

**II Semester**

1	SWE 112	Soil and Water Conservation Engineering	1+1
2	CRP 101	Fundamentals of crop Physiology	2+1
3	AEC 102	Fundamentals of Agricultural Economics	1+1
4	AGM 101	Fundamentals of Microbiology	2+1
5	AEX 102	Fundamentals of Agricultural Extension Education	2+1
6	FSN 111	Principles of Food Science and Nutrition	1+1
7	AGR 102	Introductory Agro-meteorology & Climate Change	1+1
8	HOR 112	Production Technology for Fruit and Plantation Crops	1+1
9	RSG 101	Geo- informatics for Precision Farming	1+0
10	NSS/NCC 101	NSS/NCC	0+1*
11	PED 101	Physical Education	0+1*
		Total	<b>12+8=20</b>
		<b>*Non-gradual courses compulsory courses</b>	

**THEORY****UNIT I SURVEYING**

Surveying and levelling – chain and compass – levelling – land measurement – difference in elevation.

**UNIT II SOIL EROSION**

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion – universal soil loss equation - water erosion - causes - stages of water erosion - splash, sheet, rill and gully erosion - ravines - land slides – wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

**UNIT III SOIL CONSERVATION AND WATERSHED MANAGEMENT**

Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping – cropping systems – vegetative barriers - windbreaks and shelterbelts - shifting cultivation - mechanical measures – contour bund – graded bund – broad beds and furrows – basin listing – random tie ridging – mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall – Rain water harvesting — Runoff computation - rational formula - water harvesting – farm ponds and percolation ponds -watershed concept – integrated approach and management

**UNIT IV IRRIGATION AND DRAINAGE**

Irrigation - measurement of flow in open channels - velocity area method - rectangular weir - Cippoletti weir - V notch - orifices - Parshall flume - duty of water - irrigation efficiencies - conveyance of irrigation water - surface irrigation methods - borders, furrows and check basins - drip and sprinkler irrigation component– agricultural drainage - surface and sub-surface drainage systems - drainage coefficient

**UNIT V WELLS AND PUMPS**

Types of wells– pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps

**PRACTICAL**

Study of survey instruments - chains and cross staff surveying - linear measurement - plotting and finding areas. Compass survey - observation of bearings - computation of angles- radiation, intersection. Levelling – fly levels – determination of difference in elevation – contouring. Design of contour bund and graded bund. Drip systems and Sprinkler irrigation systems. Problems on water measurement. Problems on duty of water, irrigation efficiencies. Problems on water requirement - agricultural drainage. Study of different types of wells and its selection.- Study of pumps and its selection- Visit to soil and water conservation areas

**LECTURE SCHEDULE**

1. Introduction - land surveying - uses in agriculture - chain and cross staff surveying.
2. Compass surveying - computation of angles.
3. Dumpy level - setting, observation and tabulation of readings - difference in elevation.
4. Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion – universal soil loss equations.
5. Water erosion - causes - stages of water erosion - Splash, sheet, rill and gully erosion - ravines - land slides
6. Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep - Effects of water and wind erosion

7. Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping - Cropping systems – vegetative barriers - Windbreaks and shelterbelts - shifting cultivation.
8. Mechanical measures – contour bund – graded bund - Broad beds and furrows – basin listing – random tie ridging - Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall
9. Mid semester examination.
10. Rain water harvesting – runoff computation - rational formula - runoff water harvesting - farm ponds and percolation ponds.
11. Watershed concept – Integrated approach and management
12. Irrigation - measurement of flow in open channels - velocity area method - Rectangular weir - Cippoletti weir - V notch - Orifices - Parshall flume
13. Duty of water - irrigation efficiencies - conveyance of irrigation water.
14. Surface irrigation methods - borders, furrows and check basins
15. Components of drip and sprinkler irrigation system
16. Agricultural drainage – need – surface and subsurface drainage systems - drainage coefficient
17. Types of wells - Pump types – reciprocating pumps – centrifugal pumps - Turbine pumps – submersible pumps - Jet pumps – Airlift pumps

#### **PRACTICAL SCHEDULE**

1. Study of survey instruments - chains - compass - dumpy level.
2. Chains and cross staff surveying - linear measurement - plotting and finding areas.
3. Compass survey - observation of bearings - computation of angles.
4. Compass - radiation, intersection.
5. Levelling – fly levels
6. Computation of area
7. Computation determination of difference in elevation.
8. Design of contour bund and graded bund.
9. Design of drip Irrigation systems.
10. Design of sprinkler irrigation system
11. Problems on water measurement.
12. Problems on duty of water, irrigation efficiencies.
13. Problems on water requirement - agricultural drainage.
14. Study of different types of wells
15. Study of pumps and Selection of pumps.
16. Visit to soil and water conservation areas.
17. Final practical examination.

#### **TEXT BOOKS**

1. Basak, N.N. 2008. Surveying and Levelling. 25th reprint. Tata Mc-Graw Hill Publishing Company Ltd
2. Michael, A.M. and Ojha, T.P. 2008. Irrigation Theory and Practice. Second Edition. Vikas Publication House, New Delhi

#### **E- REFERENCES**

- <http://nptel.ac.in/courses/105107122/13>
- <http://soilwater.okstate.edu/courses/lectures-powerpoint>

## **CRP 101 Fundamentals of Crop Physiology (2+1)**

### **Aim**

To impart basic knowledge on various functions and processes related to crop production, mineral nutrition, plant growth regulators and environmental stresses.

### **Theory**

#### **Unit I**

Introduction to Crop Physiology and importance of Crop Physiology in Agriculture – Plant cell: an overview, organelles- plasma membrane, chloroplast, mitochondria, peroxisome and vacuole, Structure and role of water, water potential and its components, diffusion and osmosis; imbibition, plasmolysis, Field Capacity and Permanent Wilting Point, Absorption of water, Mechanisms of water absorption, Pathways of water movement, Apoplast and symplast, Translocation of water, ascent of sap and its mechanisms - Transpiration and Stomatal physiology: structure of stomatal pore, mechanisms of stomatal opening and closing, guttation, antitranspirants.

#### **Unit II**

Mineral nutrition of plants: Criteria of essentiality, classification of nutrients, macro, micro, mobile, immobile and beneficial elements, Physiological functions and deficiency symptoms of nutrients, nutrient uptake mechanism; Hidden hunger, Foliar nutrition, root feeding and fertigation, sand culture, hydroponics and aeroponics.

#### **Unit III**

Photosynthesis: Light and dark reactions, Photosystems, red drop and Emerson enhancement effect, Photolysis of water and photophosphorylation, Z scheme,  $C_3$ ,  $C_4$  and CAM plants; Photosynthetic pathways of  $C_3$ ,  $C_4$  and CAM plants, difference between three pathways, Factors affecting photosynthesis, Photorespiration – pathway and its significance, Phloem transport, Munch hypothesis, Phloem loading and unloading, Source and sink strength and their manipulations. Respiration: Glycolysis, TCA cycle and electron transport chain; Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient. Fat metabolism: fatty acid synthesis and breakdown.

