

### I SEMESTER

S. No	Course code	Course Title	Credit load
1	AGR 101	Fundamentals of Agronomy and Agricultural Heritage	1+1
2	BIC 101	Fundamentals of Plant Biochemistry	2+1
3	SAC 101	Fundamentals of Soil Science	2+1
4	FOR 111	Introduction to Forestry	1+1
5	ENG 101	Comprehension & Communication Skills in English	1+1
6	HOR 111	Fundamentals of Horticulture	1+1
7	MAT 111	Elementary Mathematics	1+1
8	PBG 101	Introduction to Agricultural Botany	1+1
9	AEX101	Rural Sociology & Educational Psychology	2+0
10	TAM101/ ENG103	Development Education	0+1
11	NSS/NCC 101	NSS/NCC	0+1*
12	PED 101	Physical Education	0+1*
13	PED102	Yoga for human excellence	0+1*
			<b>12+9=21</b>
		<b>*Non-gradual courses compulsory courses</b>	

## **AGR 101 Fundamentals of Agronomy and Agricultural Heritage (1+1)**

### **Unit - I: Importance of agriculture**

Agriculture - Definition - Importance and scope - Branches of agriculture - Evolution of human and agriculture - History of agricultural development in the World and India.

### **Unit - II: Agricultural heritage**

Agriculture heritage - Agriculture in ancient India - Chronological agricultural technology development in India - Kautilya's Arthashastra - Sangam literature - Kambar Eazhupathu - Development of scientific Agriculture - National and International Agricultural Research Institutes in India - Indian agriculture.

### **Unit - III: Agroclimatic zones, crops and soils**

Agronomy - Definition - Importance and scope - Agro-climatic zones of Tamil Nadu - Agro ecological zones of India - Crops and their classification - Economic and agronomic - Major crops of India and Tamil Nadu - Major soils of Tamil Nadu - Factors affecting crop production - climatic - edaphic - biotic - physiographic and socio economic factors.

### **Unit - IV: Tillage and after cultivation**

Tillage - Definition - Types - Objectives - Modern concepts of tillage - Main field preparations - Seeds - seed rate - sowing methods - Crop establishment methods - Planting geometry and its effect on growth and yield - After cultivation - Thinning - Gap filling - Weeds - Definition - Weed control methods.

### **Unit - V: Cropping and farming systems**

Manures and fertilizers (organic, in-organic, green manure) - time and method of application - Irrigation  
- Principles and concepts - Cropping patterns and cropping systems - Sustainable agriculture - integrated farming systems - Organic agriculture - Principles and concepts - Dry farming - Principles and concepts.

### **Practical:**

Visit to college farm - Study of farm features and measurements - identification of crops and seeds - working out seed rate - Study of seed treatment practices - Study of tillage implements; practicing ploughing, puddling operations, practicing seeding different methods of sowing and planting - Study and practicing inter-cultivation implements; Practicing fertilizer applications - Participation in ongoing field operations.

### **Theory Lecture Schedule:**

1. Agriculture - Definition - Importance and scope - Branches of agriculture - Evolution of man and agriculture.
2. Indian agriculture - Indian economy - National income - per capita income - Agricultural income in GDP - Women in agriculture and empowerment.
3. History of agricultural development in the world and India. Agriculture heritage - Agriculture in ancient India.
4. Agriculture heritage - Agriculture in ancient India.
5. Chronological agricultural technology development in India. Kautilya's Arthashastra - Sangam literature - rainfall prediction - ITK - Tamil Almanac.

6. Development of scientific agriculture - National and International Agricultural Research Institutes.
7. Agronomy - definition - meaning and scope. Agro-climatic zones of India and Tamil Nadu - Agro ecological zones of India and Tamil Nadu.
8. Crops and major soils - classification - Economic and agricultural importance in Tamil Nadu and India.
9. **Mid Semester Examination**
10. Factors affecting crop production - climatic - edaphic - biotic- physiographic and socio economic factors.
11. Tillage - Definition - objectives - types of tillage - modern concepts of tillage - main field preparation.
12. Seeds - Seed rate - sowing methods - Germination - Crop stand establishment - Planting geometry.
13. Weeds - Definition - harmful and beneficial effects of weeds - crop weed competition and management of weeds - IWM.
14. Role of manures and fertilizers in crop production - Inter cultivation - Thinning - gap filling and other intercultural operations.
15. Irrigation - time and methods - Modern techniques of irrigation - Drainage and its importance.
16. Cropping patterns and cropping system - intensive cropping - sustainable agriculture – IFS.
17. Organic / eco - friendly agriculture - Dry farming- principles and concepts.

**Practical schedule:**

1. Visit to college farm to observe wetland farming system and identification of crops.
2. Visit to college farm to observe garden land and dry land farming systems and identification of crops.
3. Identification of seeds, manures, fertilizers, green manures and green leaf manures.
4. Identification of tools and implements.
5. Acquiring skill in handling primary and secondary tillage implements.
6. Practicing different methods of land configuration for raising nursery for wet land crops.
7. Practicing different methods of land configuration for raising nursery for garden land crops.
8. Practicing different methods of seed treatments, methods of sowing and seeding implements.
9. Working out seed rates and practicing thinning, gap filling operations for optimum crop stand and intercultural operations.
10. Working out manure and fertilizer requirement of crops.
11. Practicing methods of application: manures and fertilizers and incorporation of green manure and green leaf manure.
12. Identification of weeds, weeding practices and handling of weeding tools and implements.
13. Observing various irrigation methods.
14. Practicing harvesting operations in major field crops.
15. Participation in on-going field operations during on campus / off campus visit.
16. Visit to nearby Agricultural Research station.
17. **Final Practical Examination.**

**References:**

- Yellamananda Reddy, T. and G.H. Sankara Reddi. 1997. Principles of Agronomy. Kalyani Publishers, New Delhi.
- Sankaran, S. and V.T. Subbiah Mudaliar. 1997. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
- Reddy,S.R. Principles of Agronomy.2016.Kalyani Publishers, New Delhi.
- Somasundaram,E.2017. Agronomy: Principles and Practices. NewIndia Publishing agency, New Delhi.
- ICAR. 2015. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.

**E-References:**

1. <http://icar.res.in>
2. [ww.webcast.gov.in](http://www.webcast.gov.in)
3. [ww.icar.org.in/nasm.html](http://www.icar.org.in/nasm.html)

## **BIC 101 Fundamentals of Biochemistry (2+1)**

### **UNIT I**

#### **Carbohydrates**

Carbohydrates - occurrence and classification. Structure of monosaccharides, **oligosaccharides** and polysaccharides. Physical and chemical properties of carbohydrates – optical isomerism, optical activity, mutarotation, reducing property, reaction with acids and alkalies. **Glycoconjugates - Glycoproteins and Lectin - structure and significance.**

### **UNIT II**

#### **Lipids**

Lipids - occurrence and classification. Storage lipids - fatty acids, triacyl glycerol, essential fatty acids, waxes. **Structural lipids - role of lipids in biological membrane - glycolipids** and phospholipids - types and importance; Sterols - basic structure and their importance. Physical and chemical constants of oils. Rancidity of oils.

### **UNIT III**

#### **Proteins and Enzymes**

Amino acids - classification and structure. Essential amino acids. Properties of amino acids - amphoteric nature and isomerism. Classification of proteins based on functions and solubility. Structure of proteins: primary structure, secondary structure, tertiary structure and quaternary structure - **protein folding and denaturation.** Properties and reactions of proteins. Enzymes - Properties, classification and nomenclature. Mechanism of enzyme action. Factors affecting enzyme activity. Enzyme inhibition - Competitive, Non-competitive and Uncompetitive inhibition; **Allosteric enzymes.** Coenzymes, cofactors and isoenzyme.

### **UNIT IV**

#### **Metabolism**

Carbohydrate metabolism - breakdown of starch by amylases, glycolysis, TCA cycle and pentose phosphate pathway. Respiration - electron transport chain and oxidative phosphorylation. Bioenergetics of glucose. Lipid metabolism - lipases and phospholipases. Beta-oxidation of fatty acids and bioenergetics. Biosynthesis of fatty acids and triacyl glycerol. General catabolic pathway for amino acids - transamination, deamination and decarboxylation. Ammonia assimilating enzymes. Metabolic inter-relationship.

### **UNIT V**

#### **Secondary metabolites**

Secondary metabolites - occurrence, classification and functions of phenolics, terpenes and alkaloids.

#### **Lecture schedule:**

1. Introduction to Biochemistry, Carbohydrates – occurrence and classification R2: 1-4, 66-72.
2. Structure of monosaccharides. R2: 75-82.
3. Structure of oligosaccharides and polysaccharides. R2: 82-90.
4. Physical properties of carbohydrates - Mutarotation, optical activity, isomerism. R2: 73-78.
5. Chemical reactions of carbohydrates. R2: 90-95.
6. Glycoproteins and lectin - structure and significance. R1: 316-321.
7. Lipids - occurrence and classification. R2: 99-100.
8. Storage lipids - Fatty acids and triacyl glycerol. Essential fatty acids, waxes. R2: 101-106.
9. Structural lipids - Glycolipids and phospholipids - types and importance. R2: 107-111.

10. Sterols - basic structure and their importance. R2: 111-114.
11. Physical and chemical constants of oils. Rancidity of oils. R2: 114-119.
12. Amino acids - Classification and structure. R2: 17-21.
13. Properties of amino acids - amphoteric nature, isomerism, essential amino acids. R2: 21-26.
14. Classification of proteins based on function and solubility. R2: 26-31.
15. Structure of protein - Primary, secondary, tertiary and quaternary structure. R2: 31-41.
16. Protein folding, physical and chemical properties of proteins. R2: 41-43, R1: 52-55.
17. **Mid Semester Examination**
18. Enzymes - Properties, classification and nomenclature. R2: 123-127.
19. Mechanism of enzyme action. R2: 129-131.
20. Factors affecting enzyme activity. R2: 131-136.
21. Enzyme inhibition - competitive, non-competitive, uncompetitive and allosteric enzymes. R2: 136-137, R1: 224-225.
22. Coenzymes, cofactors and isoenzyme. R2: 127-129, 138.
23. Carbohydrate metabolism - breakdown of starch by amylases, Glycolysis - Reactions and bioenergetics. R2:159-164.
24. TCA cycle - Reactions and bioenergetics. R2: 164-168.
25. Pentose phosphate pathway - Reactions . R2: 174-177.
26. Respiration - electron transport chain and oxidative phosphorylation. R2: 170-173.
27. Lipid metabolism - lipases and phospholipases. R2: 205-208.
28. Beta-oxidation of fatty acids and bioenergetics. R2: 208-212.
29. Biosynthesis of fattyacids and triacylglycerol. R2: 213- 220.
30. Transamination, deamination and decarboxylation of amino acids. R2: 224-231.
31. Ammonia assimilating enzymes - GS, GOGAT and GDH. R2: 231-233.
32. Metabolic inter-relationship. R2: 287-289.
33. Secondary metabolites - occurrence, classification and functions of phenolics. R2: 274-276.
34. Occurrence, classification and functions of terpenes and alkaloids. R2: 277-280.

### **Practical Schedule:**

1. Qualitative analysis of carbohydrates
2. Estimation of starch
3. Estimation of amylose
4. Determination of reducing sugars
5. Qualitative analysis of amino acids
6. Sorenson's formal titration of amino acids
7. Estimation of amino acids by Ninhydrin method
8. Estimation of protein by Biuret method
9. Determination of free fatty acid of an oil
10. Determination of iodine number of an oil
11. Estimation of ascorbic acid by dye method
12. Assay of amylase
13. Estimation of total phenols
14. **Extraction and estimation of lycopene and carotenoids**
15. Separation of amino acids by paper chromatography
16. Separation of **phenols** by thin layer chromatography
17. **Final Practical Examination**

## References

1. Berg JM, Tymoczko JL and Stryer L, (2007), Biochemistry, 7<sup>th</sup> Ed. Wiley Eastern Ltd. ISBN:0-7167-8724-5.
2. Thayumanavan, B, Krishnaveni, S and Parvathi, K, (2004), Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.

## E-References:

1. Cox, MM and Nelson, DL. (2011), Principles of Biochemistry, Fourth (Indian edition) Macmillian, Worth Publishers. <http://bcs.whfreeman.com/lehninger6e> - Web links/ Tutorials/ Lecture companion Art
2. Harper's illustrated Biochemistry -<https://freemedeblogs.files.wordpress.com/2014/01/harpers-illustrated-biochemistry-28th-edition.pdf>
3. J M Berg, J L Tymoczko and L Stryer , Biochemistry, Sixth Edition - <http://www.irb.hr/users/precali/Znanost.o.Moru/Biokemija/Literatura/Lubert%20Stryer%20-%20Biochemistry.pdf>
4. Sadasivam, S and Manickam, A. (2009), Biochemical Methods, 3<sup>rd</sup> Edn, New Age International.
5. Wilson, K. and Walker, J.M. (2000), Principles and techniques of Practical Biochemistry, 5<sup>th</sup> Edn. – Cambridge University Press.
6. [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)

## **SAC 101 Fundamentals of Soil Science (2+1)**

### **Unit I**

Soil as a natural body, Pedological and edaphological concepts of soil. Components of soil. Soil genesis: Composition of Earth's crust- soil forming rocks and minerals – Primary and secondary minerals. Weathering of rocks and minerals. Factors of soil formation. Soil forming processes. Soil Profile.

### **Unit II**

Soil physical properties: Soil texture, structure, density and porosity, soil colour, consistence and plasticity. Soil water retention, movement and availability. Soil air, composition, gaseous exchange-problem and its effect on crop growth. Source, amount and flow of heat in soil, Soil temperature and crop growth.

### **Unit III**

Soil physico chemical and chemical properties: Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability. Electrical conductivity. Soil colloids - inorganic and organic. Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation.

### **Unit IV**

Soil organic matter: composition, properties and its influence on soil properties. Humic substances - nature and properties. Soil Biology : Soil organisms : macro and micro organisms, their beneficial and harmful effects. Soil enzymes. Soil pollution – Types and behaviour of pesticides. Inorganic contaminants. Prevention and mitigation of soil pollution.

## **PRACTICAL SCHEDULE**

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil colour. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Demonstration of heat transfer in soil. Preparation and standardization of laboratory reagents, indicators and buffers. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Estimation of organic matter content of soil. Study of soil map.

### **Lecture Schedule:**

1. Soil definition - Soil as a three dimensional natural body, Pedological and edaphological concepts of soil
2. Components of soil – soil a three phase system- Composition of Earth's crust.
3. Soil genesis: soil forming rocks-definition, formation, Classification of rocks- igneous, sedimentary and metamorphic rocks
4. Brief description of important rocks - mineralogical composition
5. Minerals- definition, occurrence, classification of important soil forming primary minerals - silicate and non silicate minerals, ferro and non-ferro magnesium minerals
6. Formation of secondary minerals - clay minerals and amorphous minerals
7. Weathering - Rocks and minerals - Physical, chemical and biological weathering
8. Factors of soil formation- Passive and active soil forming factors soil forming factors
9. Soil forming process- Fundamental - Simenson's four fold soil forming process -eluviation, illuviation, translocation and humification



10. Specific Soil forming processes - podzolization, laterization, salinization, alkalization, calcification, decalcification and pedoturbation
11. Soil Profile – Horizons, Master horizons and subordinate horizons, subdivisions, Lithological discontinuity.
12. Soil physical properties: Soil texture - particle size distribution - textural classes - textural triangular diagram - significance of soil texture
13. Soil structure - classification - genesis - factors influencing structural stability - significance of soil structure
14. Soil bulk density, particle density and porosity - factors influencing – significance.
15. Soil colour - causes and measurement - Munsell colour chart - factors influencing soil colour – Significance of soil colour.
16. Soil consistence - cohesion, adhesion, plasticity, Atterberg's constants - upper and lower plastic limits, plasticity number- significance of soil consistence
17. **Mid semester Examination**
18. Soil water- forms of water, units of expression and pF scale
19. Soil water potentials - gravitational, matric, osmotic- Soil moisture constants and Soil moisture measurements.
20. Movement of soil water - Saturated and unsaturated flow - infiltration, hydraulic conductivity, percolation, permeability and drainage
21. Soil air, composition, gaseous exchange – Problem and its effect on crop growth.
22. Source, amount and flow of heat in soil, soil temperature and crop growth. and crop growth.
23. Soil reaction (pH) - definition, pH scale, soil acidity and alkalinity, buffering, effect of pH on nutrient availability and factors affecting soil pH
24. Soil Electrical Conductivity - Factors affecting EC – its significance
25. Soil colloids - inorganic and organic
26. Silicate clays: constitution and classification - 1:1, 2:1 expanding and non expanding - 2:2 clay minerals, amorphous minerals and their properties
27. Sources of charge, ion exchange – positive and negative charge – isomorphous substitution, pH dependant charge.
28. Ion exchange - Cation and anion exchange capacity and base saturation
29. Soil organic matter: composition, properties and its influence on soil properties
30. Humic substances – fractionation, nature and properties, Theories of humus formation.
31. Soil Biology- Soil organisms: macro and micro organisms, their beneficial and harmful effects, Soil enzymes
32. Soil carbon sequestration and carbon trading
33. Soil pollution - behaviour of pesticides and inorganic contaminants
34. Prevention and mitigation of soil pollution

**Practical schedule:**

1. Study of soil sampling tools, collection of representative soil sample, its processing and storage.
2. Study of soil profile in field.
3. Study of soil forming rocks and minerals.
4. Determination of soil density and porosity.
5. Determination of soil colour and moisture content and porosity.
6. Determination of soil texture by feel and Bouyoucos Methods
7. Determination of soil texture by International pipette method.
8. Studies of capillary rise phenomenon of water in soil column and water movement in soil (Infiltration Rate)

9. Studies of capillary rise phenomenon of water in soil column and water movement in soil (Hydraulic conductivity)
10. Determination of soil temperature and demonstration of heat transfer.
11. Preparation and standardization of laboratory reagents, indicators and buffers
12. Determination of soil pH and electrical conductivity.
13. Determination of cation exchange capacity of soil - I.
14. Determination of cation exchange capacity of soil - II
15. Estimation of soil organic carbon.
16. Study of soil map (India and Tamil Nadu )

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

### **References**

1. Brady, N.C. and Raymond, C.Weil. 2013. The Nature and Properties of Soils (14<sup>th</sup> Edition). Pearson Education, Inc. Publishing as Prentice Hall.
2. Fundamentals of Soil Science. 2009. ISSS Publication, New Delhi.
3. Sehgal, J. 2005. Pedology concepts and applications, Kalyani Publishers, New Delhi.
4. Das, D.K. 2013. Introductory Soil science, Kalyani Publishers, New Delhi.

