultivation under greenhouse conditions: suitable varieties, climatic requirements, growing media, planting, spacing, planting density, fertilizer requirement, and fertigation.
30. Special intercultural operations in anthurium, use of growth regulators, physiological disorders, harvesting, grading, packing, and yield.
31. Lilium cultivation in greenhouses: suitable varieties, climatic requirements, growing media, planting, spacing, planting density, and fertilizer requirement.
32. Special intercultural operations in lilium, use of growth regulators, physiological disorders, harvesting, grading, packing, and yield.
33. Tulip cultivation under greenhouse conditions: suitable varieties, climatic requirements, growing media, planting, spacing, planting density, and fertilizer requirement.
34. Special intercultural operations in tulip, use of growth regulators, physiological disorders, harvesting, grading, packing, and yield.
35. Greenhouse cultivation of tomato: suitable varieties, climatic requirements, soil preparation, planting methods, spacing, and planting density.
36. Training and pruning methods in tomato, fertilizer requirement, intercultural operations, harvesting, and yield.
37. Greenhouse cultivation of bell pepper: suitable varieties, climatic requirements, soil preparation, planting, spacing, and planting density.

38. Training and pruning in bell pepper, fertilizer requirement, intercultural operations, harvesting, and yield.
39. Greenhouse cultivation of cucumber: suitable varieties, climatic requirements, soil preparation, planting, spacing, and planting density.
40. Training and pruning in cucumber, fertilizer requirement, intercultural operations, harvesting, and yield.
41. Greenhouse cultivation of strawberry: suitable varieties, climatic requirements, soil preparation, planting, spacing, and planting density.
42. Training and pruning in strawberry, fertilizer requirement, intercultural operations, harvesting, and yield.
43. Pot plant production under protected cultivation: selection of plants, climatic requirements, potting, repotting, and management practices.
44. Protected cultivation of economically important medicinal and aromatic plants such as stevia and ginseng.
45. Off-season production of flowers and vegetables under protected cultivation, including flower forcing and vegetable forcing techniques.
46. Insect pests of greenhouse crops and their management, and principles of integrated pest management in greenhouses.
47. Disease management in greenhouses, including bacterial, viral, and fungal diseases and their control measures.
48. Nematodes affecting greenhouse crops and their management strategies.

B) Practicals

1. Study of different types of greenhouses based on shape.
2. Study of different types of greenhouses based on construction.
3. Study of different types of greenhouses based on cladding material.
4. Study of materials for construction of greenhouses.
5. Study of construction of pipe framed green house.
6. Field visit to green house.
7. Raising of seedlings and saplings under protected conditions.
8. Use of protrays in quality planting material production.
9. Bed preparation and planting of crop for production.
10. Intercultural operations in green house crops
11. Regulation of irrigation in green houses
12. Fertilizers application through drip, fogging ad misting.
13. Soil EC and pH measurement.
14. Measurement of environmental parameters inside greenhouse.
15. Calculation of ventilation rates in active summer cooling system.

16. Calculation of rate of air exchange in active winter cooling system

Textbooks

1. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu.
2. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V. Jain Brothers.

Suggested Readings

1. Greenhouse operation and management by Paul V. Nelson.
2. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 484**
Course Title	**:**	**Post-Harvest Management and Value Addition**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives:

1. To educate about the different pre-harvest, harvest and post harvest factors affecting the post harvest life of fruits and vegetables
2. To educate about preparation techniques of value added products
3. To educate about the different dehydration techniques of horticultural crops

Course outlines

Theory

Importance of Post-harvest Processing of fruits and vegetables, extent and possible causes of postharvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning - Concepts and Standards, Packaging of products.