#### **Unit IV**

Plant growth regulators: physiological roles and agricultural uses, Hormones- classifications - Biosynthetic pathway and role of auxins, gibberellins, cytokinins, ethylene and ABA, Novel and new generation PGRs, Brassinosteroids and salicylic acid, Growth retardants, Commercial uses of PGRs. Photoperiodism - short, long and day neutral plants, Chailakhyan's theory of flowering, Forms of phytochrome, Pr and Pfr, regulation of flowering, Vernalisation - Theories of vernalisation, Lysenko theories, Seed germination - physiological and biochemical changes, seed dormancy and breaking methods, Senescence and abscission, physiological and biochemical changes, Physiology of fruit ripening, climacteric and non-climacteric fruits, factors affecting ripening, Manipulations. Physiological aspects of growth and development of major crops: growth analysis, role of physiological growth parameters in crop productivity.

#### **Unit V**

Classification of stresses - Physiological changes and adaptations to drought, flooding, high and low temperature, salinity and UV radiation – compatible osmolytes – membrane properties - compartmentalization – stress alleviation - Global warming – green house gases – physiological effects on crops - Carbon Sequestration.

## **Practicals**

Study of plant cells, structure and distribution of stomata, imbibition, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO<sub>2</sub> assimilation by Infra Red Gas Analyser (IRGA).

## **Theory lecture schedule**

1. Introduction and importance of Crop Physiology in Agriculture, an over view of Plant cell.
2. Structure and role of water –water potential and its components – Diffusion – Osmosis – imbibition – Plasmolysis - Field Capacity and Permanent Wilting Point
3. Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast
4. Translocation of water – ascent of sap – mechanisms of xylem transport
5. Transpiration – significance – Stomatal physiology: structure of stomata with mechanisms of stomatal opening and closing – guttation - antitranspirants
6. Mineral nutrition of plants – criteria of essentiality - classification of nutrients – macro, micro, mobile and immobile – beneficial elements, mechanism of nutrient uptake
7. Physiological functions and disorders of macronutrients, Hidden hunger
8. Physiological functions and disorders of micronutrients
9. Foliar nutrition- root feeding and fertigation – sand culture, hydroponics and aeroponics
10. Light reaction of photosynthesis – photolysis of water and photophosphorylation - Z scheme
11. Dark Reaction of photosynthesis - C<sub>3</sub>, C<sub>4</sub> and CAM pathways and differences.
12. Factors affecting photosynthesis - Photorespiration – pathway and its significance
13. Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations
14. Respiration - Glycolysis – TCA cycle.
15. Photo and oxidative phosphorylation - Electron transport chain - energy budgeting - respiratory quotient.
16. Fat metabolism: fatty acid synthesis and breakdown
17. Mid Semester Examination
18. Growth – phases of growth – factors affecting growth.
19. Hormones and plant growth regulators (PGR): physiological roles and agricultural uses - Biosynthetic pathway and role of auxins and gibberellins
20. Plant growth regulators (PGR): physiological roles and agricultural uses - Biosynthetic pathway and role of cytokinin, ethylene and ABA
21. Novel growth regulators viz., Brassinosteroids and salicylic acid – New Generation PGRs - Growth retardants and inhibitors -commercial uses of PGRs
22. Photoperiodism - short, long and day neutral plants – Chailakhyan's theory of flowering
23. Forms of phytochrome - Pr and Pfr - regulation of flowering
24. Vernalisation - theories of vernalisation – Lysenko and Hormonal theories – devernalization
25. Physiological aspects of growth and development of major crops
26. Growth analysis – role of physiological growth parameters in crop productivity
27. Seed germination - physiological and biochemical changes - seed dormancy and breaking methods
28. Senescence and abscission – physiological and biochemical changes
29. Physiology of fruit ripening- climacteric and non climacteric fruits - factors affecting ripening and manipulations
30. Drought - physiological changes - adaptation – compatible osmolytes - alleviation
31. High and low temperature stress – physiological changes - membrane properties - adaptation

32. Salt stress - physiological changes - adaptation – compartmentalization - alleviation
33. Flooding and UV radiation stresses – physiological changes - adaptation
34. Global warming – green house gases –physiological effects on crop productivity- Carbon Sequestration

#### **Practical schedule**

1. Preparation of solutions
2. Study of leaf epidermal, xylem and phloem cells
3. Determination of stomatal index and stomatal frequency
4. Measurement of plant water potential
5. Measurement of water imbibition by seed mass test
6. Estimation of photosynthetic pigments
7. Determination of photosynthetic efficiency in crops
8. Measurement of transpiration and photosynthesis by IRGA
9. Diagnosis of nutritional and physiological disorders in crops
10. Rapid tissue test for mineral nutrients
11. Estimation of relative water content
12. Measurement of osmosis and plasmolysis
13. Growth Analysis
14. Bioassay for gibberellin and cytokinin
15. Estimation of chlorophyll stability index
16. Estimation of proline content
17. Final Practical Examination

#### **Outcome**

Students will acquire basic knowledge on various functions and processes related to crop production, mineral nutrition, plant growth regulators and environmental stresses. In addition, hands on exposure to preparation of solutions, analysis of pigment composition, estimation of growth analytical parameters, diagnosis and correction of nutrient deficiencies, enzyme assays and demonstration of plant growth regulator applications.

#### **Text books**

1. Salisbury F.B. and C.W.Ross., 1992 (Fourth Edition). Plant Physiology. Publishers: Wadsworth Publishing Company, Belmont, California, USA.
2. Boominathan P., R. Sivakumar, A. Senthil, and D. Vijayalakshmi. 2014. Introduction to Plant Physiology, A.E. Publications. Coimbatore
3. Jain, V.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
4. Taiz. L. and Zeiger. E., 2015 (Sixth edition). Plant Physiology and Development. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

#### **e- books and e-references**

- <http://www.plantphys.org>
- [http://www. Biologie. Uni-hamburg. de/b-online](http://www.Biologie.Uni-hamburg.de/b-online)
- <http://6e.plantphys.net>

## **AEC 102 Fundamentals of Agricultural Economics (1+1)**

### **Objective**

This course aims to introduce the basic principles of economics including the problem of agricultural economics decision - making, laws of economics and macroeconomic concepts.

### **Theory**

#### **Unit 1: Nature and Scope of Economics**

*Economics*: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, 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, classification and characteristics, desire, want - meaning and characteristics, 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.

#### **Unit 2: Theory of Consumption**

*Demand*: meaning, kinds of demand, law of demand, demand schedule and demand curve, determinants; *Utility theory* - cardinal and ordinal utility; law of diminishing marginal utility, equi-marginal utility principle, Indifference curve analysis and properties - budget line: definition, assumptions, limitations and applications - consumer's equilibrium and derivation of demand curve. Concept of consumer surplus and its importance. *Elasticity of demand*: concept and measurement of price elasticity, income elasticity and cross elasticity. Factors influencing elasticity of demand - Importance of elasticity of demand – Standard of Living: Definition, Engel's Law of Family Expenditure.

#### **Unit 3: Theory of Production**

*Production*: process, creation of utility, factors of production definition and characteristics - 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 versus supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.

#### **Unit 4: Exchange and Theory of Distribution**

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. *Distribution theory*: meaning, factor market and pricing of factors of production - Concepts of Rent and Quasi rent - *Wages*: Real wage and money wage - *Interest*: Pure interest and gross interest – *Profit*: Meaning of economic profit.