### **e-references**

1. <http://www.sciencedirect.com/science/books>
2. <http://202.200.144.17/sykc/hjx/content/ckzl/6/2.pdf>
3. [http://www.pedosphere.com/volume01/pdf/Section.\\_01.pdf](http://www.pedosphere.com/volume01/pdf/Section._01.pdf)
4. [http://waterquality.montana.edu/docs/homeowners/Septic Drain field Soil Suitability, Presentations /6 \\_Soil Texture and \\_Structure.pdf](http://waterquality.montana.edu/docs/homeowners/Septic_Drain_field_Soil_Suitability,_Presentations/6_Soil_Texture_and_Structure.pdf)
5. [http://wfrec.ifas.ufl.edu/landscape\\_horticulture/PDFdocuments/SoilProp.pdf](http://wfrec.ifas.ufl.edu/landscape_horticulture/PDFdocuments/SoilProp.pdf)
6. [http://www.rootsofpeace.org/assets/Soil% Testing% Manual% 20V6% 20\(Feb% 208\).pdf](http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20(Feb%2008).pdf)
7. <http://www.soils.wisc.edu/courses/SS325/morphology.htm>
8. <http://www.soils.wis.edu/courses/SS325/morphology.htm>
9. <http://landresources.montana.edu/>
10. [http://ftp.wcc.nrcs.usda.gov/H....soil Other/soil-USDA-textural-class.pdf](http://ftp.wcc.nrcs.usda.gov/H....soil%20Other/soil-USDA-textural-class.pdf)

## FOR 111 Introduction to Forestry (1+1)

### UNIT I

#### Forest and Forestry

Introduction - Definition of Forest and Forestry - Role of Forest (Production, Protection and Amelioration) - Classification of Forest (Regeneration, Age, Composition, ownership, object of management, growing stock) - National Forest Policy 1988.

### UNIT II

#### Silviculture and Forest plantation

Forest regeneration - Natural regeneration- Seeds and vegetative parts (Coppice, Root suckers) - Artificial regeneration, Objectives - Nurseries - Types of nurseries, Quality seedling production techniques - Silvicultural practices for *Eucalyptus spp*, *Casuarina equisetifolia*, *Tectona grandis*, *Ailanthus excelsa*, *Melia dubia*, *Leucaena leucocephala*. Tending operations - Weeding, Cleaning, Thinning and pruning.

### UNIT III

#### Forest Mensuration

Forest Mensuration - Objectives- Diameter measurements, instruments used in diameter measurement-Height measurement, instrumental methods of height measurement - Tree form, form factor, Volume estimation of standing and felled trees.

### UNIT IV

#### Social forestry and Agroforestry

Social Forestry and its branches - Extension Forestry, Urban forestry - Agroforestry, definition-Importance- Agroforestry systems - Shifting Cultivation, Taungya, Alley cropping, Wind break, Shelter belt, Home garden - Tree and crop combination in Agroforestry - Tree crop interaction in Agroforestry - National Agroforestry Policy 2014.

### UNIT V

#### Forest Utilization

Forest Utilization - Definition - Wood products - solid wood and composite wood.- Non Wood Forest Products - fibres, floss, bamboo, tan, dye, resin, oleoresin.

#### Practical

Identification of important farm grown trees - Identification of tree seeds and seedlings- Site selection for tree nursery and layout of nursery- Study of nursery techniques for *Casuarina equisetifolia* and *Tectona grandis* - Practicing clonal propagation in trees Practicing land preparation, stacking, pitting, planting techniques and after care operations in plantations- Height measurement in trees, diameter measurement in trees, Volume estimation in trees- Identification of wood and non- wood forest products - Visit to Agroforestry plantations

#### Lecture schedule:

1. Introduction about forests, Definition of Forest and Forestry, branches in forestry
2. Role of Forest - Production function, Protection function and ameliorative functions of forests
3. Classification of Forest based on mode of regeneration, age, composition, ownership, object of management and growing stock
4. National Forest Policy 1988- Objectives and salient features
5. Forest regeneration - Types of regeneration - Natural regeneration through seeds and vegetative parts including coppice and root suckers
6. Artificial regeneration, Objectives - Nurseries - Types of nurseries, Quality seedling production techniques
7. Silvicultural practices for *Eucalyptus spp*, *Casuarina equisetifolia*, *Tectona grandis*, *Ailanthus excelsa*,

8. Silvicultural practices for *Melia dubia*, *Leucaena leucocephala*. Tending operations - Weeding, Cleaning, Thinning and pruning.

### 9. Mid Semester Examination

10. Forest Mensuration - Objectives- Diameter measurements, instruments used in diameter measurement
11. Height measurement, instrumental methods of height measurement - Tree form, form factor, Volume estimation of standing and felled trees.
12. Social Forestry and its branches - Extension Forestry and Urban forestry.
13. Agroforestry, definition- Importance- Agroforestry systems - Shifting Cultivation, Taungya, Alley cropping, Wind break, Shelter belt, Home garden
14. Tree and crop combination in Agroforestry- Tree crop interaction in Agroforestry -
15. National Agroforestry Policy 2014 , objectives and salient features
16. Forest Utilization - Definition - Wood products - solid wood and composite wood.
17. Forest Utilization - Non Wood Forest Products - fibres , floss, bamboo, tan, dye, resin, oleoresin

### Practical schedule:

1. Identification of important farm grown trees
2. Identification of tree seeds and seedlings
3. Site selection for tree nursery and layout of nursery
4. Study of nursery techniques for *Casuarina equisetifolia*
5. Study of nursery techniques for *Tectona grandis*
6. Practicing clonal propagation in trees *Eucalyptus* / *Casuarina*
7. Practicing land preparation, stacking, pitting,
8. Planting techniques in plantation
9. After care operations in plantations
10. Height measurement in trees
11. Diameter measurement in trees
12. Volume estimation in standing and felled trees
13. Identification and study of wood products
14. Identification and study non- wood forest products
15. Visit to Agroforestry plantations
16. Visit to forest based industry
17. **Final Practical Examination**

### References

1. Dwivedi, A.P. 1992. Principles and Practices of Indian Silviculture. Surya publications, Dehradun. 177p
2. Gupta. R.K 1993. Multipurpose trees for Agroforestry and Wasteland utilization. Oxford and IBH Publishing Company, New Delhi. 580p.
3. Nair.P.K.R. 1993. Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, Netherlands. 499p
4. Negi, S.S. 1986. A Hand book of Social Forestry. International Book Distributors, Dehradun. 177p
5. Puri, S and P.K.Khosla. 1993. Nursery Technology for Agroforestry - applications in Arid and Semi arid regions. Oxford and IBH Publishing Company, New Delhi. 392p
6. Khanna. L.S. 1981. Principles and Practice of Silviculture. Khanna Bandhu publications, Dehradun. 472p
7. Chaturvedi, A.N and L.S.Khanna. 1982. Forest Mensuration. International Book Distributors, Dehradun. 350p

8. Tirubhawan Mehta. 1981. Hand book of Forest Utilization. International Book Distributors, Dehradun.208 p.

## ENG 101 Comprehension and Communication Skills in English (1+1)

### Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary-Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

### Practical

Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and Listening, politeness & Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.

### Lecture Schedule:

1. **War Minus Shooting** (A lesson from the Text Book, “The Sporting Spirit” by George Orwell) textual grammar pertaining to factual comprehension and inferential comprehension & referential comprehension.
2. **War Minus Shooting** (A lesson from the Text Book, “The Sporting Spirit” by George Orwell) textual grammar pertaining to global comprehension and attitudinal comprehension
3. **War Minus Shooting** (A lesson from the Text Book, “The Sporting Spirit” by George Orwell) textual grammar on synonyms – antonyms – prefix – suffix – homonyms - homophones – TOEFL & IELTS vocabulary
4. **War Minus Shooting** (A lesson from the Text Book, “The Sporting Spirit” by George Orwell) textual grammar – English articles – preposition – conjunctions and its types
5. **A Dilemma** (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textual grammar – verbs – auxiliary verbs - modals and basic tense forms
6. **A Dilemma** (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textual grammar – sentence pattern and sentence forms (simple, compound and complex sentences)
7. **A Dilemma** (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textual grammar – subject – verb – agreement
8. **A Dilemma** (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textual grammar – transformation of sentences
9. **Mid Semester Examination**
10. **You and Your English** (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textual grammar – synthesis of sentences – reported speech (direct and indirect speech)

11. **You and Your English** (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar – paragraph writing (thesis sentences, supporting statements, inferential statements)
12. **You and Your English** (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar – four principles of writing
13. **You and Your English** (A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw) textural grammar - professional writing – summary writing and paraphrasing, synopsis writing and citation
14. Graham's flow chart on writing skills
15. Letter writing – personal and social correspondence – job application
16. precise writing – report writing and proposal writing
17. Interview skills - kinds – importance and process

### **Practical Schedule:**

1. Listening - Introduction - Listening vs Hearing - listening modes - types of listening - Intensive and Extensive Listening – practice
2. Process of Listening - methods of enhancing listening - barriers to listening and ways to overcome them – practice
3. Oral communication - organs of speech – English phonemes (consonant table, vowel table) - practice
4. English Stress & Intonation - exercises.
5. Conversation techniques and practice
6. Rate of speech (slow pace, medium pace, rhetoric)
7. Reading - types - skimming and scanning - SQ4R - critical reading - analytical reading – exercises
8. Principles and practice of presentation skills - PowerPoint preparation and presentation
9. Handout preparation - lecture notes preparation - practice and evaluation
10. Writing skills - note taking – precise writing – abstract writing – practice
11. Mind-mapping and article writing
12. Letter writing and rejoinder writing
13. Text writing - practice on table to text conversion
14. Interview skills – types of interview (group interview – panel interview – telephone interview – behavioural interview – video-conferencing interview – mock interview)
15. Practice on speaking skills – welcome address - vote of thanks - short extemporal speech
16. Group discussion – techniques – types and practice
17. **Final Practical Examination**

### **References**

- Goodale, Malcolm, *Professional Presentations*, Cambridge University, 2005.  
 Greenbaum Sidney, *Oxford English Grammar*, New Delhi, Oxford University Press. Peregoy, 2009.
- Jones Daniel, *English Pronouncing Dictionary*, Cambridge University Press, 2006. Lynch, Tony and Kenneth Anderson, *Study Speaking*, Cambridge University, 1992. Martin Cutts, *Oxford Guide to Plain English*, Oxford University Press, 2004. Sahaneya Wandy, et.al., *IELTS, Preparation and Practice*, Oxford University, 2005. Sundararajan, N, *Attentive Listening: How it Matters*, University News, March 19-25, 2005.

**E-references:**

1. [www.orwell.ru/library/articles/spirit/english/e\\_spirit](http://www.orwell.ru/library/articles/spirit/english/e_spirit)
2. [www.essays.com](http://www.essays.com)
3. [www.onestopenglish.com](http://www.onestopenglish.com)
4. [www.bogglesworld.com](http://www.bogglesworld.com)
5. [www.elweb.com](http://www.elweb.com)
6. [www.reportingskills.com](http://www.reportingskills.com)
7. [www.writing-skills.com](http://www.writing-skills.com)
8. [www.negotiation.com](http://www.negotiation.com)
9. [www.teachersdesk.com](http://www.teachersdesk.com)
10. [www.flexbilelearning.net.au](http://www.flexbilelearning.net.au)



## **HOR 111 Fundamentals of Horticulture (1+1)**

### **Unit I**

#### **History, evolution and scope of horticulture**

Origin of horticulture – history – evolution – definitions – scope and importance of horticulture – division and classification of horticultural crops – fruits, vegetables, spices and plantation crops, floriculture, landscaping, ornamental gardening, medicinal and aromatic crops – nutritive value and global and national scenario of horticultural crops.

### **Unit II**

#### **Sexual propagation**

Sexual propagation – importance, advantages and disadvantages – methods of enhancement of seed viability – types of dormancy – seed invigoration – seed treatments

### **Unit III**

#### **Asexual propagation**

Asexual propagation, importance, advantages and disadvantages - Asexual propagation types *viz.*, Types of cutting, layering, grafting and budding. Use of specialized plant parts in propagation. Propagation structures and their role. Rootstock influence – stock / scion relationship in fruit crops. Scope and importance of micro propagation in horticultural crops. Direct and indirect organogenesis – media for micro propagation and hardening.

### **Unit IV**

#### **Planting systems and pollination**

Principles of orchard establishment - Methods of planting systems including HDP and UHDP in horticultural crops – crop regulatory practices for horticultural crops – training, pruning, special operations in horticultural crops – off season production of horticultural crops. Flowering, pollination, fruit set, fruit drop, parthenocarpy, fruit ripening and senescence – Unfruitfulness and its causes.

### **Unit V.**

#### **Principles and types of garden**

Principles and types of garden – principles and types of parks – principles of herbal garden

### **Practical**

Features of an orchard - Identification of garden tools, implements and machineries. Identification of horticultural crops and herbarium making. Preparation of potting mixture, potting and repotting. Preparation of seed bed / nursery bed. Practice of sexual and asexual methods of propagation- cutting, layering, budding, grafting – specialized plant parts - Layout and planting of fruit trees. Training and pruning of fruit trees. Transplanting and care of vegetable seedlings. Making of herbaceous and shrubbery borders. Practicing irrigation, fertilizer and manures application in different crops. Preparation and application of Plant Growth Regulators – visit to tissue culture lab - Visits to commercial nurseries / orchard / garden.

**Theory Lecture schedule:**

1. Origin of horticulture – history – evolution – definitions – scope and importance of horticulture
2. Division and classification of horticultural crops – fruits, vegetables, spices and plantation crops, floriculture, landscaping, ornamental gardening, medicinal and aromatic crops
3. Nutritive value and global and national scenario of horticultural crops
4. Sexual propagation – importance, advantages and disadvantages – methods of enhancement of seed viability
5. Types of dormancy – seed invigoration – seed treatments
6. Asexual propagation, importance, advantages and disadvantages - Asexual propagation types
7. Vegetative propagation – merits and demerits – cutting and layering
8. Vegetative propagation – merits and demerits – grafting and budding
9. **Mid Semester Examination**
10. Use of specialized plant parts in propagation - Propagation structures and their role.
11. Rootstock influence – stock / scion relationship in fruit crops
12. Scope and importance of micro propagation in horticultural crops- Direct and indirect organogenesis  
– media for micro propagation and hardening
13. Principles of orchard establishment - Methods of planting systems including HDP and UHDP in horticultural crops
14. Crop regulatory practices for horticultural crops – training, pruning, special operations in horticultural crops – off season production of horticultural crops.
15. Flowering, pollination, fruit set, fruit drop, parthenocarpy, fruit ripening and senescence, unfruitfulness and its causes
16. Principles and types of garden
17. Principles and types of parks – principles of herbal garden

**Practical schedule:**

1. Visit to orchard and identifying its components
2. Identification of garden tools, implements and machineries
3. Identification of horticultural crops and herbarium making
4. Preparation of pot mixture, potting and repotting
5. Preparation of nursery beds for raising rootstocks and seedlings
6. Practicing asexual methods of propagation- cutting and layering
7. Practicing asexual methods of propagation – budding and grafting
8. Plant propagation structures and specialized plant parts for propagation
9. Layout and planting of fruit trees
10. Training and pruning of fruit trees
11. Transplanting and care of vegetable seedlings
12. Making of herbaceous and shrubbery borders
13. Practicing irrigation, fertilizer and manures application in different crops
14. Preparation and application of Plant Growth Regulators
15. Visit to tissue culture lab
16. Visit to commercial nurseries / garden
17. **Final Practical Examination**

## References

1. Sadhu, M.K. 1989. Plant Propagation. Wiley Eastern Ltd., 4835/24, Ansari Road, Daryaganj, New Delhi- 110 002. Bose, T.K., S.K. Mitra, M. K. Sadhu and B. Mitra. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prakash 206, Bidhan Sarani, Calcutta-6, India. Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greeneve. 1997. Plant Propagation - Principles and Practices. Prentice Hall of India Private Ltd., New Delhi. Nanda, K.K and V.K. Kochhar. 1995. Vegetative Propagation of Plants. Kalyani Publishers, Ludhiana.
2. George Acquaah, 2002. Horticulture – principles and practices. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Hartman, H.T. and Kester, D.E. 1986. Plant propagation – Principles and Practices – Prentice Hall of India Ltd., New Delhi.
4. Jules Janick. 1979. Horticultural Science. Surjeet Publications. New Delhi.
5. Kumar, N. 2014, Introduction to Horticulture, Oxford IBH Publications, New Delhi.