Practical

Applications of different types of packaging containers for shelf life extension, Effect of temperature on shelf life and quality of produce, Demonstration of chilling and freezing injury in vegetables and fruits, Extraction and preservation of pulps and juices, Preparation of jam, Preparation of Jelly, Preparation of RTS, Preparation of Nectar, Preparation of Squash, Osmotically dried products, Fruit bar and Candy and Tomato products, Canned products, Quality evaluation of products - Visit to processing unit/ industry

A) Theory Lecture Outlines

Lec. No. Topics

1. Scope and importance of postharvest technology of fruits and vegetables; extent and possible causes of postharvest losses.
2. Pre-harvest factors influencing postharvest quality, maturity, ripening, and shelf life of fruits and vegetables.
3. Environmental pre-harvest factors affecting postharvest quality including temperature, light, rainfall, wind, and relative humidity.
4. Cultural pre-harvest factors affecting postharvest quality such as rootstock, variety, mineral nutrition, growth regulators, irrigation, pruning, thinning, and girdling.
5. Methods used for determination of maturity indices in fruits and vegetables.
6. Maturity indices of important fruits and vegetables.
7. Harvesting and field handling practices with emphasis on different harvesting methods.
8. Postharvest handling practices and different pre-cooling methods.
9. Cleaning of fruits and vegetables including soaking, rinsing, washing by agitator, spraying water, wet brushing, and dry brushing.
10. Postharvest treatments such as waxing, wrapping, de-greening, ripening, chemical washing, and disinfestation.
11. Storage methods including traditional storages such as in-situ storage, pit storage, clamp storage, cellar and barn storage, night ventilation, wind breaks, and evaporative cool storage (ZECC principle).
12. Improved storage methods including refrigerated storage, modified atmosphere storage, controlled atmosphere storage, and hypobaric storage.
13. Ripening in fruits including definition, climacteric and non-climacteric fruits, and metabolic changes during ripening.
14. Physiological changes during ripening including seed maturation, colour development, texture changes, and carbohydrate metabolism.
15. Changes during ripening such as development of aromatic volatiles, organic acid changes, fruit abscission, respiration rate, surface wax formation, and tissue permeability.
16. Causes of deterioration of harvested fruits and vegetables with emphasis on respiration and transpiration and factors affecting them.
17. Role and importance of ethylene in ripening and senescence of fruits.
18. Postharvest diseases and physiological disorders of fruits and vegetables.
19. Heat injury, chilling injury, and freezing injury in fruits and vegetables.
20. Concept, scope, and importance of value addition and the status of fruit preservation in India.
21. Principles of food preservation including asepsis, high-temperature preservation, and low-temperature preservation.

22. Methods of preservation such as drying, filtration, chemical preservation, fermentation, carbonation, and preservation using salt and sugar.
23. Drying and dehydration of fruits and vegetables, factors affecting drying, and advantages of dehydration over sun drying.
24. Dryers used for fruits and vegetables including tray dryers, tunnel dryers, belt or conveyor dryers, foam-mat dryers, and fluidized bed dryers.
25. Dryers used for fruits and vegetables including drum dryers, spray dryers, pneumatic dryers, microwave drying, and vacuum drying.
26. Rotary dryers, freeze drying, and osmotic dehydration including principles, advantages, and disadvantages.
27. Freezing of fruits and vegetables including slow and fast freezing methods with advantages and disadvantages.
28. Freezing methods such as direct immersion, indirect contact with refrigerants, air blast freezing, cryogenic freezing, dehydro-freezing, and freeze drying with flow chart.
29. Intermediate moisture foods with special reference to jam preparation and problems in jam making.
30. Intermediate moisture foods with special reference to jelly preparation and problems in jelly making.
31. Intermediate moisture foods with special reference to marmalade preparation and problems in marmalade making.
32. Pickle making, problems in pickle making, and spoilage of pickles.
33. Preparation of pickles from fruits and vegetables.
34. Preserve and candy preparation including concepts, standards, flow chart, and problems in preservation of preserves and candied fruits.
35. Glazed fruits and vegetables including flow chart for preparation and preservation.
36. Unfermented fruit beverages such as juice, ready-to-serve beverages, nectar, cordial, and squash including preparation and preservation.
37. Unfermented beverages such as crush, syrup, fruit juice concentrate, fruit juice powder, and carbonated beverages including preparation and preservation.
38. Fermented fruit beverages such as wine, champagne, port, sherry, tokay, cider, perry, muscat, nira, and feni including preparation and preservation.
39. Tomato processing including concepts and standards and preparation of tomato juice, puree, paste, sauce, ketchup, chutney, soup, cocktail, and canned tomatoes.
40. Value-added products prepared from banana and papaya.
41. Value-added products prepared from mango and coconut.
42. Canning of fruits and vegetables including principles, process, and causes of spoilage of canned foods.