#### **Unit 5: Macroeconomic Concepts**

*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. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. *Agricultural and public finance*: meaning, micro versus macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT and GST. *Economic systems*: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

### **Practical**

Law of Diminishing Marginal Utility - Law of Equi-Marginal Utility - Indifference Curve analysis - consumer equilibrium; Individual and market demand- Measurement of Arc and Point elasticities of demand - own price, income and cross price elasticities of demand – Estimation of Consumer surplus –

Law of Diminishing Marginal Returns: Relationship among TPP, APP and MPP - Cost concepts and graphical derivation of cost curves - Estimation of total revenue and profit- Producer surplus - Supply elasticity – Exchange: Market Structure and Price determination – Computation of National Income – Study of structural changes in the economy - Estimation of Growth Rate - Money: Quantity theory of money - Measures of standard of living – Indices of human development.

### References

1. Dewett, K. K. 2004. Modern Economic Theory, Syamlal Charitable Trust, New Delhi.
2. Samuelson, P. 2004. Economics, (18/e), Tata Mc-graw-Hill, New Delhi
3. Seth, M. L. 2005. Principles of Economics, Lakshmi Narain Agarwal Co., Agra. New Delhi.

### Theory Schedule

1. *Economics*: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis.
2. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services - classification and characteristics, desire, want – meaning and characteristics, demand, utility, cost and price, wealth, capital, income and welfare.
3. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.
4. *Demand*: meaning, kinds of demand, law of demand, demand schedule and demand curve, determinants.
5. *Utility theory* - cardinal and ordinal utility; law of diminishing marginal utility, equi-marginal utility principle, Indifference curve analysis and properties - budget line - definition, assumptions, limitations and applications.
6. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus and its importance.
7. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Factors influencing elasticity of demand, Importance of elasticity of demand. Standard of Living: Definition, Engel's Law of Family Expenditure.
8. *Production*: process, creation of utility, factors of production definition and characteristics - Input Output Relationship.
9. **Mid Semester Examination**
10. *Laws of returns*: Law of variable proportions and law of returns to scale. *Cost*: Cost concepts, short run and long run cost curves.
11. *Supply*: Stock versus supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.
12. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points.
13. Distribution theory: meaning, factor market and pricing of factors of production. - Concepts of Rent and Quasi rent - *Wages*: Real wage and money wage - *Interest*: Pure interest and gross interest – *Profit*: Meaning of economic profit.
14. *National income*: Meaning and importance, circular flow, concepts of national income - accounting and approaches to measurement, difficulties in measurement.
15. *Population*: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control.
16. *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. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy.

17. *Agricultural and public finance*: meaning, micro versus macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT and GST. *Economic systems*: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

#### **Practical Schedule**

1. Law of Diminishing Marginal Utility.
2. Law of Equi - Marginal Utility.
3. Indifference Curve analysis - Properties, budget line and consumer equilibrium.
4. Individual and market demand - Graphical derivation of individual and market demand.
5. Measurement of Arc and Point elasticities of demand - own price, income and cross price elasticities of demand.
6. Estimation of Consumer surplus.
7. Law of Diminishing Marginal Returns: Relationship among TPP, APP and MPP.
8. Cost concepts and graphical derivation of cost curves.
9. Estimation of total revenue and profit.
10. Estimation of Producer surplus.
11. Estimation of Supply elasticity.
12. Exchange: Market Structure and Price determination.
13. Computation of National Income – Analysis of Trends in National Income - Study of structural changes in the economy.
14. Estimation of Growth rate of population and Food grain production.
15. Money: Quantity theory of money.
16. Measures of standard of living – Human Development Index – Physical Quality of Life Index – Gender Development Index.
17. **Final Practical Examination.**

## AGM 101 Fundamentals of Microbiology (2+1)

### Theory

#### Unit I. Introduction

Definition and scope of Microbiology. Milestones in Microbiology; biogenesis and abiogenesis theory; contributions of Antonie Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming and Waksman. Germ theory of diseases and fermentation.

#### Unit II. Microbiological Techniques

General principles of light microscopy - magnification, resolving power and numerical aperture. Different types of light and electron microscopes; three dimensional imaging - Atomic force and Confocal scanning laser microscopy. Staining techniques - principle and types of stains; simple, negative, differential and structural staining. Sterilization and disinfection techniques; principles and methods of sterilization - physical methods – heat, filters and radiation; chemical methods. Isolation, enrichment and purification techniques of bacteria, yeast, molds and actinobacteria. Preservation of microbial cultures.

#### Unit III. Microbial World

Evolutionary relationship among the living organisms. Whittaker's five kingdom concept of living organism and Carl Woese systems. Prokaryotic and eukaryotic microorganisms. Three domains of life – similarities and differences; Modern approach to the bacterial systematics. Bergey's Manual of Systematic Bacteriology. Bacteria - bacterial size, shape and arrangement; bacterial cell structure and function. Morphology of fungi and algae. General properties of viruses: different types; overview of bacteriophages; morphology of bacteriophages: Lytic and lysogenic cycles; lytic and temperate phages.

#### Unit IV. Microbial Growth and Metabolism

Bacterial growth- population growth- growth cycles of population; environment on growth – temperature, oxygen, pH and salts; nutritional classification – chemoautotrophy and photo autotroph. Energy generation in bacteria. Aerobic and anaerobic respiration and fermentation in bacteria.

#### Unit V. Microbial Genetics and Immunology

Central dogma of life. Genetic elements of bacteria; bacterial chromosomal DNA, plasmids, IS elements and transposons; Mutation - types and mutagens. Genetic recombinations; transformation, transduction and conjugation. Genetic engineering – an introduction. Basic concepts of immunology – antigen – antibody reactions and vaccines.

### Practical

Microbiological safety in the laboratory; introduction to microbiology laboratory and its equipments. Microscopes- handling with microscope. Micrometry. Methods of sterilization and equipments used for sterilization. Nutritional media and their preparations. Enumeration of microbial population - bacteria, fungi and actinobacteria. Methods of purification and preservation of microbial cultures. Staining and microscopic observations; simple and differential staining - spore staining. Measurement of bacterial growth. Identification of microorganisms - morphological identification of yeasts, molds and algae. Identification- cultural, physiological and biochemical tests for bacteria and actinobacteria.. Isolation of bacteriophages. Isolation of mutants employing physical or chemical mutagens.

### Theory schedule

1. Definition and scope of microbiology
2. Biogenesis and a biogenesis theory. Contributions by Antonie Van Leeuwenhoek and Louis Pasteur
  1. Contributions of John Tyndall, Joseph Lister, Edward Jenner, Robert Koch, Alexander Fleming and Waksman. Germ theory of fermentation and disease
4. Microscopy; principles – resolving power and magnification. Light microscopy
5. Different types of microscopes - UV, dark field, phase contrast and fluorescence
6. Electron microscopes; atomic and confocal scanning laser microscopy