## e-References

1. [http://aggie – horticulture, tamu.edu/propagation/propagation.html](http://aggie-horticulture.tamu.edu/propagation/propagation.html)
2. [http://www/britannica.com/](http://www.britannica.com/)
3. <http://www.horticulture.com.au/export/hmac.asp.asp>
4. <http://www.horticultureworld.net/hort-india.htm>
5. <http://www.fao.org/>

## MAT 111 ELEMENTARY MATHEMATICS ( 1+1)

### Unit - I

**Algebra:** Permutation and Combination -meaning of  $nPr$  and  $nCr$  (simple problems). Matrices- Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to  $3^{rd}$  order by adjoint method, Properties of determinants up to  $3^{rd}$  order and their evaluation.

### Unit - II

**Analytical Geometry:** Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines, Angles between two straight lines, Parallel lines, Perpendicular lines.

Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ .

### Unit - III

**Differential Calculus:** Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$  from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Partial differentiation with first and second order -Maxima and Minima of the functions of the form  $y = f(x)$  and  $y = f(x_1, x_2)$  (Simple problems based on it).

### Unit -IV

**Integral Calculus:** Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

### Unit-V

**Mathematical Models:** Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.

### Practical

Simple problems in Permutation and Combination -meaning of  $nPr$  and  $nCr$  Problems in Algebra of matrices, Transpose and Inverse up to  $3^{rd}$  order by adjoint method, evaluation of determinants up to  $3^{rd}$  order. Problems in Straight lines using distance formula, section formula (internal and external division), Change of axes (only origin changed)- Equation of co-ordinate axes- Equation of lines parallel to axes. Problems in equation of a line in : Slope-intercept form, Slope-point form, two point forms,

Intercept form, Normal form, General form, Point of intersection of two straight lines. Problems in Angles between two straight lines, Parallel lines, Perpendicular lines. Problems in Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ . Simple problems in limit and continuity. Problems in differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$ , derivatives of sum, difference, product and quotient of two functions. Simple problem based on differentiation of functions of functions and Logarithmic differentiation. Simple

problems based on differentiation by substitution method. Problems in partial differentiation and Maxima and Minima of the functions of the form  $y=f(x)$  and  $y=f(x_1, x_2)$ . Problems in integration of simple functions and product of two functions- Definite Integral. Integration by substitution method-Problems in Area under simple well-known curves. Problems in fitting linear, quadratic and Exponential models to experimental data.

### **Theory Lecture Schedule:**

1. Permutation and Combination -meaning of  $nPr$  and  $nCr$  (Simple Problems) .
2. Matrices- Definition of Matrices- Types of Matrices- Addition, Subtraction, Multiplication, Transpose
3. Determinants-Properties of determinants -up to 3<sup>rd</sup> order evaluation and inverse up to 3<sup>rd</sup> order by adjoint method.
4. Straight lines - Distance formula-section formula (internal and external division) - Change of axes (only origin changed) - Equation of co-ordinate axes- Equation of lines parallel to axes.
5. Forms of equation of Line-Slope-intercept form -Slope one point form - Two point form - Intercept form.
6. Normal form of equation of line- General form of equation of line- Point of intersection of two straight lines.
7. Angles between two straight lines- Parallel lines- Perpendicular lines- Angle of bisectors between two lines.
8. Circle-Equation of circle whose centre and radius is known- General equation of a circle- Equation of circle passing through three given points- Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ .

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

10. Differential Calculus - Definition of function, limit and continuity- Simple problems on limit and continuity.
11. Differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$  from first principle-Derivatives of sum, difference, product and quotient of two functions- Differentiation using functions of function rule (Simple problem based on it)
12. Logarithmic differentiation (Simple problem based on it)- Differentiation by substitution method and simple problems based on it- Differentiation of Inverse Trigonometric functions
13. Maxima and Minima of the functions of the form  $y=f(x)$  and  $y=f(x_1, x_2)$  (Simple problems based on it).
14. Integral Calculus - Integration of simple functions and Product of two functions- Definite Integral (simple problems based on it)
15. Integration by substitution method- Area under simple well-known curves (simple problems based on it).
16. Agricultural systems - Mathematical models - classification of mathematical models- Linear model.
17. Quadratic and Exponential models- applications of mathematical models in agriculture.

### **Practical Schedule:**

1. Simple problems in Permutation and Combination.
2. Problems in Addition, Subtraction, Multiplication and Transpose of a matrix
3. Problems in determinants and Inverse up to 3<sup>rd</sup> order by adjoint method.
4. Problems in Straight lines using distance formula, section formula (internal and external division), Change of axes (only origin changed)- Equation of co-ordinate axes- Equation of lines parallel to axes.

5. Problems in Slope-intercept form of equation of line, Slope-point form of equation of line, two point forms of equation of line, Intercept form of equation of line.
6. Problems in Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines.
7. Problems in Angles between two straight lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines.
8. Problems in Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ .
9. Simple problems in limit and continuity.
10. Problems in differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$ , derivatives of sum, difference, product, quotient of two functions and differentiation of functions of functions.
11. Simple problem based on Logarithmic differentiation and differentiation by substitution method.
12. Problems in Maxima and Minima of the functions of the form  $y=f(x)$  and  $y=f(x_1, x_2)$
13. Problems in integration of simple functions and product of two functions using integration by parts-Definite Integral.
14. Integration by substitution method-Problems in Area under simple well-known curves
15. Problems in fitting linear models to experimental data.
16. Problems in fitting Quadratic and Exponential models to experimental data.

**17. Final Practical Examination.**

**References:**

1. Mehta, B. C. and G. M. K. Madnani, 2014, Mathematics for Economists, Sultan Chand & Sons, New Delhi.
2. Kailasam.C, Pangayar Selvi. R and Vasanthi. R, 2010, Applied Mathematics, Agrobios (India), Jodhpur
3. James Stewart and Barhara Frank, Calculus, 2008, International Thomson Publishers, Singapore
4. Duraipandian, 2007, Calculus and Analytical Geometry, Emerald Publishers, Chennai.
5. Ranganathan.C.R. 2006, A First Course in Mathematical Models of Population Growth (with MATLAB programs), Associated publishing company, New Delhi
6. Manickavasagam Pillai, T. K and Natarajan, T. 2004. Calculus, Viswanathan Publications, Madras.

## **PBG 101 Introduction to Agricultural Botany (1+1)**

### **Unit I:**

#### **Systems of classification and general morphological description**

Bentham and Hooker's classification of plant kingdom — International code of nomenclature and its major guidelines – author citation – Agricultural classification of crops; General morphology: Life span, habit, root, stem, leaf - petiole, leaf margin, leaf apex, leaf shape, venation and phyllotaxy; Modification of roots and leaf; Floral morphology: Kinds of bracts, inflorescence; Structure of flower, androecium, gynoecium, placentation, types of fruits.

### **Unit II:**

#### **Botanical description and economic uses of Poaceae**

List of cultivated crops, economic parts, chromosome number and family description of Poaceae: Key botanical features of Rice, Wheat, Sorghum, Maize, Pearl millet, Finger millet, list of small millets, Guinea grass, Napier grass, *Cenchrus* and Sugarcane

### **Unit III:**

#### **Botanical description and economic uses of Papilionaceae**

List of cultivated crops, economic parts, chromosome number and family description of Papilionaceae: Key botanical features of Red gram, Bengal gram, Soybean, Black gram, Green gram, Cowpea, Lablab, Horse gram, Groundnut, Lucerne, *Stylosanthes*, Clitoria, Agathi and Sunnhemp,

### **Unit IV:**

#### **Botanical description and economic uses of Pedaliaceae, Asteraceae, Oleaceae, Brassicaceae, Euphorbiaceae, Arecaceae and Malvaceae**

List of cultivated crops, economic parts, chromosome number and family description of the following families and Key botanical features of the crops given against them: Pedaliaceae - Gingelly; Asteraceae - Sunflower, Safflower, Chrysanthemum; Oleaceae - Jasmine; Brassicaceae - Rapeseed and Mustard, Cabbage, Cauliflower; Euphorbiaceae: Castor; Jatropha and Tapioca; Arecaceae: Coconut, Arecanut, Oilpalm, Sugarpalm; Malvaceae: Cotton, Mesta and Bhendi.

### **Unit V:**

#### **Botanical description and economic uses of Tiliaceae, Piperaceae, Chenopodiaceae, Solanaceae, Mimosae, Moraceae, Cucurbitaceae, Alliaceae, Musaceae, Rubiaceae, Theaceae**

List of cultivated crops, economic parts, chromosome number and family description of the following families and key botanical features of the crops given against them. Tiliaceae: Jute; Piperaceae: Betelvine; Chenopodiaceae: Sugar beet; Solanaceae: Tobacco, Potato, Chilli, Tomato and Brinjal; Mimosae: Desmanthes, Subabul and Acacia; Moraceae: Mulberry; Cucurbitaceae: Cucumber, Pumpkin, Ashgourd; Alliaceae: Onion and Garlic; Musaceae: Banana, Manila hemp; Rubiaceae: Coffee; Theaceae: Tea

## **PRACTICAL**

Family features - observation and description of habit, morphology of root, stem, leaves, inflorescence, flowers, floral diagram, floral formula and economic parts of Poaceae: Rice, Wheat, Sorghum, Maize, Pearl millet, Finger millet, Guinea grass, Napier grass, *Cenchrus* and Sugarcane; Papilionaceae: Redgram, Bengal gram, Soybean, Blackgram, Greengram, Cowpea, Lab-lab, Horse gram, Groundnut, Lucerne, *Stylosanthes*, Clitoria, Agathi and Sunnhemp; Pedaliaceae: Gingelly; Asteraceae: Sunflower, Safflower and Chrysanthemum; Oleaceae:

Jasmine; Brassicaceae: Rape and Mustard, Cabbage, Cauliflower; Euphorbiaceae: Castor, Jatropha, Tapioca; Areaceae: Coconut, Arecanut, Oilpalm and Sugar palm;  
 Malvaceae: Cotton, Mesta, Bhendi; Tiliaceae: Jute; Piperaceae: Betelvine; Chenopodiaceae: Sugar beet;  
 Solanaceae: Tobacco, Potato, Chilli, Tomato and Brinjal; Mimosae: Desmanthes, Subabul and Acacia;  
 Moraceae: Mulberry; Cucurbitaceae: Cucumber, Pumpkin, Ashgourd; Alliaceae: Onion and Garlic;  
 Musaceae: Banana, Manila hemp; Rubiaceae: Coffee; Theaceae: Tea

### **Theory Lecture schedule:**

1. Bentham and Hooker's classification of plant kingdom —International code of nomenclature and its major guidelines – author citation – Agricultural classification of crops
2. General morphology: Life span, habit, root, stem, leaf - petiole, leaf margin, leaf apex, leaf shape, venation and phyllotaxy; Modification of roots, stem and leaf
3. Floral morphology: Kinds of bracts, inflorescence; Structure of flower, androecium, gynoecium, placentation, types of fruits.
4. List of cultivated crops, economic parts, chromosome number and family description of Poaceae; Key botanical features of Rice and Wheat.
5. Key botanical features of sorghum, maize, pearl millet and finger millet. List of small millets
6. Key botanical features of Guinea grass, Napier grass, *Cenchrus* and sugarcane.
7. List of cultivated crops, economic parts, chromosome number and family description of (Papilionaceae) Key botanical features of Red gram, Bengal gram and Soybean
8. Key botanical features of Black gram, Green gram, Cowpea, Lab lab, Horse gram and Groundnut.
9. **Mid Semester Examination**
10. Key botanical features of Lucerne, *Stylosanthes*, Clitoria, Agathi, and Sunnhemp.
11. List of cultivated crops, economic parts, chromosome number and family description of Pedaliaceae and Asteraceae: Key botanical features of Gingelly, Sunflower, Safflower, Chrysanthemum; Oleaceae: Jasmine
12. List of cultivated crops, economic parts, chromosome number and family description of Brassicaceae and Euphorbiaceae; Key botanical features of Rapeseed and Mustard, Cabbage, Cauliflower, Castor, Jatropha and Tapioca
13. List of cultivated crops, economic parts, chromosome number and family description of Areaceae and Malvaceae; Key botanical features of Coconut, Arecanut, Oilpalm, Sugarpalm, Cotton, Mesta and Bhendi.
14. List of cultivated crops, economic parts, chromosome number and family description of Tiliaceae, Piperaceae and Chenopodiaceae; Key botanical features of Jute, Betelvine, Sugar beet.
15. List of cultivated crops, economic parts, chromosome number and family description of Solanaceae, Mimosae and Moraceae; Key botanical features of Tobacco, Potato, Chilli, Tomato and Brinjal, Desmanthes, Subabul, Mulberry
16. List of cultivated crops, economic parts, chromosome number and family description of Cucurbitaceae and Alliaceae; Cucurbitaceae: Key botanical features of Cucumber, Pumpkin, Ashgourd; Alliaceae: Onion and Garlic
17. List of cultivated crops, economic parts, chromosome number and family description of Musaceae, Rubiaceae and Theaceae; Key botanical features of Banana, Manila hemp, Coffee and Tea



### **Practical schedule:**

1. Observing general morphology of roots, stems and leaves.
2. Observing general morphology of inflorescence - flowers, stamens and pistils.
3. Family characters, Botany, Economic parts, Floral diagram and Floral formula of the following crop plants:- Poaceae: Rice and Wheat
4. Poaceae: Sorghum, Maize, Pearl millet, Finger millet.
5. Poaceae: Guinea grass, Napier grass, *Cenchrus* and Sugarcane.
6. Papilionaceae: Redgram, Bengal gram and Soybean.
7. Papilionaceae: Blackgram, Greengram, Cowpea, Lab-lab, Horse gram and Groundnut.
8. Papilionaceae: Lucerne, *Stylosanthes*, Clitoria, Agathi, Sunnhemp, and Sesbania.
9. Pedaliaceae: Gingelly; Asteraceae: Sunflower, Safflower and Chrysanthemum;  
Oleaceae: Jasmine
10. Brassicaceae: Rapeseed and Mustard, Cabbage, Cauliflower.
11. Euphorbiaceae: Castor, Jatropha, Tapioca; Arecaceae: Coconut, Arecanut, Oilpalm and Sugar palm.
12. Malvaceae: Cotton, Mesta, Bhendi
13. Tiliaceae: Jute; Piperaceae: Betelvine; Chenopodiaceae: Sugar beet;
14. Solanaceae: Tobacco, Potato, Chilli, Tomato and Brinjal; Mimosae: Desmanthes, Subabul ,  
Moraceae:Mulberry
15. Cucurbitaceae: Cucumber,Pumpkin, Ashgourd; Alliaceae: Onion and Garlic
16. Musaceae: Banana, Manila hemp; Rubiaceae: Coffee; Theaceae: Tea
- 17. Final Practical Examination**

### **References:**

1. Daniel Sundararaj, D. and G. Thulasidas, 1993. Botany of field crops. MacMillan India Ltd., New Delhi.
2. Sambamurthy, V.S. and N.S. Subramanian, 1989. Text Book of Economic Botany, Wiley Eastern, New Delhi
3. Purse glow, 1988. Tropical Crops - Monocotyledons. The English Language book Society and Longman Co., Singapore
4. Purse glow. 1988. Tropical Crops - Dicotyledons. The English language book Society and Longman Co., Singapore.
5. Albert F. Hill and O.P. Sharma, 1996. Economic Botany. Tata McGraw - Hill Publishing Co. Ltd., New Delhi.
6. John Joel, A., C. Vanniarajan, T.S. Raveendran, and A. Gopalan 2006. Fundamentals of Crop Botany, Directorate of ODL, Tamil Nadu Agricultural University, Coimbatore-641 003.

### **E-Resources**

1. [www.nmsu.edu](http://www.nmsu.edu)
2. [www.biology200.gsu.edu](http://www.biology200.gsu.edu)

## **AEX 101 Rural Sociology and Educational Psychology (2+0)**

### **Theory**

#### **UNIT I**

##### **Introduction to Sociology, Social groups, Culture and Social Values**

Sociology and Rural Sociology – definitions; Society – rural and urban, characteristics, differences and relationships, important characteristics of Indian rural society; Social groups – definition, classification, role of social groups in extension; Culture – concept, cultural traits, characteristics, functions, Ethnocentrism, Acculturation, Cultural lag, Cultural diffusion, Marginal man, Ethos. Social Values – definition, values and norms, characteristics of values, functions;

#### **UNIT II**

##### **Social Structure, Social Stratification and Migration**

Structure of Rural Society – patterns of rural settlement, social institutions, social organizations, ecological entities (Region, Community, Neighbourhood, Family); Social Stratification – concept, functions, types, differences between class and caste system; Migration – concept, factors influencing migration.

#### **UNIT III**

##### **Social Control, Social Customs**

Social Control – definition; Customs – conventions, folkways, mores, rituals, taboos; Social Interaction Process – definition, basic social processes; Social Change – concept, factors influencing social change, indicators of social change; Social development :

#### **UNIT IV**

##### **Introduction to Educational Psychology, Intelligence, Teaching-Learning Process;**

Education – Psychology – Educational Psychology – Social Psychology – definitions, importance in extension; Basic principles of Human behaviour – Sensation, Attention, Cognitive, affective, psychomotor domain Perception – meaning, characteristics; Intelligence – concept, types, measurement, factors affecting intelligence; Personality – concept, types, measurement, factors influencing personality; Teaching–Learning Process – Teaching – definition, meaning, principles of teaching, steps in extension teaching; Learning – definition, meaning, principles, types of learning, learning situation.