43. Testing for defects in canned foods and containers used for canning such as tin and glass containers.
44. Packaging of fruits and vegetable products including definition, functions, and properties of good packaging materials.
45. Packaging materials commonly used for raw and processed fruits and vegetables including wooden, metal, and glass containers.
46. Plastics used in food packaging such as cellophane, polyvinyl chloride, polyethylene, and ethyl vinyl alcohol.
47. Food colours including importance, natural and artificial colours, and FSSAI-permitted food colours.
48. Food safety standards, rules, and regulations including FSSAI, Fruit Products Order (FPO), and Hazard Analysis and Critical Control Point (HACCP).

B) Practicals

1. Types of packaging materials
2. Cushioning materials for packing and transport of horticultural produce
3. Practicing drying techniques
4. Effects of low and high temperatures (Chilling & freezing injury and heat injury in and Fruits and Vegetables
5. Extraction and preservation of pulps.
6. Preparation of jam
7. Preparation of jelly
8. Preparation of RTS
9. Preparation of nectar
10. Preparation of squash
11. Preparation of osmotically dried products
12. Preparation of fruit bar and candy
13. Preparation of tomato sauce
14. Preparation of tomato ketchup
15. Shrink Wrapping in fruits and vegetables.
16. Visit to processing unit/ industry.

Textbooks

1. Post-harvest Management and Processing of Fruits and Vegetables by Rathore, N.S., Mathur, G.K., Chasta, S.S. ICAR, New Delhi.
2. Preservation of Fruits and Vegetables by Giridharilal, G.S., Siddappa and Tondon, G.L. ICAR, New Delhi.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU- ELCT 485**
Course Title	**:**	**Ornamental Crops, Maps & Landscaping**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs 79
2. To educate about concept, designing principles and components of landscaping
3. To educate about the physiological disorders of commercial flowers
4. To educate about the post-harvest management and value addition in flower crops and MAP

Course Outlines

Theory

Production technology of ashwagandha, costus, isabgol and geranium; Production technology of mint, aloe and ocimum, Coleus, Glory lily, Periwinkle etc.; Production technology of plants like lemongrass, citronella, vetiver and palmarosa etc., Importance and scope of ornamental crops; Importance and scope of medicinal and aromatic plants and landscaping; Principles of landscaping; Landscape uses of trees, shrubs and climbers, Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and lilium; Production technology of chrysanthemum and carnation; Package of practices for loose flowers like marigold and jasmine under open conditions; Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, flower arrangement, Herbaceous Border, Hedge, Edge etc.; Processing and value addition imp 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 MAP, Bed preparation and planting of MAP; 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.

A) Theory Lecture Outlines

Lec.No. Topics

1. Importance and scope of ornamental crops and landscaping in India and abroad.
2. Landscape uses of trees, shrubs, and climbers in different landscape situations.
3. Principles of landscaping including initial approach, axis, focal point, mass effect, unity, space, divisional lines, proportion and scale, texture, time and light, tone and colour, mobility, rhythm, balance, contrast, harmony, vista, and style.
4. Production technology of cut flowers under protected conditions with special reference to rose: introduction, origin and distribution, classification, species and varieties.
5. Climate and soil requirements of rose, propagation, rootstocks, stock–scion compatibility, land preparation, planting, manures and fertilizers, cultural operations, harvesting, postharvest management, yield, and rose by-products.
6. Production technology of gerbera under protected conditions: introduction, origin and distribution, classification, species and varieties.
7. Climate and soil requirements of gerbera, propagation, land preparation, planting, nutrient management, cultural operations, use of growth regulators, physiological disorders, harvesting, postharvest management, and yield.
8. Production technology of chrysanthemum under protected conditions: introduction, origin and distribution, classification, species and varieties.
9. Climate and soil requirements of chrysanthemum, propagation, planting, nutrient management, cultural operations, use of growth regulators, harvesting, postharvest management, and yield.
10. Production technology of carnation under protected conditions: introduction, origin and distribution, classification, species and varieties.
11. Climate and soil requirements of carnation, propagation, planting, nutrient management, cultural operations, physiological disorders, harvesting, postharvest management, and yield.
12. Production technology of orchids under protected conditions: introduction, origin and distribution, classification, species and varieties.
13. Climate and soil requirements of orchids, propagation, planting, nutrient management, cultural operations, use of growth regulators, physiological disorders, harvesting, postharvest management, and yield.
14. Production technology of lilium under protected conditions: introduction, origin and distribution, classification, species and varieties.
15. Climate and soil requirements of lilium, propagation, planting, nutrient management, cultural operations, physiological disorders, harvesting, postharvest management, and yield.