7. Staining techniques - principle and types of stains - staining techniques- simple, negative, differential and structural staining methods
8. Sterilization – principle – physical agents and chemical methods
9. Isolation and enrichment culture techniques; preservation techniques
10. Evolutionary relationship - position of microbes in living world – concepts and developments in classification of microorganisms
11. Groups of microorganisms - prokaryotes and eukaryotes. Archaea – ecology; differences among archaea, eubacteria and eukaryotes
12. Bergey's manual of systematic bacteriology – outline only. Economic importance of bacteria
13. Bacteria- size, shape, structure and arrangement of cells
14. Bacteria - external and internal structures in bacteria and their functionality
15. Morphology and classification of fungi and economic importance
16. Morphology and classification of algae and economic importance
17. Viruses and their properties; bacteriophages – lytic and lysogenic and temperate phages
18. **Mid Semester Examination**
19. Reproduction in bacteria - population growth and growth phases – generation time and specific growth rate
20. Batch and continuous culture – chemostat and turbidostat; synchronous culture. Diauxic growth curve.
21. Conditions for growth - temperature requirements - aerobes and anaerobes – other factors influencing growth; methods of assessment of growth.
22. Nutritional types of bacteria. Metabolic diversity in microbes.
23. Aerobic respiration and anaerobic respiration
24. Fermentative mode of respiration
25. Oxygenic and anoxygenic mode of photosynthesis
26. Energy generation by substrate level phosphorylation, oxidative and photo phosphorylation
27. Genetic elements in bacteria – structure and functions of bacterial chromosome and plasmid and transposons
28. Mutation in bacteria – principles and types. Mutagens – physical, chemical and biological
29. Genetic recombination – competency - transformation
30. Genetic recombination by Conjugation – concept of Hfr
31. Genetic recombination by Transduction – generalized and specialized
32. Microorganisms as tools in genetic engineering
33. Immunology – principles – specific and non-specific defense
34. Antigen – antibody reactions – vaccines - applications

#### **Practical schedule**

1. Safety in Microbiology laboratory. Microscopes – handling light microscope
2. Micrometry-measurement of microorganisms
3. Aseptic techniques – working with equipment and apparatus
4. Preparation of growth media for bacteria, yeast, molds and actinobacteria
5. Isolation of microorganisms by serial dilution and plating technique
6. Purification of bacteria and actinobacteria
7. Purification of yeasts and molds
8. Preservation of bacteria, fungi and actinobacteria
9. Staining techniques - positive and negative staining
10. Differential staining - Gram staining

11. Turbidometric assessment of growth of bacteria
12. Morphological characteristics of bacteria and actinobacteria
13. Biochemical characteristics of bacteria and actinobacteria
14. Identification of yeasts, molds and algae - morphological characterization
15. Isolation of bacteriophages
16. Isolation of bacterial mutants by UV irradiation / chemical mutagenesis

#### **17. Practical Examination**

##### **Text Books**

1. Michael T. Madigan , Kelly S. Bender Daniel H. Buckley , W. Matthew Sattley, David A. Stahl 2017. Brock Biology of Microorganisms, 15<sup>th</sup> edition
2. ebook.:Prescott, Harley and Klein, 2013. Microbiology, 9<sup>th</sup> edition, McGraw Hill Publishing
3. ebook: Michael J. Leboffee and Burton E.Pierce 2011. A photographic Atlas for the Microbiology Laboratory 4<sup>th</sup> edition, Marton Publishing Company

##### **Reference Books**

1. Hans G. Schlegel, 2012. General Microbiology, 7<sup>th</sup> edition
2. Ronald M. Atlas, 1997. Principles of Microbiology, Second edition
3. Tortora, G.J., B.R.Funke and C.L. Case, 2009. Microbiology- An Introduction, 9<sup>th</sup> edition
4. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

##### **Web pages**

<http://www.microbes.info>  
<http://aem.asm.org>  
<http://microbelibrary.com>  
<http://www.rapidmicrobiology.com>

**AEX 102      Fundamentals of Agricultural Extension Education      (2+1)**

**Objective:**

This course intends to expose students to the fundamentals of extension education, extension systems in India, programme planning and rural development efforts, extension administration. To impart knowledge to the students on different extension methods and approaches used for transfer of agricultural technology. The course will also provide an opportunity to students to visit different organizations involved in extension activities and rural development work. To enable them to develop practical skills on preparation of different extension teaching methods.

**Theory**

**Unit I              Extension education and programme planning**

Education- meaning, definition & types; extension education –meaning, definition, scope and process; objectives and principles of extension education. Programme planning – definition, meaning, process, principles and steps in programme development

**Unit II              Extension System In India**

Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development scheme, Gurgaon Experiment, etc.) Post – independence era (Etawah pilot project, Nilokheri Experiment, etc.,) Various extension/ agricultural development programmes launched by ICAR/Govt. of India(IADP, IAAP, HYVP,KVK, ORP, ND, NATP, NAIP etc., )

**Unit III              Rural Development, Administration, monitoring and evaluation**

Rural Development –Concept, meaning, definition: various rural development programmes launched by Govt. of India. Community development –meaning, definition, concepts and principles, physiology of community development. Rural leadership: concept and definition, types of leaders in rural context: extension administration: meaning, concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes

**Unit IV              New Trends in Agricultural Extension**

New trends in agricultural extension –Privatization of extension, Cyber extension/ E-extension, (Internet, cyber cafes, video and teleconferencing, Interactive Multimedia Compact disk (IMCD), Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Village Knowledge Centre (VKC), DEMIC, Geographical Information System (GIS), market led extension, farmer led extension, expert systems etc.,

**Unit V              Transfer of Technology, Diffusion of Innovations and extension methods**

Transfer of technology concept, models, capacity building of extension personnel, extension teaching methods: meaning, classification, individual, group and mass contact methods, media mix strategies: communication: meaning, definition, models elements, characteristics and barriers to communication Agricultural Journalism: Agricultural journalism (Print media) - definition, principles, importance, ABC of news, types of news. Diffusion of Innovations – definition, elements; Innovation – definition, attributes; Adoption – meaning, steps in adoption process, adopter categories, factors influencing adoption of innovations; process and stages of adoption, adopter categories.

**Practical**

To get acquainted with university extension system, group discussion- exercise, handling and use of audio visual equipments and digital camera and LCD projector: preparation and use of AV aids, preparation of extension literature-leaflet, booklet, folder, pamphlet newstories 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 and other development departments at district level: visit to NGO 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.

### Theory Schedule

1. Education- meaning, definition and types;  
Extension education – meaning, definition, scope and process; objectives and principles and function of extension education.
2. Programme planning – definition, meaning, process, principles and steps in programme planning / development
3. Extension efforts in pre-independence era (IVP, Sriniketan, Marthandam, Firka Development scheme, Sevagram, Gurgaon Experiment, Baroda Village Reconstruction Project Grow more Food Campaign, IVS, Firka Vikas Yojana etc.) Post – independence era (Etawah pilot project, Nilokheri Experiment,
4. Extension/ agricultural development programmes launched by ICAR/Govt. of India ICAR Programmes – National demonstration, ORP, Lap to Land Programme, FTC.,
5. Extension programmes of Ministry of Agriculture – Training and Visit (T&V) System, Broad Based Extension System (BBES), Agricultural Technology Management Agency (ATMA); Firstline Extension System – KVK, IVLP, ATIC, Frontline demonstrations.
6. Rural Development – meaning, definition, concept and importance. Rural Development in India. Democratic Decentralization –Meaning of Democratic Decentralization and Panchayat Raj – Three tiers of Panchayat Raj system – Powers, Functions and Organizational setup.
7. Community Development Programme (CDP), National Extension Service (NES), Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) - their strengths and weaknesses
8. High Yielding Variety Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), Integrated Rural Development Programme (IRDP) - their strengths and weaknesses.
9. National Agricultural Technology Project (NATP), Integrated Tribal Development Agency (ITDA), Small Farmers Development Agency (SFDA), Marginal Farmers and Agricultural Labourers Development Agency (MFAL) - their strengths and weaknesses
10. National Rural Employment Programme (NREP), Rural landless Employment Guarantee Programme (RLEGP), Drought Prone Area Programme (DPAP), Command Area Development Programme (CADP), Food for Work Programme (FFW), Jawahar Rozgar Yojana (JRY), Employment Assurance Scheme (EAS),
11. Indira Awaas Yojana (IAY), Swarnajayanthi Gram Swarozgar Yojana (SGSY), Prime Minister Employment Yojana (PMEY), Swarna Jayanthi Shahari Rozgar Yojana (SJSRY), Pradhan Mantri Gram Sadak Yojana (PMGSY) , ARYA -their strengths and weaknesses.
12. Sampoorna Grameen Rozgar Yojana (SGRY), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Providing Urban Amenities to Rural Areas (PURA), National Agricultural Innovation Project (NAIP), NADP (RKVY) - their strengths and weaknesses
13. Community development –meaning, definition, concepts and principles, physiology of community development
14. Rural leadership: concept and definition, types of leaders in rural context and selection of leaders.
15. Extension administration: meaning, concept, scope, principles and functions.
16. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes, types and evaluation