#### **UNIT V**

##### **Motivation, Attitude**

Motivation – concept, Maslow’s hierarchy of needs, intrinsic and extrinsic motivation, techniques of motivation, importance in extension; Attitude – concept, factors influencing the development of attitudes.

## **Theory Schedule**

1. Sociology and Rural Sociology – Definitions, nature of rural sociology,
2. Importance of rural sociology in extension education.
3. Society – rural and urban, characteristics, differences and relationship, important characteristics of Indian rural society;
4. Social Groups – definitions, classification, role of social groups in extension.
5. Culture – concept, cultural traits, characteristics, functions,
6. Ethnocentrism, Acculturation, Cultural lag, Cultural diffusion, Marginal man, Ethos.
7. Structure of Rural Society – patterns of rural settlement,
8. Social institutions, Social organizations and ecological entities - Region, Community, Neighbourhood, and Family.
9. Social Stratification – concept, functions, types, differences between class and caste system;
10. Social Values – definition, values and norms, characteristics of values, functions.
11. Migration – concept, factors influencing migration.
12. Social Control – definition;
13. Customs – conventions, folkways, mores, rituals, taboos;
14. Social Interaction Process – definition, basic social processes.
15. Social Change – concept, theories, factors and indicators of social change.
16. Social development
- 17. Mid semester Examination.**
18. Education – Psychology – Educational Psychology –definitions, importance in extension.
19. Social Psychology – Definitions, importance in extension.
20. Basic principles of Human behaviour –
21. Cognitive, affective, psychomotor domain
22. Perception – meaning, characteristics.
23. Sensation, Attention
24. Intelligence – concept, types,
25. Intelligence - measurement, factors affecting intelligence;
26. Personality – concept, types,
27. Personality measurement- factors influencing personality
28. Teaching–Learning Process – Teaching – definition, meaning,
29. Principles of teaching, steps in extension teaching.
30. Learning – definition, meaning, principles,
31. Types of learning, learning situation.
32. Motivation – concept, Maslow’s hierarchy of needs (including selfless-service), intrinsic and extrinsic motivation,
- 33. Techniques of motivation, importance of motivation in extension.**
34. Attitude – concept, factors influencing the development of attitudes.

## **References:**

1. Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi Press, Bapatla, Andhra Pradesh. Chatterjee, S. 2000. Advanced Educational Psychology, Books & Allied (P) Ltd., Calcutta.
2. Chauhan, S.S. 2001. Advanced Educational Psychology, Vikas Publishing House Pvt. Ltd., New Delhi. Chitambar, J.B.1997. Introductory Rural Sociology, New Age International (P) Ltd., Publishers, New Delhi.
3. Dahama, O.P. and O.P. Bhatnagar. 2007. Education and Communication for Development, Oxford &
4. IBH Publishing Co. Pvt. Ltd., New Delhi.

5. Kundu, C.L and Tutoo, D.N. 2001. Educational Psychology, Sterling Publishers Pvt. Ltd., New Delhi.
6. Lester Crow, D and Alice Crow. 1973. Educational Psychology, Eurasia Publishing House Pvt. Ltd.,  
7. New Delhi.
8. Madumita Gupta. 2011. Fundamentals of Sociology, Pacific Publications, New Delhi. Mangal, S.K. 2000. Educational Psychology, Prakash Brothers, Ludhiana.
9. Shankar Rao, C.N. 2012. Sociology – Principles of Sociology with an Introduction to Social Thought,  
10. S.Chand & Co. Ltd., New Delhi.
11. Sharma, R.N. 1968. Principles of Sociology, Asia Publishing House, New Delhi.
12. Supe. S.V. 2012. Text book of Extension Education, Agrotech Publishing Academy, Udaipur. Usha Rao. 2008. Advanced Educational Psychology, Himalaya Publishing House, New Delhi.
13. Vidya Bhushan and Sachdeva, D.R. 2003. An Introduction to Sociology, Kitab Mahal, Allahabad.

**E-References:**

1. [www.sociologyguide.com](http://www.sociologyguide.com)
2. [eu.wikipedia.org](http://eu.wikipedia.org)
3. [www.princeton.edu](http://www.princeton.edu)

**nehf;fk;**

,sepiy ntshz;ik gapYk; hzth;fSf;Fk jkpH; ,yf;fpa';fs; tHp ntshz;ik kw;Wk; ntshz;ik rhh;e;j  
 bjhHpy;El;g';fisa[k; bra;jpfisa[k; mwpaw;-jw;fhybra;jy;ntshz; bjhHpy;El;g';fnshL bghUj;jpg;  
 ghj;jjy;-ntshz;ik jtpu njhl;lf;fiy\_ tdtpay;-ntshz;bghwpapay;- kidapay; rhh;e;j fUj;Jf;fis  
 btspf;bfhzh;jy;- ntshz;;Jiwf;F ,d;wpaikahj fiyr;brhw;fs;-bkhHpg;bgah;g;g[-ghuk;ghpa  
 bjhHpy;El;g';fis mwpaw;bra;jy;-khzth;fspd; vjph;fhyj; njitf;F mog;gilahd ngr;Rg;gap-  
**neh;r**;rpfhziy vjph;bfhs;Sk; tifapy; bkd;jpwd;fshd jiyikg;gz;g[-MSikg;gz;g[- fhyntykz;ik  
 Mfpatw;wpy; jpwk;bgwr;bra;jy;-khzth;fspd; Ma;t[f;fl;Liu jpwid tsh;jjy;-ntshz;ik ,jH;fs;/ E}y;fs;  
 Fwpj;J tpHpg;g[zh;it tH';Fjy;-fzpdp tHp jkpHpy; ntshz; bra;jpfis gjpntw;wk;/ gjptpwf;fk;  
 bra;a[k; Kiwfis mwpaw;bra;jy; Mfpatw;iwfkfhnehbhz;L ghli;jpl;l;j;ij tiuaiw bra;jy;

**ghlj;jpl;lk;**

bjhy;fhg;gpak; fhli;Lk; Kjw;bghUs;/ fUg;bghUs;-r';f,yf;fpaj;jpy; nthshz; bjhHpy; El;g';fs;-  
 gjpbdz; fPH;f;fzf;F E}y;fspy; ntshz;ikmwptpay;-gs;S ,yf;fpa';fs;/ VbuGgl/ ,yf;fpaj;jpy; ntshz;  
 bghwpapay;- njhl;ltpay;- tdtpay; kidapay;- NHypay; ntshz;ikg; gHbkhHpfs;- ,yf;fpak; fhli;Lk;  
 thH;tpay; bewpKiw-,fs;;fhy ,yf;fpa';fspy; ntshz;ikr; rpe;jidfs;-gpiHapd;wpvGJk; Kiwfs;-  
 ghuk;ghpaj; bjhHpy;El;';fs;-yffpaj;jpy; bkd;jpwd;fs; - mwptpay; jkpH; tsh;r;rpepiyfs;-  
 fiyr;brhy;yhf;fk;-bkhHpbgah;g;g[-fl;Liur; RUf;fk; vGJjy;-fzpdpcyfy; jkpH;

**bra;Kiwg; gapw;rpf;**

1. bjhy;fhg;gpak; fhli;Lk; Kjw;bghUs;/ fUg;bghUs;/ jhtutpay; mwpt[/ ntshz; khe;jh; Fw bra;jpfis  
 mwpjy;
2. r';f ,yf;fpaj;jpy; ntshz;py;bjhHEl;g';fs;-(vl;Lj;bjhif/ gj;Jg;ghl;L)
3. gjpbdz; fPH;f;fzf;F E}y;fspy; ntshz;ikmwptpay;
4. gs;S ,yf;fpa';fs;/ VbuGgl\_cHth; thH;tpay; bewpKiwfSk; ntshz;ikj; bjhHpy; El;g';fSk;
5. ,yf;fpaj;jpy; ntshz; bghwpapay;-njhl;ltpay;-tdtpay;- kidapay;- NHypay;
6. ntshz;ikg; gHbkhHpfs;-cHt[ tpjmwptpay;- gUtk;- kiH - ehw;WeLjy;- vU ,Ljy;-  
 ePh;g;ghrdk;-fisntykz;ik\_gaph;ghJfhg;g[-mWtil\_cHth; rKjhak;
7. ,yf;fpak; fhli;Lk; thH;tpay; bewpKiwfs;
8. ,f;fhy ,yf;fpa';fspy; ntshz;ikr; rpe;jidfs;-ghujp/ghujpjhrd; gilg;g[fs;-g[Jf;ftpij
9. **ilepiyg; gUtj;njh;t[**
10. gpiHapd;wpvGJk; Kiwfs;- vGj;Jg; gpiHfs;- brhw;gpiHfs;- brhw; gphpg;g[g;gpiH-  
 thf;fpag;gpiH\_bka;g;g[j; jpUj;jk;
11. ghuk;ghpa ntshz;ikj; bjhHpy;El;g';fs;
12. ,yf;fpaj;jpy; bkd;jpwd;fs;-jiyikg;gz;g[-fhyntykz;ik
13. MSikg;gz;g[k;ghLnk\_kdpj cwt[j;jpwd;fs; tsh;jjy;
14. mwptpay; jkpH; tsh;r;rpepiyfs;/ ntshz; E}y;fs;/ ntshz;-mYtyff;,jH;fs;fojk;
15. fiyr;brhy;yhf;fk;- ntshz; fiyr; brhw;fiscUthf;Fk; \_jug;gLj;Jjy;Kiw-,yf;fpantshz;  
 fiyr;brhw;fs;/ tl;lhuntshz;iktHf;Fr;-mfuhjpapay;brw;fs;
16. bkhHpbgah;g;g[-Kf;fpapjpf;- goepiyfs;- bkhHpbgah;ghshpd; ,d;wpaikahg; gz;g[fs;-  
 ntshz; bra;jpfisbkhHpbgah;jjy;-fl;Liur; RUf;fk; vGJjy;
17. fzpdpcyfy; jkpH;- tpf;fpgPoah\_ntshz; bra;jpfis; gjpntw;wk; bra;jy;-ntshz;  
 bra;jpfis ,izajstHpmwpjy;

**nkW;ghh;it E}y;fs;**

1. fe;jrhkp.,y.br.ntshz;ika[k; gz;ghLk;/ jkpH;ehLntshz;ikg; gy;fiyf;fHfk;/ nfhak;g[j  
1974
2. fe;jrhkp. ,y.br.,yf;fpaj;jpy; ntshz;ik/ jkpH;ehLntshz;ikg;gy;fiyf;fHfk;/ nfhak;g[j;  
1981.
3. fe;jrhkp. ,y.br. ntshz;ikgHbkhHpfs;/ fiyr;bry;tk;jpg;gfk;;/  
nfhak;g[j;J}h; 1983. FHe;jrhkp.th.br.mwptpay; jkpH;/ ghujpgjg;gfk;/  
brd;id
4. kPdhI;rpRe;juk;. kh. kw;Wk; V.,y.tprayl;Rkp./ jfty; bjhlh;gpy; jkpH;  
bkhHpg;gad;ghL nf.Mh;.v.Mg;brl; gphpz;lh;/ nfhit\_2002
5. kzpnkfiy.k.jkpH; bkhHpj; jl;jpy; ntshz;ptpaypd;mw Rtlfs;/ njtpgjg;gfk;/  
jpUr;ruphg;gs;sp/ 2002
6. ,yf;fpaKk; ntshz;ika[k;/ midj;jpe;jpamwptpay; jkpH;f; fHfk;/ j";rht{h;;/  
2006 jkpHhpd; kug[r;bry;t';fs;/ cyfj; jkpHuha;r;rpepWtdk;/ brd;id
7. re;jpunrfud;/ ,uh/ bkhHpg;ghlk;-gilg;ghf;fj;jpwd; tsh;j;jy;
8. ntshz;fiyr;brhy; ngufuhjp/ jkpH; ehLntshz;ikg; gy;fiyf;fHfk;/ nfhak;g[j;J}h;/  
2008. ghnte;jd;/ ,uh/ jkpHpy; mwptpay; ,jH;fs;/ rhKnty;/ @gp#; fpwp!; gjpg;gfk;/  
nfhak;g[j;J}h; lhf;lh; ,uhjhbry;yg;gd;/ fiyr;brhy;yhf;fk;/ jkpH;g; gy;fiyf;fHfk;/ j";rht{h;

**ENG 103 DEVELOPMENT EDUCATION (0+1)**  
**(Alternate course for non-Tamil students)**

**Unit I**

## **Basic principles of learning**

Basic principles of learning - discussion - Bloom's classification of educational objectives – cognitive, affective, psychomotor domain(s) - teaching and learning.

## **Unit II**

### **Career development**

Career development – growth and development, education – for – life and life – long education, motivation and morale - occupation and profession, training and education, lateral thinking and convergent thinking.

## **Unit III**

### **Entrepreneurship**

Entrepreneur- intrapreneur – managing an intrapreneur – motivation and entrepreneurship - development – planning, monitoring and evaluation.

## **Unit IV**

### **Communication skills**

Interpersonal communication – transactional communication - role – play - brainstorming – demonstration -the conduct of symposium - conferencing – the concept and presentation of a paper - scientific article writing and editing - popular article writing, editing and blogging -project proposal - project report – writing.

## **Unit V**

### **Simulation exercises**

Simulation - educational simulation-Interactive teaching - business simulation – company's annual report for analysis.

## **Lecture Schedule:**

1. Basic principles of learning - binary terms viz., growth and development, education – for – life and life – long education, motivation and morale .
2. Occupation and profession, training and education, lateral thinking and convergent thinking, teaching and learning – discussion.
3. Bloom's classification of educational objectives – cognitive, affective, psychomotor domain(s)
4. Career development – opportunity for graduates of agriculture and allied sciences – discussion
5. Success story of a farmer / entrepreneur – factors involved – role – play.
6. Brainstorming – demonstration.
7. Simulation – Educational Simulation-Interactive Teaching - Business Simulation – Company's annual report for analysis
8. Interpersonal communication – Transactional communication – ice breaker
- 9. Mid Semester Examination**
10. The conduct of a symposium
11. Conferencing – the concept and presentation of a paper
12. Scientific Article Writing and Editing
13. Popular Article Writing, Editing and Blogging
14. Project proposal
15. Project Report – writing
16. Entrepreneur – intrapreneur – Managing an intrapreneur – motivation and entrepreneurship development – planning, monitoring and evaluation.

## 17. Final Practical Examination

### References

1. Sudarsanam.R 1985. "Development Education" Chapter 1,2
2. Krishna Mohan and Meera Banerji, (1990). "Developing Communication Skills", Macmillan Pub. Co., Ch.6,9,10,13 and 15.

### E-References :

<http://www.e-booksdirectory.com/details.php?ebook=9481>



## NSS 101 NATIONAL SERVICE SCHEME (0+1)

### I Year

Orientation – NSS origin – motto – symbol – NSS administration at different levels – programme planning – Rural Projects – Urban projects – Government schemes – Career guidance – Self help groups

– Environment protection – Use of natural energy – Conventional energy resources – Soil and Water conservation – Community health programmes – Women and child welfare – Education for all – National days – Commemorative days – NSS thematic programmes – literacy & computer awareness campaigns.

### II Year

Popularization of agro techniques – Self employment opportunities – Animal health, Dairy and Poultry farming – Road safety – Training on First aid and emergency cell. Popularization of small savings – communal harmony and National integration – Care of Senior citizens – Personality development – meditation, Yoga Art of living – Activities on the preservation of National monuments, cultural heritage and folklore – special camp activities – National days – commemorative days – NSS thematic programmes – literacy & computer awareness campaigns.

### Practical Schedule:

#### I Semester

1. Orientation of NSS volunteers and programme coordinator and Programme officers.
2. Origin of NSS in India and its development
3. NSS motto, symbol and NSS awards
4. Organizational set up of NSS at Central, State University and college levels.
5. Programme planning – Theme of the year – planning implementation at PC, PO and NSS volunteer level.
6. Visit to selected village - gathering basic data on socio economic status.
7. Participatory rural appraisal – studying the needs of the target group.
8. Visit of urban slum and gathering data on socio economic status.
9. Self involvement and methods of creating rapport with the target group.
10. Awareness campaign on welfare schemes of the central and state government.
11. Formation career guidance group with NSS volunteers and students welfare unit
12. Cycle rally on environmental protection.
13. Campus development activities – clean environment campaign, formation of plastic free zones.
14. Campus development, tree planting maintenance and greening the campus cleaning.
15. **15 Final Examination.**

## II Semester

1. 1–3: Motivation of rural and urban youth for formation of SHG (Self Help Groups) in collaboration with Government machineries and NGOs.
2. Campaign on ill effects of plastics in the adjoining campus areas – Villages / urban areas.
3. Campaign on *Parthenium* eradication.
4. Cycle rally on air pollution – Vehicle exhaust and other means.
5. Popularization of biogas and smokeless chulah.
6. Demonstration on the use of wind energy and solar energy.
7. Demonstration of water harvesting techniques.
8. Demonstration on soil conservation techniques wherever possible.
9. Campaign on Community health programmes of central and state Government – involving Health department officials.
10. AIDS awareness campaign ; campaign on diabetes and healthy food habits and drug abuse
11. Planning formation of blood donors club – involving NGOs.
12. Campaign on gender equality and women empowerment.
13. Campaign on child health care – immunization, food habits and child labour abolition.