16. Production technology of anthurium under protected conditions: introduction, origin and distribution, classification, species and varieties, and growing media.
17. Propagation, systems of growing, planting, fertigation, cultural operations, physiological disorders, harvesting, postharvest management, and yield of anthurium.
18. Production technology of cut flowers under open conditions with special reference to gladiolus: introduction, origin and distribution, classification, species and varieties.
19. Climate and soil requirements of gladiolus, propagation, planting, nutrient management, cultural operations, physiological disorders, harvesting, postharvest management, and yield.
20. Production technology of tuberose under open conditions: introduction, origin and distribution, classification, species and varieties.
21. Climate and soil requirements of tuberose, propagation, planting, nutrient management, cultural operations, physiological disorders, harvesting, postharvest management, and yield.
22. Production technology of loose flowers with special reference to marigold: introduction, origin and distribution, species, varieties, and hybrids.
23. Climate and soil requirements of marigold, propagation, planting, nutrient management, cultural operations, use of growth regulators, harvesting, postharvest management, and yield.
24. Production technology of jasmine: introduction, origin and distribution, species, varieties, and hybrids.
25. Climate and soil requirements of jasmine, propagation, planting, nutrient management, cultural operations, harvesting, postharvest management, and yield.
26. Production technology of crossandra: introduction, origin and distribution, species, varieties, and hybrids.
27. Climate and soil requirements of crossandra, propagation, planting, nutrient management, cultural operations, harvesting, postharvest management, and yield.
28. Postharvest handling, storage, and marketing of cut flowers.
29. Scope and importance of medicinal plants and production technology of ashwagandha.
30. Production technology of aloe and costus including botanical description, agronomy, harvesting, and yield.
31. Production technology of periwinkle and isabgol including botanical description, agronomy, harvesting, and yield.
32. Production technology of coleus and glory lily including botanical description, agronomy, harvesting, and yield.
33. Production technology of belladonna including botanical description, agronomy, harvesting, and yield.
34. Production technology of dioscorea including botanical description, agronomy, harvesting, and yield.

35. Production technology of rauvolfia including botanical description, agronomy, harvesting, and yield.
36. Importance of aromatic plants, essential oil industry in India, properties of essential oils, and production technology of lemongrass.
37. Production technology of citronella and palmarosa including botanical description, agronomy, harvesting, and yield.
38. Production technology of mint and ocimum including botanical description, agronomy, harvesting, and yield.
39. Production technology of geranium and davanam including botanical description, agronomy, harvesting, and yield.
40. Production technology of vetiver including botanical description, agronomy, harvesting, and yield.
41. Concept and components of home landscaping, carpet bedding, and topiary.
42. Bonsai: styles, plants, containers, cultural practices, special practices, care, and maintenance.
43. Lawns: grasses used, establishment, and maintenance practices.
44. Flower arrangement: principles, styles, and Japanese style of flower arrangement (Ikebana).
45. Herbaceous borders, hedges, and edges: plants used, growing, and maintenance.
46. Dehydration techniques for drying flowers, importance of dry flowers, pot-pourri, and methods of dehydration.
47. Extraction methods of essential oils including water distillation, water and steam distillation, and steam distillation with their advantages and disadvantages.
48. Advanced extraction methods of essential oils including cold fat extraction, hot fat extraction, solvent extraction, expression, supercritical fluid extraction, and storage of essential oils.

B) Practicals

1. Identification of ornamental plants
2. Identification of Medicinal and Aromatic Plants
3. Nursery bed preparation and sowing of seasonal flower seeds
4. Propagation of Medicinal and Aromatic Plants.
5. Bed preparation and planting of Medicinal and Aromatic Plants
6. Propagation of ornamental plants by terminal/herbaceous cuttings.
7. Propagation of Anthurium and orchids
8. Propagation of bougainvillea
9. Planting of gerbera suckers and gladiolus corms
10. Establishment and maintenance of lawn
11. Preparation of flower preservatives and their use in extending the vase life of cut flowers
12. Training and pruning of ornamental plants and raising of hedge and edge
13. Planning and layout of garden
14. Drying / dehydration techniques for flower drying