17 **Mid semester Examination**

- 18 New trends in agricultural extension -Privatization of Agricultural extension- Meaning- definition- importance in Agricultural Extension.
19. Cyber extension/ E-extension, (Internet, cyber cafes, video and teleconferencing, web streaming and multimedia.
20. Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Village Knowledge Centre (VKC), DEMIC, Geographical Information System (GIS),
- 21 Market led extension, farmer led extension : Meaning, definition, challenges and importance in agricultural extension.
- 22 Expert systems –meaning, definition, application in agriculture.
- 23 Transfer of technology concept, models, PTD, FSRE.
- 24 Capacity building of extension personnel- Training- definition, need for training, training process, models , strategies, steps in conducting training programmes
- 25 Training need assessment, building up of training programme- trainer roles: training insituteion for extension personnel- KVK, EEI, MANAGE, NAARM.
- 26 Extension teaching methods: meaning, classification; Individual methods- Farm and Home, Personal letter, Official call, observation and Result demonstration
- 27 Group Contact- Method demonstration, meeting, lecture, debate, workshop, seminar, forum, conference, symposium, panel, brain storming, buzz session , role playing and simulation games.
- 28 Mass contact methods- Campaign, exhibition, farmers day and field trip- purpose procedure, merit and demerits and media mix strategies
- 29 Communication – meaning, definition, types, elements and characteristics
- 30 Communication models (Aristotle, Shanon-Weaver, Berlo, Schramm, Leagans, Rogers & Shoemaker) – elements and their characteristics; Barriers in communication
- 31 Agricultural Journalism: Agricultural journalism (Print media) - definition, principles, importance, ABC of news, types of news.
- 32 Diffusion of Innovations – definition, elements; Innovation – definition, attributes;
- 33 Adoption – meaning, steps in adoption process, stages, adopter categories, factors influencing adoption of innovations ;Consequences of innovations

34 **Final Examination**

**Practical schedule**

1. Visit to State department of Agri/ Horti to understand the organizational setup, roles, functions and various schemes.
2. Study the organizational set up and functions of DRDA.
3. Visit to NGO and learning from their experience in rural development
4. Visit to KVK to study the mandated activities
5. To study the ToT system of SAUs / Agricultural colleges
6. Exercise on practicing group discussion technique and presentation skills
7. Study on Art of Photography, Video techniques and preparing multimedia presentations and handling of AV aids and LCD projectors
8. Preparation of Posters, charts, leaflet, folder, booklet and Pamphlet
9. Preparation of news stories and success stories.
10. Exercise on practicing Art of Public Speaking (micro teaching skills)
11. To visit the village and understand the socio cultural and agricultural related problems being encountered by the villagers/ farmers
12. Practicing selected PRA techniques in a village setting
13. Visit to Community Radio/ Educational Media Centre to understand the process of programme production.

14. Exercise on Script writing for Radio and TV programme
15. Visit to All India Radio Station / TV to study the various activities & programmes.
16. Visit to the News Agency /TNAU press to study the process
17. Final Practical Exam

### **Suggested Readings (Textbooks, Reviews, Journals)**

- Ahuja, B.N. 1997. Theory and Practice of Journalism, Surjeet Publications, New Delhi.
- Benor Daniel, Q. James Harrison and Baxter Michael. 1984. Agricultural Extension – The Training and Visit System, A World Bank Publication, Washington, USA.
- Chauhan Nikulsinh. 2013. Use of ICTs in Agricultural Extension, Biotech Books.
- Gamble Dennis, Blunden, S. and Wallace, G. 2000. A Systematic Framework for understanding and Improving a Farming or Equine System, (AgPak SA 22), University of Western Sydney, Hawkesbury, NSW, Australia.
- Hough George, A. 2004. News Writing. Kanishka Publishers, New Delhi.
- Dahama, O.P and O.P. Bhatnagar. 1985. Education and Communication for Development, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Dipak de, Basavaprabhu Jirli. 2010. A Handbook of Extension Education, Agrobios, India.
- Katar Singh. 1999. Rural Development – Principles, Policies and Management, Sage Publications India Pvt. Ltd., New Delhi.
- Kelsey, L.D and C.C. Hearne. 1967. Cooperative Extension Work, Cornell University Press, New York.
- Manoharan Muthiah, P. and R. Arunachalam. 2003. Agricultural Extension, Himalaya Publishing House, Mumbai.
- Narayanasamy, N. 2009. Participatory Rural Appraisal Principles, Methods and Application, Sage Publications India Pvt. Ltd., New Delhi.
- Neela Mukherjee. 1993. Participatory Rural Appraisal: Methodology and Applications, Concept Publishing Co.
- Pandey, B.K. 2005. Rural Development, ISHA Books, New Delhi.
- Pandey, V.C. 2003. Information Communication Technology and Education (The Changing World ICT Governance), Isha Publishers.
- Ray, G.L. 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
- Reddy Adivi, A. 1993. Extension Education, Shree Lakshmi Press, Bapatla, Andhra Pradesh.
- Rishipal. 2011. Training and Development Methods, S.Chand and Co. Ltd., New Delhi.
- Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, New York.
- Sagar Mondal and Ray, G.L. 2007. Text book of Rural Development, Kalyani Publishers, New Delhi.
- Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
- Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
- Sanjay Prakash Sharma. 2006. Panchayat Raj, Vista International Publishing House, New Delhi.
- Singh, A.K. 2012. Agricultural Extension, Agrobios, New Delhi.
- Sivasudevaro, B and Rajannikanthu, G. 2007. Rural Development and Entrepreneurship Development, The Associated Publications, Ambala.
- Supe, S.V. 1997. An Introduction to Extension Education, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.



- Van den Ban, A.W and H.S. Hawkins. 2002. Agricultural Extension, CBS Publishers & Distributors, New Delhi.

#### **Journals**

- International Journal of Extension Education
- Indian Journal of Extension Education
- Journal of Extension Education – Coimbatore
- Journal of Extension Education – Bhubaneswar
- Rajasthan Journal of Extension Education
- The Journal of Agricultural Education and Extension
- Journal of Agricultural Extension Management
- Journal of Agricultural Education and Extension
- Indian Journal of Gender Studies
- Indian Research Journal of Extension Education
- Journal of Community Mobilization and Sustainable Development
- Indian Journal of Social Sciences
- Agricultural Extension Review
- Journal of Extension Education - Coimbatore
- Journal of Rural Development
- Yojana

#### **Web resources**

- [rural.nic.in](http://rural.nic.in)
- [www.panchayat.gov.in](http://www.panchayat.gov.in)
- [wcd.nic.in](http://wcd.nic.in)
- [moud.nic.in](http://moud.nic.in)
- [mhupa.gov.in](http://mhupa.gov.in)
- [www.i4d.com](http://www.i4d.com)
- [www.panasia.org](http://www.panasia.org)
- [www.joe.org](http://www.joe.org)

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**Theory****Unit I: Principles of Food Science and Nutrition**

Food Science - definition – classification of foods – functional and nutritional classification. Food groups and food pyramid. Methods of cooking - moist, dry and microwave - principles, merits and demerits. Importance and scope of nutrition – relation of nutrition to health.