## III Semester

1. Conducting field days with KVK to popularize improved agro techniques.
2. Conducting seminar / workshop in a nearby village to motivate the youth on agribusiness (involving DEE, KVK, NGO and local agro-entrepreneurs).
- 3–5 Campaign on self employment opportunities like Apiculture, mushroom cultivation, Food processing and value addition, production of biocontrol agents and biofertilizers, nursery techniques, seed production, tissue culture, vermicompost, manufacture of small gadgets and agricultural implements as per local needs and feasibility.
6. Animal health care campaign – Dairy and poultry farming - Forage production techniques and silage making.
7. Training the NSS volunteers on road safety measures in involving traffic wardens and RTO.
8. Training NSS volunteers on First AID and emergency call involving NGOs and organizations like St. John's Ambulance, Red Cross, etc.,
9. Organizing road safety rally.
10. Motivating NSS Volunteers on small savings concept and conveying the message to the public through them.
12. Observation of National integration and communal harmony.
- 14– 16 : Campus development and greening activities
17. **Final Examination.**

#### IV Semester

1. Visit to orphanages and old age homes to look after their needs.
2. Personality development programmes – Building up self confidence in youth.
3. Teaching NSS volunteers on mediation Yoga and art of healthy living with trained teachers
4. Visit of nearby National Monument / Places of tourist importance and campaign on cleanliness and preservation.
5. Exploration of hidden talents of village youth and public on folklore, traditional art, sports, martial arts and cultural heritage . Campus improvement activities Visit to special camp village and pre camp planning.
6. **Final Examination.**

Besides the above, NSS volunteers will attend work during important occasions like Convocation, Farmers day, Sports meet and other University / College functions. NSS Volunteers will attend one special camp in the selected village for a duration of 10 days and undertake various activities based on the need of that village. For all out door regular activities villages / slums nearby the campus may be selected to avoid transport cost (cycle able distance) Special camp activity will be conducted in a village situated within a radius of 15 – 20 KM.

#### EVALUATION

##### A. Regular activities

<b>60</b>	=	I Semester	15 marks
<b>marks</b>		II Semester	15 marks
		III Semester	15 marks
		IV Semester	15 marks

(Written test 10 marks – participation in programmes and behavior-5 marks) 80% attendance is mandatory for attending special camp

##### B. Special camp activities

a. Attendance in daily activities during special camp:	30 marks
b. Special camp activity report :	5 marks
c. <i>Viva - voce</i> on the 10th day of the special camp :	5 marks
<b>Tota</b>	<b>40 marks</b>

## **NCC 101 National Cadet Corps (0+1)**

### **I Year**

General - Military History – Introduction to NCC – Aims of NCC – Principles of NCC, NCC organization, Duties of good citizen – system of NCC training – Foot drill – Arms drill – Guard of Honour – Ceremonial Drill – Weapon training – First aid – Rifle and Light machine gun – Map reading – Civil defence – Leadership.

### **II Year**

Drill – Weapon drill – Weapon training and firing – Introduction to National Integration – Historical – geographical – Religions back ground of India – Health and Sanitation – Aid to Civil Authorities – Civil defence – Ecology / Nature awareness – Map reading – Social service – Adventure Activities – Leadership qualities.

### **ISemester**

1. NCC song – Aims and Motto of NCC – Motivation of cadets
2. History of NCC and organization of NCC
3. Food drill – General and word of Command
4. Human Resource Development – Motivation – Duties of Good citizen
5. National Integration – Indian History and Culture
6. Health and Hygiene – Structure and Function of a human body, hygiene and Sanitation
7. Social Service – weaker sections of our society and their needs
8. Self Defence – Theory and practice, prevention of untoward incidence
9. Map reading – introduction to map, and lay out of map
10. Disaster Management Civil defence organization and its duties
11. Communication – Different types – media
12. Signals – introduction to radio, telephony procedures
13. Field Engineering – principles and applications, camouflage and concealment
14. Adventure training introduction, different types
15. First Aid – methods and practices
16. Environment and Ecology – conservation
17. **Final Examination.**

### **II Semester**

1. Drill – Weapon drill – Word of Commands
2. National integration- unity in diversity
3. Guard of Honour and Ceremonial drill
4. Types of weapon, Parts, Stripping and Assembling of light gun.
5. Rifle firing and follow up activities
6. Camps, types of Camps, Preparation and participation
7. Awards, different types, Ranks of officers and Cadets
8. Map reading – judging distance, conventional signs and uses of compass.
9. Leadership traits, types, perception
10. Fire Fighting, Role of NCC during natural hazards
11. Field Engineering – section formation
12. Obstacle training
13. Health and Sanitation – preventable diseases, Fractures and types of treatments
14. Environment and Ecology-Pollution and its control.
15. Social Service – contribution of youth towards social welfare
16. First Aid – Snake bite and other common medical Emergencies.
17. **Final Examination.**

### III Semester

1. Drill – Individual word of command
2. Weapon training – parts of heavy weapons
3. Stripping and assembling of heavy weapons
4. Importance of team work values, code of ethics
5. Disaster management during Earth Quake
6. Evacuation of Casualties
7. Map reading – Camposs and Service Protractor
8. Aids to civil authority
9. Section and platoon formation
10. Social service, NGO's and their contribution to the society
11. Roll of NCC cadets in civil administration
12. Traffic rules and Road signs
13. Mines and types of mine fields
14. Dressing of Wounds, physical and mental health
15. Field signals
16. Air raid warning, Fire fighting
17. **Final Examination.**

### IV Semester

1. Drill – Foot drill
2. Formation of squad and squad drill
3. Man Management, Morale
4. Time Management, stress management
5. Ecology and Environment wild life conservation
6. Adventure Activities, Trekking Camp
7. Map reading – Field to Map – Map to Field – Grids and scale systems
8. Communication systems – Internet – Faxi mail – Satellites
9. Collection and Distribution of Aid material
10. Field Engineering – Mines, anti tanks, explosives
11. Opportunities for NCC cadets in Army and other services
12. Social Service, Family Planning
13. Section battle drill
14. Roll of NCC cadets in National programmes.
15. Visit to Wellington, Coonoor.
16. Self defence mechanisms
17. **Final examination.**

Besides the above schedule, NCC cadets will be involved during important occasions during convocation, Independence day, Republic day, etc.

### EVALUATION:

		<b>Sem I</b>	<b>Sem II</b>	<b>Sem III</b>	<b>Sem IV</b>	<b>Total</b>
A.	Regular activities and Behaviour	10	10	10	10	40
B.	Participation in camps and special assignments	5	5	5	5	20
C.	Written test and viva	10	10	10	10	40
	<b>Total</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>100</b>

## PED 101 Physical Education (0+1)

### Practical

(17 Practical classes – 2½ hours each class – 17 classes will be converted into 40 practical hours and 2½ hours for evaluation)

### I Semester (20 Hours)

Exercises for strength, agility, co-ordination, flexibility, co-operation, vital capacity endurance, speed and for various systems of our body and team spirit.

Exercise for Good Posture – Conditioning and calisthenics for various Athletic activities *i.e* (a) Before start – Arm stretch, hand stretch and cat stretch (b) Loosening up jogging, bending and twisting (c) Standing – Lateral Arc, triangle and hands to feet pose (d) Sitting – camel kneel, spinal twist and supine knee bend (e) Relaxation – The corpse pose, quick and deep relaxation. Basic gymnastic exercises – participation of athletic events – running, throwing and jumping events.

### Skill development in anyone of the following games

Warming up, suitable exercise, lead up games, advance skill for all the games.

**Basket Ball** : Dribbling, pass, two or three men pass, pivot, lay up shot, shooting, pass break, hook pass, screening, positional play, defence and offence tactics.

**Volley Ball** : Fingering, under arm pass, over head pass, setting, spiking, back pass, jump pass, stunts, elementary dive, flaying dive, roll, blocking and various types of services.

**Ball Badminton** : Grip, service, foot work, fore hand stroke, back hand stroke, lob, smash, volley, wall practice, spin service and defence tactics.

**Foot ball** : Dribbling, passing, dodging, kicking, heading, screening, chest pass, throwing, dragging, goal kick, defence and offence tactics.

**Hockey** : Grip, bully, dribbling, hitting, drive, push strokes, scoop, flick, stopping, various types of passes, dodging, defence and offence tactics.

**Kho-Kho** : Quadra ped, bi-ped, how to given kho, taking a direction, recede, parallel toe method, bullet tow method, distal method, foot out, dive, ring game, chains and pursue and defence skills.

**Chess** : Moves, move of king, move of pawns, move of rooks, move of bishops, move of queen, move of knights, en passant, castling, check and notation.

**Kabaddi** : Raid, touch, cant, catch, struggle, various types of defence and offence tactics.

**Cricket** : Grip, bowling, spin, leg spin, off spin, medium, batting, dive, sweep, mode of delivery, fielding, rolling etc.

**Tennis** : Grip, forehand drive, back hand drive, stroke, backhand ground stroke, service, volley, smash, wall practice, foot work, defence and offence tactics.

**Table Tennis** : Grip, tossing and serving, spin serve, rally, smash, flick, defence and offence tactics.

**Shuttle Badminton** : Grip, foot work, service, setting, smash, volley, forehand and back hand stroke, back hand serve and defence.

**Gymnastics** : Balanced walk, execution, floor exercise, tumbling/acrobatics, grip, release, swinging, parallel bar exercise, horizontal bar exercise, flic-flac-walk and pyramids.

## **ATHLETICS**

- (a) **Sprint** : Medium start, long start, bunch start, set, pick up, finish, upsweep, downsweep, placement, receiving and exchanging.
- (b) **Jumps** : Western roll, belly roll, eastern cut off, fass ferry flop, approach, take off, straddle, hitch-kick, handging, clearance, landing, strides etc.
- (c) **Throws** : Grip, momentum, pre shift, sub phase, the wind up, foot work, entry to the turn, shift, angle of release, follow throw, delivery, front cross step, rear cross step, hop step, fuck method pary obraine, discoput, rotation, carry and glide.
- (d) **Hurdles** : Finding lead leg, use of lead leg and trial leg, flight, clearing, finish.

Lead up games, advance skills and game for any one of the above games.

## **II Semester (20+ 2 ½ hours)**

Rules and regulations of anyone of the games and athletic events.

Aims and objectiaves of yoga – asanas : ie. padmasana, pujankasana, sarvangasana, chakrasana,dhanurasana, halasana, mayurasana and savasana, asanas for ailments, back pain, arthritis, abdominal problems, stress, fatiguel, Insomnia, obsity, circulation, hypertension, varicose veins, respiration, heart, digenstion, headaches, depression, addiction and eye problems.

Mental balance and importance – development of concentration suriyanamaskar – advance skills of any one of the games which were taught in the I semester.

## **METHOD OF EVALUATION:**

a. Attendance	60 Marks
b. Behavior	10 Marks
c. Participation in Sports and Games	20 Marks
d. Final <i>Viva Voce</i>	10 Marks

Marks will be awarded at the end of the IV Semester based on the above method of evaluation procedure. Final class grade chart of each student will be sent to the Dean of concerned colleges of Tamil Nadu Agricultural University.

## **PED 102 YOGA FOR HUMAN EXCELLENCE (0+1)**

### **UNIT - 1:**

#### **PHYSICAL HEALTH AND REJUVENATION OF LIFE-FORCE**

Significance of Value Education - Types of Education – Yoga for Human Excellence Principles and Purpose of living - Body structure – Body functions – Reasons for Diseases and Prevention - Concept of Health – Role of limit and method in five deeds for good health - Importance of Naturopathy - Objectives of physical exercises Benefits of physical exercises - Kayakalpa yoga philosophy - Youthfulness practices Enriching bio-magnetism.

### **UNIT - 2:**

#### **MENTAL PROSPERITY AND SOCIAL WELFARE**

Mind functions – Mental frequency – Thought – Brain and Memory power – Problem solving and Decision making skills - Need and benefits for meditation - SKY Yoga types of meditation Part 1: Eye brow centre meditation - Genetic centre meditation - Spinal cord clearance - Crown centre meditation - Analysis of thoughts – Moralization of desires - Neutralization of Anger – Eradication of Worries – Benefits of blessings - Human culture and values – Five-fold culture - Time management – Personality Assessment - Environment awareness and protection - Family peace – World peace - Five duties - Harmonious friendship – Greatness of Womanhood.

### **UNIT - 3:**

#### **YOGA PRACTICES – I**

PHASE I - Simplified Physical Exercises: Hand exercise - Leg exercise – Neuro muscular breathing exercise – Eye exercise – Kapalabathi - PHASE II – Makarasana Part 1 & 2 – Body massage - Acu-pressure – Relaxation exercise - Youthfulness practices (Kayakalpa) - SKY Yoga types of meditation Part 1: Eye Brow centre meditation - Genetic centre meditation - Spinal Clearance - Crown centre meditation.

#### **Practical Schedule:**

1. Significance of Value Education - Types of Education – Yoga for Human Excellence – Eye brow centre meditation (Aghna) - Simplified Physical Exercises – Objective of physical exercises – Benefits of exercises.
2. Principles and Purpose of living - Genetic centre meditation - Explanation and initiation of Genetic centre - SPE – Hand exercises, Leg Exercises, Neuro Muscular Breathing exercises, Eye exercises, Kapalabathi and Relaxation
3. Kayakalpa yoga philosophy - Youthfulness practices - Enriching bio-magnetism - Eye brow
4. centre meditation Practice (Aghna) - Kayakalpa Yoga – Explanation and Kayakalpa Practice
5. Body structure – Body functions - Genetic centre meditation Practice - Simplified Physical Exercises - Makarasana, Massage and Acupressure and Relaxation - Kayakalpa
6. Concept of Health – Role of limit and method in five deeds for good health - Spinal cord Clearance - Explanation and practice - Simplified Physical Exercises Full exercises – Kayakalpa
7. Reasons for Diseases and Prevention - Crown centre meditation- Initiation (Thuriyam)
8. Importance of crown centre meditation - Simplified Physical Exercises Full exercises - Kayakalpa



9. Importance of Naturopathy - Crown centre meditation- (Thuriyam) - Simplified Physical Exercises Full exercises - Kayakalpa
10. Mind functions – Mental frequency – Thought – Brain and Memory power - Crown centre meditation- (Thuriyam) - Simplified Physical Exercises Full exercises - Kayakalpa
11. Analysis of thought - Moralization of desire - Genetic centre meditation Practice - Simplified Physical Exercises Full exercises - Kayakalpa
12. Neutralization of Anger – Eradication of Worries – Eye brow centre meditation Practice (Aghna) - Simplified Physical Exercises Full exercises - Kayakalpa
13. Benefits of blessings - Human culture and values – Crown centre meditation- (Thuriyam) - Simplified Physical Exercises Full exercises - Kayakalpa
14. Fivefold culture – Time management - Crown centre meditation- (Thuriyam) - Simplified Physical Exercises Full exercises - Kayakalpa
15. Environment awareness and protection - Genetic centre meditation Practice - Simplified Physical Exercises Full exercises - Kayakalpa
16. Family peace – World peace - Harmonious friendship – Crown centre meditation- (Thuriyam)
17. Simplified Physical Exercises Full exercises – Kayakalpa
18. Greatness of Womanhood - Five duties - Genetic centre meditation Practice - Simplified Physical Exercises Full exercises - Kayakalpa
19. Personality Assessment - Crown centre meditation- (Thuriyam) - Simplified Physical Exercises Full exercises – Kayakalpa
20. Physical health and mental health – revision

## II SEMESTER

S. No	Course code	Course Title	Credit load
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*
		<b>Total</b>	<b>13+8=21</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)

### 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<sub>3</sub>, C<sub>4</sub> and CAM plants; Photosynthetic pathways of C<sub>3</sub>, C<sub>4</sub> 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:**

9. Introduction and importance of Crop Physiology in Agriculture, an over view of Plant cell.
10. Structure and role of water –water potential and its components – Diffusion – Osmosis – imbibition – Plasmolysis - Field Capacity and Permanent Wilting Point
11. Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast
12. Translocation of water – ascent of sap – mechanisms of xylem transport
13. Transpiration – significance – Stomatal physiology: structure of stomata with mechanisms of stomatal opening and closing – guttation - antitranspirants
14. Mineral nutrition of plants – criteria of essentiality - classification of nutrients – macro, micro, mobile and immobile – beneficial elements, mechanism of nutrient uptake
15. Physiological functions and disorders of macronutrients, Hidden hunger
16. Physiological functions and disorders of micronutrients
17. Foliar nutrition- root feeding and fertigation – sand culture, hydroponics and aeroponics
18. Light reaction of photosynthesis – photolysis of water and photophosphorylation - Z scheme
19. Dark Reaction of photosynthesis - C3, C4 and CAM pathways and differences.
20. Factors affecting photosynthesis - Photorespiration – pathway and its significance
21. Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations
22. Respiration - Glycolysis – TCA cycle.
23. Photo and oxidative phosphorylation - Electron transport chain - energy budgeting - respiratory quotient.
24. Fat metabolism: fatty acid synthesis and breakdown
25. **Mid Semester Examination**
26. Growth – phases of growth – factors affecting growth.
27. Hormones and plant growth regulators (PGR): physiological roles and agricultural uses - Biosynthetic pathway and role of auxins and gibberellins
28. Plant growth regulators (PGR): physiological roles and agricultural uses - Biosynthetic pathway and role of cytokinin, ethylene and ABA
29. Novel growth regulators viz., Brassinosteroids and salicylic acid – New Generation PGRs - Growth retardants and inhibitors -commercial uses of PGRs
30. Photoperiodism - short, long and day neutral plants – Chailakhyan’s theory of flowering
31. Forms of phytochrome - Pr and Pfr - regulation of flowering
32. Vernalisation - theories of vernalisation – Lysenko and Hormonal theories – devernalization
33. Physiological aspects of growth and development of major crops
34. Growth analysis – role of physiological growth parameters in crop productivity
35. Seed germination - physiological and biochemical changes - seed dormancy and breaking methods
36. Senescence and abscission – physiological and biochemical changes
35. Physiology of fruit ripening- climacteric and non climacteric fruits - factors affecting ripening and manipulations
36. Drought - physiological changes - adaptation – compatible osmolytes - alleviation
37. High and low temperature stress – physiological changes - membrane properties - adaptation
38. Salt stress - physiological changes - adaptation – compartmentalization - alleviation
39. Flooding and UV radiation stresses – physiological changes - adaptation
40. Global warming – green house gases –physiological effects on crop productivity- Carbon