15. Extraction of essential oils
16. Visit to commercial flower unit/MAP unit

Textbooks

1. Floriculture in India by G.S. Randhawa and Mukopadhyay
2. Introduction to spices, plantation crops, medicinal and aromatic plants by N. Kumar, Abdul Khadder, P. Rangaswamy, I. Irulappam

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course No.	**:**	**AU-ELCT- 491**
Course Title	**:**	**Agricultural Journalism**
Credits	**:**	**4 (3+1)**
Year	**:**	**IV**
Semester	**:**	**I**

Objectives

To impart knowledge and skill in agricultural journalism

Course Outlines

Theory

Journalism – Meaning, nature, importance, and types of journalism. Agricultural Journalism – Meaning, definition, principle, objectives, types, and scope. Similarities and difference between agricultural journalism and other types of journalism. Role of agricultural journalist, Training of agricultural journalist. Qualities of journalist, Role of journalist /journalism in agricultural development and development of newspaper and magazines readers. Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers. Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines. The agricultural story: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story. Gathering farm information-Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events, Other sources: electronic media, field study. Success stories-definition, nature, components, guidelines of writing a success story Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body Readability measure- Readability ease score, automated readability index, gunning fog index How to improve readability of articles and stories. Use of photograph in agricultural journalism- Basic principles of photography – Composition, exposure, lens, light Use of artwork (Graphs, charts maps, etc) Writing the captions Editorial mechanism: Copy reading, headline and Course Title writing Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader Layout – Meaning, principles of layout and design.

Practical

Practice in writing an agricultural news story. Practice in writing an agricultural feature story. Covering agricultural events for the information collection. Practice in interviewing for the information collection. Abstracting stories from research and scientific materials and wire services. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading. Practice in headline and Course Title writing Practising proof reading. Practice in lay outing of newspaper. Testing copy with a readability formula. Visit a publishing office

A) Theory Lecture Outlines

Lec.No. Topics

1. Journalism- Concept, Meaning, Nature, Significance, and Various types of journalism.
2. Agricultural Journalism- Meaning, definition, scope, principles, objectives, types of agricultural journalism
3. Similarities and difference between Agricultural journalism and other types of journalism
4. Agricultural Journalists -Role, Essential qualities of Journalist, role of journalist /journalism in agricultural development
5. Training of agricultural journalist on Agri technologies- Agri Journalism
6. Development of newspaper and magazines readers
7. Newspaper and Magazine as communication media- Characteristics, kinds and functions of newspaper
8. Characteristics of Newspaper and magazine readers
9. Newspaper and magazines- Form, content, style and language , Standard part of newspaper and magazines.
10. The Agricultural story- Types, structure and subject matter of the agricultural story.

11 &12 .Gathering farm information - Sources of farm information: Abstracting from research and scientific Materials, interviews, coverage of events, Other sources- electronic media, field study.

13. Writing a Success story.-Success story: Definition, Nature, Components, Guidelines
14. Writing a News story, difference between news and feature story.
15. The principle of writing a news story, Inverted pyramid structure.
16. Organizing the material, treatment of the story, writing the news lead and the body.
17. Readability Measure-readability ease score, automated readability index, gunning fog index
18. Guidelines for improving the readability of articles and stories
19. Photography - Basic principles of photography composition, exposure, lens, light.
20. Proofreading: Definition, Proof-reading signs and Symbols, Levels of Proofreading, Duties of a Proof-reader; Editorial Process: Copyreading
21. Illustrating Agricultural Stories: Use of Photographs and Artwork (Graphs, Charts, Maps, etc.)