**Unit -II: Carbohydrate, Protein and Fat**

Carbohydrate – classification, functions, digestion and absorption, sources and Recommended Dietary allowance (RDA). Energy value of foods – determination. Protein – classification, functions digestion and absorption, sources and requirements. Protein quality of foods – supplementary value of protein. Fat - classification functions, digestion and absorption, sources and requirements. Rancidity – types of rancidity and prevention. Deficiency states of protein, carbohydrate and fat nutrition – signs and symptoms.

**Unit III: Vitamin and Mineral Nutrition**

Fat Soluble vitamins – A, D, E and K- functions, sources, requirements and deficiency. Water soluble vitamins – thiamine , riboflavin , niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid ascorbic acid – functions, sources, deficiency and requirements. Minerals - calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, deficiency and requirements. Importance of water – maintenance of electrolyte balance. Dietary fibre - importance, health benefits, sources and requirements.

**Unit IV: Food Preservation and Processing**

Introduction – preservation by sugar - processing of jam, squash, jelly, marmalade and beverages. Preservation by using salt, chemicals, dehydration technology, canning technology, preservation by low temperature and irradiation techniques. Processing of puffed, flaked and extruded products. Quality control of raw and processed products.

**Unit V: Food Quality and Safety**

Food packaging materials – requirements – methods – nutrition labeling. Food adulterants and their detection methods. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

**Practical**

Determination of energy value of Foods, cooking quality tests – cereals and pulses. Estimation of moisture, protein and fat. Processing of jam, jelly, squash, ready to serve beverages (RTS). Preparation of flaked, puffed and extruded products. Visit to food industries and quality control laboratory.

**Theory Schedule**

1. Food Science – definition, scope and classification, food pyramid.
2. Methods, merits and demerits of moist heat, dry heat and microwave cooking of foods.
3. Importance and scope of nutrition and the relation of nutrition to health.
4. Carbohydrate – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
5. Protein – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements. Protein quality – supplementary value of protein.
6. Fat - classification, functions, digestion and absorption, deficiency symptoms, sources and requirements. Rancidity – types. Determination of energy value of foods.
7. Fat soluble vitamins – A, D, E and K – functions, deficiency symptoms, sources and requirements.

8. Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, cyanocobalamin, biotin, pantothenic acid, ascorbic acid – functions, deficiency symptoms, sources and requirements.

#### **9. Mid Semester Examination**

10. Minerals – calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, requirements and deficiency diseases.
11. Importance of water and maintenance of electrolyte balance. Health benefits of fibre.
12. Preservation of food by low and high temperature and food irradiation.
13. Processing of puffed, flaked and extruded products
14. Preservation by using sugar (jam, jelly, squash and marmalade), preservation by using salt (brining and pickling) and use of preservatives in food preservation.
15. Food packaging – importance, types of packaging materials and nutrition labeling.
16. Common food adulterants and their detection.
17. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

#### **Practical Schedule**

1. Cooking tests for cereals and pulses
2. Determination of energy value of food
3. Estimation of moisture
4. Estimation of protein
5. Estimation of fat
6. Estimation of ascorbic acid
7. Estimation of iron
8. Estimation of crude fibre
9. Processing of jam and jelly
10. Processing of squash and RTS
11. Puffing of pulses
12. Extrusion of cereals and millets
13. Canning of fruits and vegetables
14. Processing of dehydrated fruits and vegetables
15. Identification of common food adulterants
16. Visit to food processing unit and quality control lab
17. Final Practical Examination

#### **TEXT BOOKS**

1. Srilakshmi, B. 2005. Food Science. New Age International (P) Ltd., Publishers, New Delhi.
2. Srivastava, R.P., and Sanjeevkumar. S. 2013. Fruit and Vegetable preservation. International Book Distributing Co. Lucknow.
3. Srilakshmi .B. 2015. Nutrition Science. New Age International Pvt. Ltd. New Delhi.

#### **JOURNALS**

1. The Indian Journal of Nutrition and Dietetics
2. Journal of Food Science and Technology
3. Critical Reviews of Food Science and Nutrition

#### **WEB RESOURCES**

1. [www.cellinteractive.com](http://www.cellinteractive.com)
2. [www.nutrition.org.uk](http://www.nutrition.org.uk)
3. [www.fnict.nal.usda.gov](http://www.fnict.nal.usda.gov)
4. [www.myfooddiary.com](http://www.myfooddiary.com)

## **AGR 102. Introductory Agro-meteorology & Climate Change (1+1)**

### **Theory:**

#### **Unit - I: Climate and weather**

Meteorology - Agricultural Meteorology - Importance and scope in crop production - Coordinates of India and Tamil Nadu - Atmosphere - Composition and vertical layers of atmosphere (stratification) - Climate - Weather - Factors affecting climate and weather - Climatic types - Different agricultural seasons of India and Tamil Nadu and climatic characteristics of India.

#### **Unit - II: Solar radiation, RH and Wind**

Solar radiation - Light intensity, quality, direction and duration - Air and Soil temperature - Diurnal variation - importance in crop production. Heat unit and its importance in agriculture. Relative Humidity and its importance - vapor pressure deficit and its importance - Wind and its effect on crops.

#### **Unit - III: Atmospheric pressure and precipitation**

Atmospheric pressure - cyclones, anticyclones, tornado, hurricane and storms - Wind systems of the world -. Clouds - types and their classification. Precipitation - forms - monsoon - Seasons of India- rainfall variability drought, flood and their effect - Cloud seeding - Evaporation - transpiration - Evapotranspiration - PET.

#### **Unit - IV: Agroclimatic zones and remote sensing**

Agro climatic Zones of India and Tamil Nadu - Agro climatic normals - Weather forecasting - synoptic chart - crop weather calendar - Remote sensing - Impact of climate and weather on crop production and pest and diseases.

#### **Unit - V: Climate change**

Climate change- climate variability - definition and causes of climate change - Impact of climate change on Agriculture.

### **Practical:**

Observatory - Site selection and layout. Acquiring skill in use of Pyranometers - Sunshine recorder - Maximum, Minimum, Grass minimum and Soil thermometers - Thermograph, Dry and wet bulb thermometers - Hygograph - Psychrometers - Fortein's barometer - Barograph - Altimeter; Wind vane, Anemometer - Raingauge - Ordinary and self-recording - Dew guage; Automatic weather station - Evaporimeters - Lysimeters, Automatic weather station - Preparation of synoptic charts and crop weather calendars. Rainfall probability analysis. Mapping of Agroclimatic Zones.