**Practical schedule:**

17. Preparation of solutions
18. Study of leaf epidermal, xylem and phloem cells
19. Determination of stomatal index and stomatal frequency
20. Measurement of plant water potential
21. Measurement of water imbibition by seed mass test
22. Estimation of photosynthetic pigments

23. Determination of photosynthetic efficiency in crops
24. Measurement of transpiration and photosynthesis by IRGA
25. Diagnosis of nutritional and physiological disorders in crops
26. Rapid tissue test for mineral nutrients
27. Estimation of relative water content
28. Measurement of osmosis and plasmolysis
29. Growth Analysis
30. Bioassay for gibberellin and cytokinin
31. Estimation of chlorophyll stability index
32. Estimation of proline content
33. **Final Practical Examination**

### **References**

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

### **E -references**

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

## AEC 101 Fundamentals of Agricultural Economics (1+1)

### 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.

## Theory Schedule:

10. *Economics*: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis.
11. 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.
12. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.
13. *Demand*: meaning, kinds of demand, law of demand, demand schedule and demand curve, determinants.
14. *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.
15. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus and its importance.
16. 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.
17. *Production*: process, creation of utility, factors of production definition and characteristics - Input Output Relationship.
18. **Mid Semester Examination**
19. *Laws of returns*: Law of variable proportions and law of returns to scale. *Cost*: Cost concepts, short run and long run cost curves.
20. *Supply*: Stock versus supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.
21. 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.
22. 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**

35. Law of Diminishing Marginal Utility.
36. Law of Equi - Marginal Utility.
37. Indifference Curve analysis - Properties, budget line and consumer equilibrium.
38. Individual and market demand - Graphical derivation of individual and market demand.
39. Measurement of Arc and Point elasticities of demand - own price, income and cross price elasticities of demand.
40. Estimation of Consumer surplus.
41. Law of Diminishing Marginal Returns: Relationship among TPP, APP and MPP.
42. Cost concepts and graphical derivation of cost curves.
43. Estimation of total revenue and profit.
44. Estimation of Producer surplus.
45. Estimation of Supply elasticity.
46. Exchange: Market Structure and Price determination.
47. Computation of National Income – Analysis of Trends in National Income - Study of structural changes in the economy.
48. Estimation of Growth rate of population and Food grain production.
49. Money: Quantity theory of money.
50. Measures of standard of living – Human Development Index – Physical Quality of Life Index – Gender Development Index.
51. **Final Practical Examination.**

### **References**

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

## 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. Procaryotic 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 lecture schedule:**

6. Definition and scope of microbiology
7. Biogenesis and a biogenesis theory. Contributions by Antonie Van Leeuwenhoek and Louis Pasteur
18. Contributions of John Tyndall, Joseph Lister, Edward Jenner, Robert Koch, Alexander Fleming and Waksman. Germ theory of fermentation and disease
19. Microscopy; principles – resolving power and magnification. Light microscopy
20. Different types of microscopes - UV, dark field, phase contrast and fluorescence
21. Electron microscopes; atomic and confocal scanning laser microscopy
22. Staining techniques - principle and types of stains - staining techniques- simple, negative, differential and structural staining methods
23. Sterilization – principle – physical agents and chemical methods
24. Isolation and enrichment culture techniques; preservation techniques
25. Evolutionary relationship - position of microbes in living world – concepts and developments in classification of microorganisms
26. Groups of microorganisms - prokaryotes and eukaryotes. Archaea – ecology; differences among archaea, eubacteria and eukaryotes
27. Bergey's manual of systematic bacteriology – outline only. Economic importance of bacteria
28. Bacteria- size, shape, structure and arrangement of cells
29. Bacteria - external and internal structures in bacteria and their functionality
30. Morphology and classification of fungi and economic importance
31. Morphology and classification of algae and economic importance
32. Viruses and their properties; bacteriophages – lytic and lysogenic and temperate phages
33. **Mid Semester Examination**
34. Reproduction in bacteria - population growth and growth phases – generation time and specific growth rate
35. Batch and continuous culture – chemostat and turbidostat; synchronous culture. Diauxic growth curve.
36. Conditions for growth - temperature requirements - aerobes and anaerobes – other factors influencing growth; methods of assessment of growth.
37. Nutritional types of bacteria. Metabolic diversity in microbes.
38. Aerobic respiration and anaerobic respiration
39. Fermentative mode of respiration
40. Oxygenic and anoxygenic mode of photosynthesis
41. Energy generation by substrate level phosphorylation, oxidative and photo phosphorylation
42. Genetic elements in bacteria – structure and functions of bacterial chromosome and plasmid and transposons
43. Mutation in bacteria – principles and types. Mutagens – physical, chemical and biological
44. Genetic recombination – competency - transformation
45. Genetic recombination by Conjugation – concept of Hfr
46. Genetic recombination by Transduction – generalized and specialized
47. Microorganisms as tools in genetic engineering
48. Immunology – principles – specific and non-specific defense
49. Antigen – antibody reactions – vaccines - applications

### **Practical schedule**

5. Safety in Microbiology laboratory. Microscopes – handling light microscope
6. Micrometry-measurement of microorganisms
7. Aseptic techniques – working with equipment and apparatus
11. Preparation of growth media for bacteria, yeast, molds and actinobacteria
12. Isolation of microorganisms by serial dilution and plating technique
13. Purification of bacteria and actinobacteria
14. Purification of yeasts and molds
15. Preservation of bacteria, fungi and actinobacteria
16. Staining techniques - positive and negative staining
10. Differential staining - Gram staining
7. Turbidometric assessment of growth of bacteria
8. Morphological characteristics of bacteria and actinobacteria
9. Biochemical characteristics of bacteria and actinobacteria
10. Identification of yeasts, molds and algae - morphological characterization
11. Isolation of bacteriophages
12. Isolation of bacterial mutants by UV irradiation / chemical mutagenesis

### **13. Practical Examination**

#### **Reference :**

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

#### **E- Reference :**

1. <http://www.microbes.info>
2. <http://aem.asm.org>
3. <http://microbelibrary.com>
4. <http://www.rapidmicrobiology.com>

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

### **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 Lecture schedule

9. Education- meaning, definition and types; Extension education – meaning, definition, scope and process; objectives and principles and function of extension education.
10. Programme planning – definition, meaning, process, principles and steps in programme planning / development
11. 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,
12. Extension/ agricultural development programmes launched by ICAR/Govt. of India ICAR Programmes – National demonstration, ORP, Lap to Land Programme, FTC.,
13. 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.
14. 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.
15. Community Development Programme (CDP), National Extension Service (NES), Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) - their strengths and weaknesses
16. High Yielding Variety Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), Integrated Rural Development Programme (IRDP) - their strengths and weaknesses.
17. 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
18. 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),
19. 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:**

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



## References :

1. Ahuja, B.N. 1997. Theory and Practice of Journalism, Surjeet Publications, New Delhi.
2. Benor Daniel, Q. James Harrison and Baxter Michael. 1984. Agricultural Extension – The Training and Visit System, A World Bank Publication, Washington, USA.
3. Chauhan Nikulsinh. 2013. Use of ICTs in Agricultural Extension, Biotech Books.
4. 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.
5. Hough George, A. 2004. News Writing. Kanishka Publishers, New Delhi.
6. Dahama, O.P and O.P. Bhatnagar. 1985. Education and Communication for Development, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Dipak de, Basavaprabhu Jirli. 2010. A Handbook of Extension Education, Agrobios, India.
8. Katar Singh. 1999. Rural Development – Principles, Policies and Management, Sage Publications India Pvt. Ltd., New Delhi.
9. Kelsey, L.D and C.C. Hearne. 1967. Cooperative Extension Work, Cornell University Press, New York.
10. Manoharan Muthiah, P. and R. Arunachalam. 2003. Agricultural Extension, Himalaya Publishing House, Mumbai.
11. Narayanasamy, N. 2009. Participatory Rural Appraisal Principles, Methods and Application, Sage Publications India Pvt. Ltd., New Delhi.
12. Neela Mukherjee. 1993. Participatory Rural Appraisal: Methodology and Applications, Concept Publishing Co.
13. Pandey, B.K. 2005. Rural Development, ISHA Books, New Delhi.
14. Pandey, V.C. 2003. Information Communication Technology and Education (The Changing World ICT Governance), Isha Publishers.
15. Ray, G.L. 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
16. Reddy Adivi, A. 1993. Extension Education, Shree Lakshmi Press, Bapatla, Andhra Pradesh.
17. Rishipal. 2011. Training and Development Methods, S.Chand and Co. Ltd., New Delhi.
18. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, New York.
19. Sagar Mondal and Ray, G.L. 2007. Text book of Rural Development, Kalyani Publishers, New Delhi.
20. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
21. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
22. Sanjay Prakash Sharma. 2006. Panchayat Raj, Vista International Publishing House, New Delhi.
23. Singh, A.K. 2012. Agricultural Extension, Agrobios, New Delhi.
24. Sivasudevaro, B and Rajannikanthu, G. 2007. Rural Development and Entrepreneurship Development, The Associated Publications, Ambala.
25. Supe, S.V. 1997. An Introduction to Extension Education, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
26. Van den Ban, A.W and H.S. Hawkins. 2002. Agricultural Extension, CBS Publishers & Distributors, New Delhi.

## E -Reference

1. [rural.nic.in](http://rural.nic.in)
2. [www.panchayat.gov.in](http://www.panchayat.gov.in)
3. [wcd.nic.in](http://wcd.nic.in)
4. [moud.nic.in](http://moud.nic.in)
5. [mhupa.gov.in](http://mhupa.gov.in)
6. [www.i4d.com](http://www.i4d.com)
7. [www.panasia.org](http://www.panasia.org)
8. [www.joe.org](http://www.joe.org)

## **FSN 111 Principles of Food Science and Nutrition (1+1)**

### **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 Lecture Schedule:**

18. Food Science – definition, scope and classification, food pyramid.
19. Methods, merits and demerits of moist heat, dry heat and microwave cooking of foods.
20. Importance and scope of nutrition and the relation of nutrition to health.
21. Carbohydrate – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
2. Protein – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements. Protein quality – supplementary value of protein.
3. Fat - classification, functions, digestion and absorption, deficiency symptoms, sources and requirements. Rancidity – types. Determination of energy value of foods.

4. Fat soluble vitamins – A, D, E and K – functions, deficiency symptoms, sources and requirements.
5. Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid, ascorbic acid – functions, deficiency symptoms, sources and requirements.
- 6. Mid Semester Examination**
7. Minerals – calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, requirements and deficiency diseases.
8. Importance of water and maintenance of electrolyte balance. Health benefits of fibre.
9. Preservation of food by low and high temperature and food irradiation.
10. Processing of puffed, flaked and extruded products
11. Preservation by using sugar (jam, jelly, squash and marmalade), preservation by using salt (brining and pickling) and use of preservatives in food preservation.
12. Food packaging – importance, types of packaging materials and nutrition labeling.
13. Common food adulterants and their detection.
14. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

**Practical Schedule :**

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

**References :**

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.

**E- References :**

18. [www.cellinteractive.com](http://www.cellinteractive.com)
19. [www.nutrition.org.uk](http://www.nutrition.org.uk)
20. [www.fnrc.nal.usda.gov](http://www.fnrc.nal.usda.gov)
21. [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 - Co-ordinates 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 - Hygrograph - Psychrometers - Fortin's barometer - Barograph - Altimeter; Wind vane, Anemometer - Rain gauge - Ordinary and self-recording - Dew gauge; 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:**

11. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production.
12. Coordinates of India and Tamil Nadu. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
13. 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.
14. Solar radiation - Radiation balance - Wave length characteristics and their effect on crop production - Light - effect of intensity, quality, direction and duration on crop production.
15. Air temperature - Factors affecting temperature. Diurnal and seasonal variation in air temperature - Isotherm, Heat unit and its use - Heat and cold injuries.
16. Role of temperature in crop production. Soil temperature - Importance in crop production. Factors affecting soil temperature, diurnal and seasonal variation in soil temperature.
18. 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.

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

**Practical Schedule:**

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

## References

1. Mavi, H.S., 1996. Introduction to Agrometeorology, oxford and IBH Publishing Co., New Delhi. Gopaldaswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur. Prasad, Reddy, S.R. and Reddy, D.S. 2014. Agro meteorology. Kalyani Publishers, NewDelhi
2. 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.
3. Smith, J.W. 2013. Agricultural meteorology. Axis Books (India), Jodhpur
4. Rao, P.2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd, NewDelhi
5. Murthy, R.V. 2002. Basic Principles of Agricultural Meteorology. BS Publications, Hyderabad.
6. Singh, J. 2014. Textbook of Agricultural meteorology. Oxford Book Company, New Delhi.
7. Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University Press, Thrissur.

## E-References:

1. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
2. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)
3. [www.imd.gov.in](http://www.imd.gov.in)

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

### **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 –fertiligation - 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 – fertiligation - 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 –fertiligation - 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 lecture 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. **Mandarin and Acid Lime)**
8. 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**
9. 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**
10. **Mid semester examination**
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 **Pomegranate, jackfruit and minor fruits**
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 **Apple and pear**
13. 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**
14. 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**
15. 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** .



16. 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** .
17. 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** .
18. 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**.
19. 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**

4. Propagation techniques, selection of planting material, varieties, important cultural practices for **Mango**
5. Propagation techniques, selection of planting material, varieties, important cultural practices for **Banana**
6. Propagation techniques, selection of planting material, varieties, important cultural practices for **Papaya**
7. Propagation techniques, selection of planting material, varieties, important cultural practices for **Guava**
8. Propagation techniques, selection of planting material, varieties, important cultural practices for **Sapota**
9. Propagation techniques, selection of planting material, varieties, important cultural practices for **Grapes**
10. Propagation techniques, selection of planting material, varieties, important cultural practices for **Citrus (Mandarin and acid lime)**
11. Propagation techniques, selection of planting material, varieties, important cultural practices for **Pomegranate**
12. Propagation techniques, selection of planting material, varieties, important cultural practices for **Jackfruit**
18. Preparation and application of PGR's for propagation.
19. 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**

## Reference

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. IIIV. 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

1. <http://www.jhortscib.com>
2. <http://journal.ashspublications.org>
3. <http://www.actahort.org/>
4. <http://www.aphorticulture.com/crops.htm>
5. <http://cpcri.nic.in/>
6. <http://indiancoffee.org>

## **RSG 101 Geo-informatics 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
35. Introduction to Crop Simulation Models and their uses for optimization of Agricultural Inputs
36. Drones for precision agriculture

## **References**

### 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

## **E - references**

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)

### III SEMESTER

S. No.	Course code	Course Title	Credit load
1	PAT 201	Fundamentals of Plant Pathology	2+1
2	AEN 201	Fundamentals of Entomology	2+1
3	SST 201	Principles of Seed Technology	2+1
4	AGR 201	Crop Production Technology – I ( <i>Kharif</i> crops)	1+1
5	HOR 211	Production Technology for Vegetables and Spices	1+1
6	ENS 201	Environmental Studies & Disaster Management	2+1
7	AMP 201	Livestock and Poultry Management	2+1
8	AEC 201	Farm Management, Production & Resource Economics	1+1
9	SAC 201	Soil Resource Inventory	1+1
10	FMP 211	Farm Machinery and Power	1+1
11	AGR 202	Study tour	0+1*
12	NSS/NCC 101	NSS/NCC	0+1*
13	PED 101	Physical Education	0+1*
		<b>Total</b>	<b>15+10=25</b>
		*Non-gradual courses compulsory courses	

**PAT 201 Fundamentals of Plant Pathology (2+1)**

**Theory**

**Unit I:**

**Plant pathogenic organisms**

Plant Pathology- Definition - History- Economic importance of plant diseases- Plant Pathogenic organisms – Protozoa, Phytonomas, chromista, Fungi, Bacteria, *Candidatus Phytoplasma*, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites

**Unit II:**

**Pathogenesis**

Koch's postulates- Pathogenesis - Mode of infection – pre-penetration, penetration and post penetration - Role of enzymes and toxins on disease development-Effect of pathogen on physiological functions of the plants

**Unit III:**

**General characters and taxonomy of Protozoa, Chromista and fungi**

General characters– somatic structures, types of mycelia - reproduction (Vegetative, asexual and sexual) – Types of parasitism. Classification (Kirk *et al.*, 2001) and symptoms of **Kingdom:Protozoa**, **Phylum:Plasmodiophoromycota**, *Plasmodiophora brassicae*. **Kingdom:Chromista**, **Phylum:Oomycota**-*Pythium,Phytophthora, Sclerospora, Plasmopara* and *Albugo* **Kingdom:Fungi** , **Phylum:Chytridiomycota**-*Synchytrium*, **Phylum: Zygomycota** -*Mucor, Rhizopus*

**Unit IV:**

**General characters and taxonomy of fungi - Ascomycota and Basidiomycota**

**Phylum: Ascomycota**, *Taphrina, Capnodium, Mycosphaerella, Macrophomina, Cochliobolus, Lewia, Venturia, Eurotium, Talaromyces, Sclerotinia, Erysiphe, Leveillula, Phyllactinia, Claviceps, Gibberella, Ustilagoidea, Verticillium, Glomerella, Pestalotiopsis* and *Magnaporthe*

**Unit V:**

**Bacteria, Phytoplasma, virus, viroid, Algae, Phanerogams and abiotic disorders**

General characters and symptoms- phytopathogenic bacteria,*Candidatus Phytoplasma*, Spiroplasma, Fastidious vascular bacteria, viruses, viroids, algae, Phanerogams –Abiotic disorders.