22. Writing Captions, Headline and Course Title Writing and Their Importance in Agricultural Journalism
23. Layout- Meaning, Principles, and Design of Various Print Media for Agricultural Journalism
24. Agri-Journalism- Case Studies, Impactful Narratives, Success Stories, and Key lessons
25. A Theoretical orientation on videography for documentation
26. Scriptwriting for Radio- Principles and Guidelines
27. Scriptwriting for Television- Principles, and Guidelines
28. Digital Agricultural Journalism: Meaning, Definition, Scope, and Importance in modern agriculture.
29. Digital Media in Agricultural Journalism: Evolution, Transition from traditional to digital media, and Impact on Agriculture Reporting
30. Differences Between Digital and Traditional Journalism, Advantages and Challenges in Digital context
31. Agriculture Journalism services of SAU for Agricultural Development.
32. Digital Journalist's Toolkit: Essential Tools for Reporting, Editing, and Content Publishing
33. Digital Platform Writing: Style Adaptation for Web Audiences - Brevity, Clarity, and SEO
34. Structure and Formatting of Web Content: Use of Inverted Pyramid, Bullet Points, and Paragraph Spacing to enhance readability. Incorporating Links and Hypermedia-Practicing Effective Linking and Citation, and Adding Multimedia Elements
35. Writing for Social Media: Adapting Agricultural Stories for Platforms - Twitter, Facebook, and Instagram
36. Blogging and Microblogging in Agri-Journalism- Effective Platforms, Styles, and Strategies
37. Multimedia: Introduction, Role of Text, Audio, Video, and Visuals in Digital Journalism.
38. Integrating Multimedia Elements in Digital Stories-Techniques for Combining Text, Images, Audio, and Video into Cohesive stories.
39. Audio Content Creation and Podcasting- Creating and distributing audio content,-interviews and reports.
40. Social Media Platforms- A Comprehensive Overview of Major Platforms and Their Distinct Characteristics.
41. Social Media strategy for Agricultural Journalism- Developing social media strategy, Identifying Goals, Target Audiences, and Types of Content.
42. Basics of Digital Editing- Tools and Techniques for editing and Enhancing Digital and Multimedia Content.
43. Introduction to SEO for Agricultural Journalists, Optimizing Digital Content Techniques for search engines. Writing for SEO without Sacrificing Readability- Balancing Keyword Use with Natural Language.

44. Publishing and Promoting Content Online- Steps for publishing, distributing, and promoting digital content.
45. Emerging Technologies in Digital Journalism: Applications of AI, Machine Learning, and Blockchain technologies in Agricultural Journalism.
46. Augmented Reality (AR) and Virtual Reality (VR) in Agricultural Journalism: Exploring Immersive Technologies and Their Potential uses.
47. Online Privacy and Data Security, - Safeguarding sources and personal information in digital platforms. Handling Online Harassment and Trolling - Strategies to maintain professionalism and personal safety
48. Ethical Considerations in Digital Journalism- Addressing Copyright, Plagiarism, Maintaining Integrity, and Handling fake news and Misinformation.

B) Practical

1. Practice in writing an agricultural news story/ Success story
2. Practice in writing an agricultural feature story/ popular article
3. Covering agricultural events for the information collection.
4. Practice in interviewing for the information collection
5. Abstracting stories from research and scientific materials and wire services.
6. Developing Script for Television
7. Developing Script for Television
8. Practicing proof reading, editing, and copy reading.
9. Using metrics to assess engagement, reach, and influence. Analytics and measuring social media Success.
10. Podcasting and Audio Content Creation- Developing and distributing audio content, including interviews and reports.
11. Integrating Multimedia Elements into Digital Stories- Editing - How to combine text, images, audio and video into cohesive stories.
12. Testing copy with a readability formula.
13. Visit to a publishing office: documentation of process of Agri journalism
14. Practice in writing for Digitals platforms; Social Media and Blogging in Agricultural Journalism
15. Developing a Social Media Strategy for Agricultural Journalism- Identifying goals, target audiences and content types.
16. Study and documentation of on Agric journalism services of SAU.

Textbooks

1. Introduction to Journalism-Book by Carole Fleming, Emma Hemmingway, and Gillian Moore

2. Agricultural Extension and farm Journalism – A K Singh

Suggested Readings

1. Basic Journalism Book by Rangaswami Parthasarathy
2. News Reporting and Editing Book by K. M. Shrivastava
3. Professional Journalism Book by MV Kamath
4. The Journalist's Handbook Book by MV Kamath.

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RAJAMPET, YSR KADAPA DISTRICT, AP – 516126, INDIA

Course Structure for B.Sc. (Hons.) Agriculture
Semester VIII (Fourth Year II Semester)

S.No	Course Title	Credits
1.	Student READY (Rural Agricultural Work Experience Programme (RAWEP) / Industrial Attachment /Experiential Learning / Hands on Training/ Project Work / Internship	**20 Credits**