### **Theory**

#### **Lecture Schedule:**

1. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production.
2. Coordinates of India and Tamil Nadu. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
3. Climate and weather - Factors affecting climate and weather. Macroclimate - Meso climate - Microclimate - Definition and their importance - Different climates of India and Tamil Nadu and their characterization.
4. Solar radiation - Radiation balance - Wave length characteristics and their effect on crop production - Light - effect of intensity, quality, direction and duration on crop production.
5. Air temperature - Factors affecting temperature. Diurnal and seasonal variation in air temperature - Isotherm, Heat unit and its use - Heat and cold injuries.
6. Role of temperature in crop production. Soil temperature - Importance in crop production. Factors affecting soil temperature, diurnal and seasonal variation in soil temperature.
7. Humidity - Types - Dew point temperature - Vapour pressure deficit - Diurnal variation in Relative humidity and its effect on crop production - Wind and its role on crop production.

8. Atmospheric pressure, diurnal and seasonal variation - Isobar – cyclone, hurricane, tornado and storms.
9. **Mid Semester Examination.**
10. Wind systems of the world - wind speed in different seasons -. Clouds and their classification - Concepts of cloud seeding - present status.
11. Precipitation - Forms of precipitation - Isohyte - Monsoon - Different monsoons of India - Rainfall variability - Drought and flood - Impact on crop production.
12. Evaporation - Transpiration, evapotranspiration - Potential evapotranspiration - Definition and their importance in agricultural production. Agroclimatic zones of Tamil Nadu - Agroclimatic normals for field crops.
13. Weather forecasting - Types, importance, Agro Advisory Services - Synoptic chart - Crop weather calendar.
14. Remote sensing and its application in agriculture.
15. Effect of weather and climate on crop production, soil fertility and incidence of pest and diseases.
16. Climate change, climate variability - definition and causes of climate change.
17. Impact of climate change on Agriculture.

#### **Practical Schedule:**

1. Site selection and layout for Agromet Observatory - Calculation of local time - Time of observation of different weather elements - Reviewing agromet registers.
2. Measurements of solar radiation (pyranometers), sunshine hours (sunshine recorder) - working out weekly and monthly mean for graphical representation.
3. Measurement of air and soil temperature and grass minimum thermometers and thermographs - drawing isolines.
4. Humidity measurements - use of wet and dry bulb thermometers - Psychrometers - Hygrograph - Measurement of wind direction and wind speed and conversion (KMPH, KNOT, and M/Sec.) - Beaufort's scale.
5. Measurement of atmospheric pressure - barograph - Fortin's barometer - Isobars based on past data for different seasons.
6. Measurement of rainfall - Ordinary and self-recording rain gauges - Measurement of Dew - dew gauge- study of Automatic weather station.
7. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data- Measurement of Evapotranspiration- Lysimeter.
8. Heat Unit concept- GDD, HTU, PTU for fixing time of sowing.
9. Probability analysis of rainfall for crop planning.
10. Drawing Synoptic charts for understanding weather.
11. Preparation of crop weather calendars and forecast based agro advisories.
12. Preparation pest weather calendar and pest forewarning.
13. Estimation of length of growing periods using weekly rainfall data.
14. Water balance studies.
15. Identification of efficient cropping zone- RYI, RSI.
16. Mapping of agro climatic Zones of India and Tamil Nadu and its characterization.
17. **Practical Examination.**

#### **References**

- Mavi, H.S., 1996. Introduction to Agrometeorology, oxford and IBH Publishing Co., New Delhi.
- Gopalswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur. Prasad, Reddy, S.R. and Reddy, D.S. 2014. Agro meteorology. Kalyani Publishers, NewDelhi
- Reddy, S.R. 2014. Introduction to Agriculture and Agrometeorology. Kalyani Publishers, NewDelhi.

Patra, A.K. 2016. Principles and applications of Agricultural Meteorology. New India Publishing Agency, New Delhi.

Smith, J.W. 2013. Agricultural meteorology. Axis Books (India), Jodhpur

Rao, P. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd, New Delhi

Murthy, R.V. 2002. Basic Principles of Agricultural Meteorology. BS Publications, Hyderabad.

Singh, J. 2014. Textbook of Agricultural meteorology. Oxford Book Company, New Delhi.

Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University Press, Thrissur.

**E:References:**

[www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)

[www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)

[www.imd.gov.in](http://www.imd.gov.in)

## **HOR 112 . Production Technology for Fruit and Plantation Crops (1+1)**

### **Aim**

To impart knowledge on the production techniques of tropical, sub tropical, temperate fruit crops and plantation crops.

### **Syllabus**

#### **Theory**

##### **Unit I: 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.

##### **UNIT II: Crop production techniques in tropical fruit crops**

Climate and soil requirements – varieties – propagation and use of rootstocks- planting density and systems of planting - High density and ultra high density planting - cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- value addition.

**Fruit crops:** mango, banana, papaya, guava, sapota

##### **UNIT III: Crop production techniques in subtropical fruit crops**

Climate and soil requirements – varieties – propagation and use of rootstocks- planting density and systems of planting - High density and ultra high density planting - cropping systems - after care - training and pruning - water, nutrient and weed management – fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest and value addition.

**Fruit crops:** citrus, grape, litchi, pineapple, pomegranate, jackfruit and minor fruits

##### **UNIT IV: Crop production techniques temperate fruit crops**

Climate and soil requirements – varieties – propagation and use of rootstocks - planting density and systems of planting -High density and ultra high density planting -cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest and value addition.

**Fruit crops:** apple, pear, peach, strawberry, nut crops.

##### **UNIT V Crop production techniques in palms and plantation crops**

Climate and soil requirements - varieties - propagation - nursery management - planting and - planting systems - cropping systems - after care - water, nutrient and weed management - intercropping - multi-tier cropping system - mulching - special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition

**Palms:** Coconut, Arecanut, Oil palm and Palmyrah

Climate and soil requirements - varieties- propagation - nursery management - planting and planting systems - cropping systems- after care- training and pruning - water, nutrient and weed management - shade management - intercropping - mulching - cover cropping - special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition.

**Plantation crops:** Tea, Coffee, Cocoa, Cashew, Rubber

#### **Practical**

Propagation methods for fruit crops - description and identification of varieties - preparation of plant bio regulators & their uses – nutrient deficiency and disorders of fruit crops - fertilizers- application - pests and diseases- micro propagation in fruit crops- Visit to commercial orchard.

**Fruit Crops: Mango, banana, papaya, guava, sapota, grapes, citrus (Mandarin and acid lime), pomegranate and jackfruit**

Propagation methods for plantation crops - description and identification of plantation crops - preparation of plant bio regulators & their uses - nutritional disorders of plantation crops - fertilizers- application - pests and diseases- cost economics of plantation crops. Visit to plantations and plantation industries.

**Palms and plantation Crops: Coconut, Arecanut, Cashew, Tea, Coffee, Rubber and Cocoa**

### Theory schedule

1. Importance and scope of fruit and plantation crop industry in India – nutritional value of fruit crops
2. Classification of fruit crops – area, production, productivity and export potential of fruit and plantation crops
3. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning- top working - water, nutrient and weed management- canopy management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Mango**
4. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- water and nutrient management – fertigation - Weed control - Plant growth regulation - important disorders – maturity indices and harvest- post harvest management of **Banana**
5. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation- important disorders – maturity indices and harvest - post harvest management of **Papaya, Guava and sapota**
6. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation – nutrient deficiencies and important disorders – maturity indices and harvest- post harvest management of **Citrus (Sweet orange, Mandarin and Acid Lime)**
7. Climate and soil – varieties - propagation methods - planting and cropping systems-after care – systems of training and pruning and bud forecasting - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Grapes**
8. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - plant growth regulation- important disorders – maturity indices and harvest - post harvest management of **pineapple and litchi**
9. **Mid semester examination**
10. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Pomegranate, jackfruit and minor fruits**
11. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of **Apple and pear**
12. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - plant growth regulation -



important disorders – maturity indices and harvest - post harvest management of **Peach and strawberry, nut crops** .