**Practical**

General characters of fungi – Types of mycelia -Types of vegetative, asexual and sexual spores- asexual and sexual fruiting bodies .Study of important taxonomic characters and symptoms produced by *Plasmodiophora, Pythium Phytophthora, Sclerospora, Plasmopara, Albugo, Mucor, Rhizopus, Taphrina, Capnodium, Cercospora, (Mycosphaerella), Botryodiplodia (Botryosphaeria), Curvularia, Drechslera (Helminthosporium), Alternaria, Venturia, Erysiphe, Phyllactinia, Uncinula, Leveillula* and *Claviceps, Fusarium (Gibberella, Nectria), Verticillium, Colletotrichum (Glomerella) Pestalotia (Pestalosphaeria), Pyricularia(Magnaporthe) Sarocladium, Macrophomina, Puccinia, Uromyces, Hemileia, Ustilago Sphacelotheca (Sporisorium), Tolyposporium (Moesziomyces), Exobasidium, Sclerotium, Rhizoctonia (Thanatephorus) Ganoderma Agaricus, Pleurotus* and *Calocybe*. Symptoms of bacterial diseases, *Candidatus Phytoplasma*, Fastidious vascular bacteria, algal parasite, phanerogamic parasites and non-parasitic diseases

### Theory lecture schedule

- Definition of Plant Pathology – History of Plant Pathology
- Losses caused by plant diseases
- Causes of Plant diseases – Protozoa , Chromista, , fungi, Bacteria, Fastidious vascular bacteria, Spiroplasma, *Candidatus Phytoplasma*,
- Causes of Plant diseases -Virus, viroid, algal, phanerogamic parasites and abiotic disorders
- Pathogenesis – stages in pathogenesis – pre-penetration, penetration and post penetration
- Role of enzymes in disease development
- Role of toxins in disease development
- Effect of pathogen on physiological functions of the plants- Effect on Photosynthesis- Transpiration- Respiration- translocation of water and nutrients
- General characters of fungi- Mycelia – vegetative resting structures
- Asexual reproduction in fungi
- Sexual reproduction in fungi
- Parasitism in fungi- Types of parasitism – parasite, saprophyte, obligate parasite, facultative parasite, facultative saprophyte- Mode of nutrition in fungi- biotrophs, hemibiotrophs, perthotrophs/ necrotrophs and symbiosis
- Classification of Kingdom Protozoa - important taxonomic characters , symptoms and life cycle of *Plasmodiophora brassicae* and symptoms of Protozoan diseases
- Classification of Kingdom Chromista- General characters of Oomycetes- Symptoms and life cycle of *Pythium*, *Phytophthora* and *Albugo*
- Symptoms and life cycle of *Sclerospora* and *Plasmopara*
- Classification of Kingdom– Chytridiomycota and Zygomycota - important characters, symptoms and life cycles of *Synchytrium* and *Rhizopus* and *Mucor*
- **Mid Semester Examination**
- Classification of Kingdom– Ascomycota- important characters
- Symptoms and life cycles of *Taphrina*, *Capnodium*, *Cercospora*, (*Mycosphaerella*), *Macrophomina*, *Cochliobolus* (*Helminthosporium*), *Lewia* (*Alternaria*) and *Venturia*
- Symptoms and life cycles of *Eurotium*, *Talaromyces*, *Erysiphe*, *Leveillula* and *Phyllactinia*,
- Symptoms and taxonomic characters of *Claviceps*, *Fusarium* (*Gibberella*, *Nectria*) and *Verticillium*
- Symptoms and taxonomic characters of *Colletotrichum* (*Glomerella*) *Pestalotia* (*Pestalospaeria*), *Pyricularia* (*Magnoportha*) ,*Sarocladium* and *Ustilagoidea*
- Classification of Kingdom - Basidiomycota- important characters
- Symptoms and life cycles of *Puccinia* ,*Uromyces*, *Hemileia*
- Symptoms and taxonomic characters of *Ustilago*, *Sphacelotheca* (*Sporisorium*), *Tolyposporium* (*Moesziomyces*), *Tilletia* and *Exobasidium*
- Symptoms and taxonomic characters of *Athelium*, *Thanetophorus* and *Ganoderma*
- Important taxonomic characters of *Agaricus*, *Pleurotus* and *Calocybe*
- Classification and general characters of phytopathogenic bacteria
- Symptoms and characters of *Xanthomonas*, *Ralstonia*, *Erwinia*, *Pantoea*, *Pectobacterium*, *Agrobacterium* (*Rhizobium*), *Corynebacterium* (*Clavibacter*.) and *Streptomyces*
- Important characters and symptoms of *Candidatus Phytoplasma* diseases – Phyllody, little leaf, yellow dwarf and sandal spike, Fastidious vascular bacteria and Spiroplasma
- Virus - definition, nature and properties of plant virus, Single stranded, Double stranded RNA and DNA viruses and Transmission of plant viruses

7. Common symptoms of virus diseases – mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis , ring spot, vein clearing, leaf crinkle, rosette and bunchy top
8. Important characters and symptoms of Viroid, Algal and Phanerogamic parasites
9. Symptoms and characters of non-parasitic diseases

### Practical schedule

18. General characters of fungi – Types of mycelia -Types of vegetative, asexual and sexual spores- asexual and sexual fruiting bodies.
19. Study of important taxonomic characters and symptoms produced by *Plasmodiophora*, *Pythium* and *Phytophthora*.
20. Study of important taxonomic characters and symptoms produced by *Sclerospora* *Plasmopara* and *Albugo*
21. Study of important taxonomic characters and symptoms produced by *Rhizopus*, *Taphrina*, *Capnodium*, *Cercospora*, (*Mycosphaerella*), *Botryodiplodia* (*Botryosphaeria*), *Drechslera* (*Helminthosporium*) and *Alternaria*
22. Study of important taxonomic characters and symptoms produced by *Eurotium*, *Talaromyces*, *Erysiphe*, *Leveillula*, *Phyllactinia*, *Uncinula* , *Podosphaera* and *Sphaerotheca*
23. Study of important taxonomic characters and symptoms produced by *Claviceps*, *Fusarium* (*Gibberella*, *Nectria*) and *Verticillium*
24. Study of important taxonomic characters and symptoms produced by *Colletotrichum* (*Glomerella*), *Pestalotia* (*Pestalosphaeria*), *Pyricularia* (*Magnoportha*) *Sarocladium* and *Macrophomina*
25. Study of important taxonomic characters and symptoms produced by *Puccinia*, *Uromyces*, and *Hemileia*
26. Field visit for exposing students on different crop diseases
27. Study of important taxonomic characters and symptoms produced by *Ustilago*, *Sphacelotheca* (*Sporisorium*), *Tolyposporium* (*Moesziomyces*), and *Exobasidium*
28. Study of important taxonomic characters of *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella*
29. Study of important taxonomic characters and Symptoms produced by *Athelium*, *Thanetophorus* and *Ganoderma*
30. Symptoms of bacterial diseases – leaf blight, leaf streak, canker, scab, crown gall, wilt and soft rot.
31. Symptoms of *Candidatus Phytoplasma* and Algae
32. Symptoms and vectors of viral diseases – mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis , ring spot, vein clearing, leaf crinkle, rosette and bunchy top
33. Phanerogamic parasites and non-parasitic diseases
34. **Final Practical Examination.**

### References

18. Alice D, and Jeyalakshmi C 2014. Plant Pathology. A.E Publications ,Coimbatore
19. Agrios, G.N. 2005. Plant Pathology – (5<sup>th</sup> Edition). Academic Press, New York.

### E- references

1. Agrios, G.N. 2005. Plant Pathology – (5<sup>th</sup> Edition). Academic Press, New York.
2. Richard N. Strange. 2003. Introduction of Plant Pathology - John Wiley & Sons Ltd, London
3. John Webster and Ronald Weber, 2007. Introduction to fungi by Cambridge University Press, UK



**AEN 201 FUNDAMENTALS OF ENTOMOLOGY (2+1)**

**Theory**

**Unit I: History and importance of Entomology; Insect morphology**

History of Entomology in India; Position of insects in the animal kingdom and their relationship with other classes of Arthropoda; Reasons for insect dominance. General organisation of insect body wall - structure and function, cuticular appendages, moulting; Body regions - insect head, thorax and abdomen, their structure and appendages.

**Unit II:**

**Anatomy and physiology (Part – I) :** Digestive, excretory, respiratory, circulatory and nervous systems in insects.

**Unit III:**

**Anatomy and physiology (Part – II) :** Reproductive systems in insects, sense organs and their functions, exocrine and endocrine glands; Embryonic and post embryonic development.

**Unit IV:**

**Taxonomy of Apterygota and Exopterygota**

Insect systematics; Distinguishing characters of agriculturally important orders and families of Hexapoda. Apterygota (Thysanura, Diplura, Protura and Collembola); Exopterygota (Ephemeroptera, Odonata, Orthoptera, Phasmida, Dictyoptera, Embioptera, Dermaptera, Hemiptera, Isoptera, Psocoptera, Mallophaga, Thysanoptera and Siphunculata).

**Unit V:**

**Taxonomy of Endopterygota**

Distinguishing characters of agriculturally important families of Lepidoptera, Coleoptera, Diptera, Hymenoptera, Siphonaptera, Neuroptera and Strepsiptera.

**Practical**

Observations on external features of grasshopper / cockroach, Methods of insect collection, preservation – Preparation of Riker mount. Types of insect head, antenna, mouth parts – Structure of thorax. Types of insect legs, wings and their modifications – wing coupling. Structure of abdomen, and its modifications. Metamorphosis in insects – immature stages in insects. Study of digestive and reproductive systems of grasshopper / cockroach – Observing the characters of agriculturally important orders and families.

**Theory lecture schedule:**

37. History of Entomology in India; Position of insects in the animal kingdom - relationship with other members of Arthropoda
38. Structural, morphological and physiological factors responsible for dominance
39. Insect body wall - its structure and function; cuticular appendages
40. Moulting process in insects
41. Structure of insect head and its appendages
42. Structure of insect thorax and its appendages
43. Structure of insect abdomen and its appendages

41. Structure of alimentary canal and its modifications; Digestive enzymes, digestion and absorption of nutrients
  42. Excretory system - Malpighian tubules - accessory excretory organs and physiology of excretion
  43. Respiratory system – types - structure of trachea - tracheoles - types of spiracles - respiration in aquatic and endoparasitic insects
  44. Circulatory system - haemocoel and dorsal vessel - circulation of blood -composition of haemolymph - haemocytes and their functions
  45. Nervous system - Structure of neuron – types of nervous systems
  46. Axonic and synaptic transmissions of nerve impulses
  47. Male and female reproductive systems in insects – structure and modifications - Spermatogenesis and Oogenesis
  48. Oviparous, viviparous, paedogenesis, polyembryony, ovoviporous and parthenogenesis
  49. Embryogenesis; Types of metamorphosis – Immature stages of insects
  - 50. Mid-semester examination**
  51. Structure of sense organs - types of sensilla – photoreceptors, chemoreceptors and mechanoreceptors
  52. Exocrine and endocrine glands and their function - effect on metamorphosis and reproduction
  53. Tropism and Biocommunication in insects — Sound and light production
  54. Systematics - principles and procedures of classification and nomenclature of insects
  55. Distinguishing characters of insect orders — Apterygota (Thysanura, Diplura, Protura and Collembola), Exopterygota — (Ephemeroptera, Odonata and Phasmida)
  23. Orthoptera (Ensifera - Tettigoniidae, Gryllidae and Gryllotalpidae; Caelifera - Acrididae and Tetrigidae), Dictyoptera, Dermaptera and Embioptera
  34. Isoptera — social life in termites
  35. Thysanoptera, Psocoptera, Mallophaga and Siphunculata.
  26. Hemiptera – Homoptera (Delphacidae, Flatidae, Cercopidae, Cicadidae, Membracidae, Cicadellidae, Psyllidae, Aleyrodidae, Aphididae, Margarodidae, Kerridae, Pseudococcidae, Coccidae, Asterolecaniidae and Diaspididae)
  7. Hemiptera - Heteroptera (Tingidae, Reduviidae, Cimicidae, Anthocoridae, Miridae, Lygaeidae, Pyrrhocoridae, Coreidae, Scutellaridae, Pentatomidae, Veliidae, Gerridae, Naucoridae, Belostomatidae, Nepidae, Notonectidae and Corixidae)
  8. Endopterygota — Classification of Lepidoptera – suborders; butterfly families (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae and Hesperidae)
  29. Moth families (Psychidae, Gelechiidae, Metarbellidae, Cochliidiidae, Pyralidae, Crambidae, Pterophoridae, Geometridae, Bombycidae, Saturniidae, Sphingidae, Arctiidae, Noctuidae and Lymantriidae)
  7. Classification of Coleoptera – suborders; Adephaga (Carabidae, Cicindellidae, Dytiscidae, Gyrinidae)
  8. Polyphaga (Hydrophilidae, Staphylinidae, Passalidae, Lucanidae, Scarabaeidae, Dynastidae, Melolonthidae, Cetonidae, Buprestidae, Elateridae, Lampyriidae, Cantharidae, Dermestidae, Anobiidae, Bostrychidae, Coccinellidae, Tenebrionidae, Meloidae, Cerambycidae, Bruchidae, Chrysomelidae, Apionidae and Curculionidae)
  9. Diptera – Suborders; Nematocera (Tipulidae, Psychodidae, Culicidae, Bibionidae, and Cecidomyiidae), Brachycera (Tabanidae, Asilidae and Bombyliidae.), Cyclorhapha (Syrphidae, Drosophilidae, Muscidae, Calliphoridae, Tachinidae, Hippoboscidae, Micropezidae, Agromyzidae, Chloropidae and Tephritidae)
- 6
12. Hymenoptera–Suborders; Symphyta (Tenthredinidae) Apocrita (Ichneumonidae, Braconidae, Evaniidae, Agaonidae, Chalcididae, Encyrtidae, Eulophidae, Trichogrammatidae, Bethylinidae, Chrysididae, Scoliidae, Mutillidae, Formicidae, Vespidae, Sphecidae, Megachilidae, Anthophoridae, Xylocopidae and Apidae)

13. Neuroptera (Mantispidae, Chrysopidae, Myrmeleontidae and Ascalaphidae); Siphonaptera and Strepsiptera

**Practical schedule:**

23. Observations on external features of grasshopper / cockroach and other members of phylum Arthropoda
24. Methods of insect collection, preservation, display and storage
25. Types of insect head and antenna
26. Mouth parts of cockroach, modifications in the mouth parts in plant bug, female mosquito, honeybee, thrips, antlion grub, house fly, moths and butterflies
27. Structure of thorax and their appendages —modifications in insect legs and wings — wing venation, regions and angles — wing coupling.
28. Structure of abdomen and their appendages
29. Types of immature stages of insects
30. Study of digestive system, male and female reproductive systems
31. Observing the characters of Apterygota - Collembola and Thysanura and Exopterygota -Odonata and Ephemeroptera and Phasmida
32. Observing the characters of Dictyoptera, Dermaptera, Embioptera, Orthoptera (Ensifera - Tettigonidae, Gryllidae and Gryllotalpidae; Caelifera - Acrididae and Tetrigidae), Mallophaga and Siphunculata
33. Observing the characters of Exopterygota —Isoptera and Hemiptera — Homoptera (Delphacidae, Flatidae, Cercopidae, Cicadidae, Membracidae, Cicadellidae, Psyllidae, Aleyrodidae, Aphididae, Margarodidae, Kerridae, Pseudococcidae, Coccidae, Asterolecaniidae and Diaspididae) Heteroptera (Tingidae, Reduviidae, Cimicidae, Anthocoridae, Miridae, Lygaeidae, Pyrrhocoridae, Coreidae, Scutellaridae, Pentatomidae, Veliidae, Gerridae, Naucoridae, Belastomatidae, Nepidae, Notonectidae and Corixidae)
18. Observing the characters of orders Thysanoptera and Diptera- Nematocera (Tipulidae, Psychodidae, Culicidae, Bibionidae, and Cecidomyiidae), Brachycera (Tabanidae, Asilidae and Bombyliidae.), Cyclorhapha (Syrphidae, Drosophilidae, Muscidae, Calliphoridae, Tachinidae, Hippoboscidae, Micropezidae, Agromyzidae, Chloropidae and Tephritidae)
19. Observing the characters of Hymenoptera-Symphyla (Tenthredinidae) Apocrita (Ichneumonidae, Braconidae, Evaniidae, Agaonidae, Chalcididae, Encyrtidae, Eulophidae, Trichogrammatidae, Bethyidae, Chrysididae, Scoliidae, Mutillidae, Formicidae, Vespidae, Sphecidae, Megachilidae, Anthophoridae, Xylocopidae and Apidae)
20. Observing the characters of Coleoptera - Adephaga (Carabidae, Cicindellidae, Dytiscidae, Gyrinidae) Polyphaga (Hydrophilidae, Staphylinidae, Passalidae, Lucanidae, Scarabaeidae, Dynastidae, Melolonthidae, Cetonidae, Buprestidae, Elateridae, Lampyriidae, Cantharidae, Dermestidae, Anobiidae, Bostrychidae, Coccinellidae, Tenebrionidae, Meloidae, Cerambycidae, Bruchidae, Chrysomelidae, Apionidae and Curculionidae)
21. Observing the characters of Lepidoptera - Butterfly families (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae and Hesperidae), Moth families (Psychidae, Gelechiidae, Metarbellidae, Cochliidiidae, Pyralidae, Crambidae, Pterophoridae, Geometridae, Bombycidae, Saturniidae, Sphingidae, Arctiidae, Noctuidae and Lymantriidae)
52. Observing the characters of Neuroptera (Mantispidae, Chrysopidae, Myrmeleontidae and Ascalaphidae), Siphonoptera. Identification and naming of collected insects based on characters — order and family

**53. Final Practical examination**

**References:**

Richards O.W. and R.G. Davies. 1977. *Imm's General Text Book of Entomology*. Vol.I and II. Chapman and Hall Publication, London. 1354p. {ISBN 0412 15220 7}

Chapman, R.F. 1998. *The Insects: Structure and Function*. Fourth Edition. Cambridge University Press. 770p. {ISBN 0 521 78732 7}

Snodgrass, R.E. 1994. *Principles of Insect Morphology*. CBS publishers and distributors, New Delhi. 667p.  
David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications,  
Chennai, 386 p. {ISBN: 978-81-921477-0-3}  
Srivastava, P. D. and R. P. Singh. 1997. *An Introduction to Entomology*. Concept Publishing Company,  
New Delhi.