12. Climate and soil requirements - varieties - propagation - nursery management - planting systems - planting density -nutrient, water and weed management - intercropping at various ages of plantation -multitier cropping - shade management - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of **Coconut**
13. Climate and soil requirements - varieties - propagation - nursery management - planting systems - planting density - nutrient, water and weed management - intercropping at various ages of plantation - multitier cropping – shade management - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of **Arecanut and Cocoa** .
14. Climate and soil requirements - varieties - propagation - nursery management - planting and planting density - HDP - UHDP - nutrient, water and weed management - cover cropping - tapping - use of plant growth regulators - top working - maturity indices - harvest and yield , latex yield and processing - pests and diseases - grading - processing and value addition **Rubber and Cashew** .
15. Climate and soil requirements- varieties – propagation - nursery management - planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of **Tea** .
16. Climate and soil requirements - varieties – propagation - nursery management - planting - nutrient, water and weed management - mixed and inter cropping - shade management - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of **Coffee**.
17. Climate and soil requirements - varieties – propagation - nursery management - planting - nutrient, water and weed management - water conservation techniques - leaf pruning - pollination - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition **Oil palm and Palmyrah**.

#### **Practical schedule**

1. Propagation techniques, selection of planting material, varieties, important cultural practices for **Mango**
2. Propagation techniques, selection of planting material, varieties, important cultural practices for **Banana**
3. Propagation techniques, selection of planting material, varieties, important cultural practices for **Papaya**
4. Propagation techniques, selection of planting material, varieties, important cultural practices for **Guava**
5. Propagation techniques, selection of planting material, varieties, important cultural practices for **Sapota**
6. Propagation techniques, selection of planting material, varieties, important cultural practices for **Grapes**
7. Propagation techniques, selection of planting material, varieties, important cultural practices for **Citrus (Mandarin and acid lime)**
8. Propagation techniques, selection of planting material, varieties, important cultural practices for **Pomegranate**

9. Propagation techniques, selection of planting material, varieties, important cultural practices for **Jackfruit**
10. Preparation and application of PGR's for propagation.
11. Micro propagation, protocol for mass multiplication and hardening of fruit crops.
12. Identification and description of varieties - mother palm and seed nut selection - nursery practices- seedling selection – fertilizers - application - nutritional disorders - pests and diseases of **Coconut**
13. Identification and description of varieties - mother palm and seed nut selection- nursery practices- fertilizers - application - nutritional disorders - pests and diseases of **Arecanut and cocoa**
14. Identification and description of varieties - nursery practices - training and pruning - pests and diseases – processing of **Tea and coffee**
15. Identification and description of varieties, clones - bud wood nursery practices - propagation techniques - top working – preparation of plant bio regulators and its uses- pests and diseases - processing of **Rubber and cashew**
16. Visit to commercial orchard and plantation industries.
- 17. Practical examination**

#### **Outcome**

- Students will be imparted with wide knowledge on major tropical, a few sub tropical and temperate fruit and plantation crops
- Hands on training on various propagation methods and important cultural practices for major fruit and plantation crops will be provided (Practical)

#### **Reference text books**

1. Kumar, N. 2014. Introduction to Horticulture. Oxford & IBH Publishing co. Pvt. Ltd.
2. Chadha, K.L and Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vols. IIIIV. Malhotra Publ. House
3. Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India Publishing Agency, New Delhi.
5. Veeeraragavathatham, D and et al.,2004. Scientific fruit culture, Sun Associates, Coimbatore.
6. Henry Louis, I. 2002. Coconut- The wonder palm. Hi - Tech Coconut Corporation, Nagercoil.

#### **E references**

<http://www.jhortscib.com>  
<http://journal.ashspublications.org>  
<http://www.actahort.org/>  
<http://www.aphorticulture.com/crops.htm>  
<http://cpcricri.nic.in/>  
<http://indiancoffee.org>

## **RSG 101 Geoinformatics for Precision Farming (1+0)**

### **Theory**

#### **Unit I**

Remote sensing: Concepts - Electromagnetic radiation: principles and theories- Energy interaction: atmosphere and earth surface features- Spectral reflectance of earth features- Platforms and sensors: types and characteristics. Image Processing and Interpretation – Digital image processing: Image Classification - Optical, Microwave and Drones

#### **Unit II**

GIS: Definition, Components and functions- Raster and vector data models and non-spatial data types - Raster Data Analysis: Local, Neighborhood and Regional Operations- Vector Data Analysis: Querying, Buffering, Overlay

#### **Unit III**

Geodesy and its basic principles -Global Positioning System – components and its functions. GPS survey methods- Error sources - DEM – Sources, Generation and application.

#### **Unit IV**

Precision agriculture: concepts and techniques; their issues and concerns –STCR / VRT approach for precision agriculture - Soil moisture, Pest and Disease incidence – nutrient deficiencies – linking with VRT using Geospatial Technologies

#### **Unit V**

Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies. Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs – Drones for precision agriculture

### **Theory schedule**

1. Remote sensing concepts and Electromagnetic radiation. Energy interaction: atmosphere and earth surface features and Spectral reflectance
2. Platforms and sensors: types and characteristics
3. Elements of visual photo/image interpretation
4. Digital image processing -Image classification – Optical, Microwave and Drones
5. GIS: Definition and Components and functions
6. Raster and vector data models and non-spatial data types
7. Raster Data Analysis: Local, Neighborhood and Regional Operations.
8. Vector Data Analysis: Querying, Buffering, Overlay and Network Analysis
9. **Mid-semester Examination**
10. Geodesy and its basic principles
11. GPS: components and functions - GPS Survey and Error Sources
12. Precision agriculture: concepts and techniques; their issues and concerns – STCR / VRT approach
13. Soil moisture, Pest and Disease incidence – nutrient deficiencies – linking with VRT using Geospatial Technologies
14. Crop discrimination and Yield monitoring using Remote Sensing
15. Soil mapping; fertilizer recommendation using geospatial technologies
16. Introduction to Crop Simulation Models and their uses for optimization of Agricultural Inputs
17. Drones for precision agriculture

**Textbooks**For Remote Sensing part of syllabus

Anji Reddy, M. 2008. Textbook of Remote Sensing and Geographic Information Systems. Third Edition. BS Publication, Hyderabad

For GIS part of syllabus

Rolf A.de By. 2001. Principles of Geographic Information Systems. ITC Educational Textbook Series I

For Application part of syllabus

Roy, P.S., R.S.Dwivedi and D.Vijayan.2010. Remote Sensing Applications. NRSC Publication. ISBN: 978-81-909460-0-1

**Web resources**

1. [www.physicalgeography.net](http://www.physicalgeography.net)
2. [www.gisdevelopment.net](http://www.gisdevelopment.net)
3. [www.gis.nic.in](http://www.gis.nic.in)
4. [www.geos.iitb.ac.in/remotesensing.html](http://www.geos.iitb.ac.in/remotesensing.html)
5. [www.dimensionigis.com/remote\\_sensing.html](http://www.dimensionigis.com/remote_sensing.html)