**E- References:**

17. <http://www.itis.usda.gov/it is/>
18. [www.zin.ru/animalia](http://www.zin.ru/animalia)
19. <https://courses.cit.cornell.edu/ent201/content/anatomy2.pdf>
20. [www.insectsexplained.com/03external.htm](http://www.insectsexplained.com/03external.htm)
21. [www.earthlife.net/insects/anatomy.html](http://www.earthlife.net/insects/anatomy.html)
22. [www.insectidentification.org/orders\\_insect.asp](http://www.insectidentification.org/orders_insect.asp)

## **SST 201 Principles of Seed Technology (2+1)**

### **Theory**

#### **Unit I –**

##### **Seed : Importance and biology**

Seed and seed technology: definition -importance -Characters of good quality seed -Seed development and maturation - Germination - phases of seed germination - Dormancy - types of seed dormancy - Different classes of seed - generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio -Seed renewal period. Varietal deterioration of crops - causes and maintenance.

#### **Unit II –**

##### **Seed Production**

Principles of seed production- Foundation and certified seed production of varieties and hybrids - Cereals - rice, maize, sorghum and bajra - Pulses - greengram, blackgram and redgram - Oilseeds - groundnut, sesame, sunflower and castor - Cotton, Forage crops - Cenchrus sp and lucerne - Vegetables - tomato, brinjal, chillies, bhendi, onion and gourds - bittergourd, ashgourd, snakegourd, ribbedgourd, bottlegourd and pumpkin. Principles of GM crop and organic seed production.

#### **Unit III –**

##### **Post harvest handling of seeds**

Post harvest handling of seeds - threshing methods - drying - methods of seed drying - Seed processing - seed cleaning and grading - Processing equipments -cleaner cum grader -Upgrading equipments - specific gravity separator, colour sorter, indented cylinder separator, spiral separator, magnetic separator, needle separator - working principles - Seed quality enhancement techniques - importance - seed fortification, seed priming, seed coating, seed pelleting.

#### **Unit IV –**

##### **Seed Quality Control and Seed Testing**

Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards. Post harvest inspection - processing, bagging and tagging. Seed Act and Rules - Seed law enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983 - Salient features of PPV&FRA 2001 - National Seed Policy 2002 - Seed Bill 2004. Seed testing for quality assessment - importance - Varietal identification through grow out test, molecular and biochemical test. Detection of genetically modified crops.

#### **Unit V - Seed Storage and marketing**

Seed storage – principles- factors affecting seed longevity during storage – Seed treatments and packaging materials - measures for pest and disease control during storage and godown sanitation. Seed marketing - structure and organization - sales promotional activities. factors affecting seed marketing and demand - International seed movement - role of international organizations, WTO and OECD in seed trade.

### **Practical**

Study on seed structure of major cereals - rice, wheat, maize, sorghum and bajra - Pulses - greengram, blackgram, redgram, bengalgram and field pea - Oilseeds - groundnut, sesame, sunflower, castor, soybean and mustard - Cotton - Forage crops - Vegetable crops. Seed production techniques - identification of physical and genetic contaminants - supplementary pollination in hybrid rice - detasselling techniques in hybrid maize - emasculation and dusting technique in cotton - supplementary pollination in sunflower - pre-germinative technique and enhancing female flowers in cucurbits - assessment of physiological maturity indices - seed extraction methods in vegetables. Visit to seed production farms - Seed enhancement techniques - seed coating, seed priming and seed pelleting. Visit to seed processing plant. Seed certification - field inspection and counting procedure - Seed sampling and testing - seed moisture content, physical purity, seed germination, viability - Seed and seedling vigour test - Seed health test- Genetic purity test -grow out test and electrophoresis - Seed production planning - economics - Visit to seed testing laboratory.

**Theory lecture schedule:**

14. Seed and seed technology - definition -importance -Characters of good quality seed.
15. Seed development and maturation.
16. Germination - phases of seed germination - Dormancy - types of seed dormancy.
17. Different classes of seed - generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio -Seed renewal period.
18. Varietal deterioration of crops - causes and maintenance.
19. Principles of seed production - factors affecting seed production - physical and genetic contaminants.
20. Seed production techniques in varieties and hybrids of rice.
21. Seed production techniques in varieties and hybrids of maize.
22. Seed production techniques in varieties and hybrids of sorghum and bajra.
23. Seed production techniques in greengram and blackgram varieties.
24. Seed production techniques in varieties and hybrids of redgram.
25. Seed production techniques in varieties and hybrids of sunflower and groundnut varieties.
26. Seed production techniques in varieties and hybrids of castor and sesame varieties.
27. Seed production techniques in varieties and hybrids of cotton.
28. Seed production techniques in Cenchrus species and lucerne.
29. Seed production techniques in varieties and hybrids of tomato, brinjal and chillies.
30. Seed production techniques in varieties and hybrids of bhendi and onion.
- 31. Mid semester examination.**
32. Seed production techniques in varieties and hybrids of gourds - bittergourd, ashgourd, snakegourd, ribbedgourd, bottlegourd and pumpkin.
33. Principles of GM crop and organic seed production.
34. Post harvest handling of seeds - threshing methods - drying - methods of seed drying.
22. Seed processing - principle - importance - seed processing sequence for different crops - equipments.
18. Principles and mechanism of seed cleaning and grading - processing equipments - cleaner cum grader - specific gravity separator.
19. Principles and mechanism of upgrading equipments - colour sorter - indented cylinder separator - spiral separator - magnetic separator - needle separator
20. Seed quality enhancement techniques - importance - seed fortification - seed priming - seed coating - seed pelleting.
21. Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards - post harvest inspection - processing - bagging and tagging.
22. Seed Act and Rules - Seed law enforcement - Duties and powers of seed inspector - offences and penalties - Seeds Control Order 1983.
18. Salient features of PPV&FRA, 2001 - National Seed Policy, 2002 - Seed Bill, 2004.
19. Seed testing for quality assessment - importance - methods.
20. Varietal Identification - grow out test - molecular and biochemical test - Detection of genetically modified crops.
21. Seed storage - principles - factors affecting seed longevity during storage.

22. Seed treatment and packaging materials - measures for pest and disease control during storage and godown sanitation.
23. Seed marketing - structure and organization - sales promotional activities - factors affecting seed marketing and demand.
24. International seed movement - role of international organizations - WTO and OECD in seed trade.

#### **Practical schedule:**

20. Study on external and internal seed structure and identification of major cereals - pulses - oilseeds - cotton - forage crops and vegetable crops.
21. Practicing supplementary pollination techniques in hybrid rice and detasselling techniques in hybrid maize.
22. Practicing emasculation and dusting technique in cotton and supplementary pollination in sunflower.
23. Practicing pre-germinative technique and female flowers production enhancement techniques in cucurbits.
24. Assessment of physiological maturity indices in various crops and seed extraction methods in vegetables.
25. Visit to seed production farms.
26. Seed enhancement techniques - Seed coating - seed priming and seed pelleting.
27. Seed certification - field inspection and counting procedure - identification of physical and genetic contaminants in seed production plots and roguing.
28. Seed testing - seed sampling - mixing - dividing - equipments.
29. Estimation of seed moisture content and physical purity.
30. Seed germination testing - tetrazolium test for viability - evaluation.
31. Genetic purity test - grow out test - electrophoresis.
32. Seed health testing - methods.
33. Seed and seedling vigour test - brick gravel test, paper piercing test - cool and cold test - accelerated ageing test.
34. Seed production planning - economics.
35. Visit to seed processing plant and seed testing laboratory.

#### **36. Final practical examination.**

#### **References**

35. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
36. Bhaskaran, M., A.Bharathi and K.Vanangamudi. 2013. Text Book on Principles of seed production and quality control. Kalyani Publishers, New Delhi.
37. Indian Minimum Seed Certification Standards. 2014. Published by GOI, MOA, New Delhi.
38. Seed legislations. 2014. Published by GOI, MOA, New Delhi.

#### **E-References**

1. [www.fao.org](http://www.fao.org)
2. [www.seednet.gov.in](http://www.seednet.gov.in)
3. [www.agricoop.nic.in](http://www.agricoop.nic.in)
4. [www.online library.willey.com](http://www.online library.willey.com)
5. [www.sciencedirect.com](http://www.sciencedirect.com)
6. Seed Science Research ([www.jgateplus.com](http://www.jgateplus.com))
7. Seed Science and Technology ([www.jgateplus.com](http://www.jgateplus.com))

## AGR 201 Crop production technology – I ( *Kharif crops*) ( 1+1)

### Theory :

#### Unit - I:

##### Cereals

Rice, Maize, - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield.

#### Unit - II:

##### Millets

Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

#### Unit - III:

##### Pulses

Redgram, Blackgram, Greengram, , Cowpea, - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

#### Unit - IV:

##### Oilseeds (Kharif)

Groundnut, sesame, Soybean- Origin, and geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### Unit - V:

##### Fibre and forage

Cotton, jute, fodder sorghum, cumbu napier- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Cereals	Rice, maize
Millets	Sorghum, pearl millet, finger millet and minor millets
Pulses	Pigeonpea, green gram, black gram, cowpea,
Oilseeds	Groundnut, sesame, soybean
Fibre & Forage	Cotton, jute, fodder sorghum, Cumbu napier

### Theory Lecture Schedule:

1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.
2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
3. Rice - Origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - yield - economic benefits.
5. Special type of Rice cultivation – SRI - and Hybrid rice cultivation.
6. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
9. **Mid semester Examination.**
10. Pigeonpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
2. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses.



3. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics.
4. Sesame and Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
5. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
6. Jute- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
7. Fodder sorghum- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
8. Cumbu napier- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

### **Practical Schedule:**

18. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria.
19. Practicing various nursery types and main field preparation for rice crop.
20. Nursery and main field preparation for important millets, pulses and oilseeds.
21. Acquiring skill in different seed treatment techniques in important kharif crops.
22. Estimation of plant population per unit area for important kharif crops.
23. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets.
24. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
25. Acquiring skill in using seed drill for sowing operations.
26. Acquiring skill in foliar nutrition for important field crops.
27. Observations on growth parameters of cereals and millets.
28. Observations on growth parameters of pulses and oilseeds.
29. Study of yield parameters and estimation of yield in cereals and millets.
30. Study of yield parameters and estimation of yield in pulses and oilseeds.
31. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
32. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses , cotton and oilseeds.
33. Visit to nearby Agricultural Research Station / Farmer's field.
34. **Practical Examination.**

### **References:**

- Ahlawat, I.P.S., Om Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama publishing House, Meerut.
- Chidda Singh. 2010. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
- Singh. S.S. 2015. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.
- Reddy,S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
- Joshi, M. 2015. Textbook of Field crops. PHI Learning Pvt. Ltd., New Delhi
- ICAR 2015. Hand book of Agriculture. Indian Council of Agriculture, New Delhi
- Crop production Guide 2012. Directorate of Agriculture, Chennai.

### **E-References:**

1. [www.crida.org](http://www.crida.org)
2. [www.cgiar.org](http://www.cgiar.org)
3. [www.tnau.ac.in/agriportal](http://www.tnau.ac.in/agriportal)

## **HOR 211 Production technology of vegetables and spices (1+1)**

### **Theory**

#### **Vegetables**

##### **Unit I: Scope, Importance and classification of vegetables**

Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu- National economy- nutritive value of vegetables and human nutrition.

##### **Unit II: Production technology of tropical vegetable crops**

Origin - climate and soil – varieties and hybrids – seeds and sowing – transplanting – water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulators - physiological disorders - maturity indices – harvest – pest and diseases – seed production

**Crops:** Tomato, chilli, brinjal, bhendi, gourds (ash gourd, pumpkin, bitter gourd, ridge gourd, bottle gourd, snake gourd and watermelon) onion, cassava, amaranthus and moringa.

##### **Unit III: Production technology of temperate vegetable crops**

Origin -climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrient and plant growth regulators- physiological disorders- maturity indices – harvest – pest and diseases – seed production

**(Crops:** Cabbage, cauliflower, potato, carrot, radish, beetroot, peas and french beans, Protected cultivation of vegetables (tomato, capsicum and cucumber).

### **SPICES**

##### **Unit IV: Crop production techniques of major spices**

Spices- scope and importance - classification of spices - origin, area and production - role of commodity boards- export potential of spices.

Climate and soil - varieties - propagation - nursery management and planting – cropping systems-training practices - nutrient, water and weed management - shade regulation - maturity indices - harvest and yield - pests and diseases - processing - value addition.

##### **Black pepper, Cardamom, Turmeric, Ginger and Garlic**

##### **Unit V: Crop production techniques in seed spices, tree spices and other spices**

Climate and soil- varieties - propagation, nursery management and planting- training , pruning canopy management- weed and water management- shade regulation- nutrient management including drip and fertigation – harvest and yield – pests and diseases – processing – value addition.

##### **Coriander, Fenugreek, Cumin, Fennel, Clove, Nutmeg, Cinnamon, Curry leaf, Tamarind and Herbal spices**

### **Practical**

#### **Vegetables**

Layout of kitchen garden – seed sowing – nursery management – grafting in vegetables water and nutrient management – fertigation – weed management – practices in use of plant growth regulators - Special horticultural practices in vegetable production - study of maturity indices - Identification of physiological disorders - protected cultivation - visit to vegetable nursery unit/ protected cultivation unit.

## Spices

Identification of spices - description of varieties - Propagation methods - rapid multiplication techniques

22. seed collection and extraction - raising of nurseries - seed sowing - seed treatment - fertilizer application - harvesting – pests and diseases - processing - cost economics - visit to spice gardens

## **Black pepper, Cardamom, Turmeric, Ginger, Coriander, Fenugreek, Curry leaf, Clove, Nutmeg and Cinnamon**

### **Theory lecture schedule**

15. Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu- National economy- nutritive value of vegetables and human nutrition .
16. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of tomato, chilli and brinjal
17. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of bhendi and onion.
18. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield– pest and diseases – seed production of gourds (ash gourd, pumpkin, bitter gourd, ridge gourd, bottle gourd, snake gourd and watermelon)
19. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator- physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of cassava and potato
20. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of moringa and amaranthus.
21. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of cabbage and cauliflower.
22. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of carrot , beetroot and radish.
23. **Mid -semester examination**
24. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of french beans and peas .
25. Protected cultivation of vegetables (tomato, capsicum and cucumber)
23. Spices- scope and importance - classification of spices - origin, area and production - role of commodity boards- export potential of spices. **Black pepper** - climate and soil- varieties – propagation – rapid multiplication techniques - nursery management and planting- nutrient, water and weed management - special horticultural practices - role of growth regulators - shade regulation- maturity indices - harvest and yield - pests and diseases –post harvest practices-processing and value addition.
24. **Cardamom** - climate and soil - varieties - propagation - nutrient, water and weed management-shade regulation- mulching - maturity indices - harvest and yield - pests and diseases –post harvest practices-processing and value addition.

25. **Turmeric , Ginger and Garlic** - Climate and soil- varieties - propagation, nursery management and planting- nutrient, water and weed management- inter cropping- physiological disorders -maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.
15. **Seed spices** - climate and soil- varieties - seed treatment/ sowing – nutrient, water and weed management- intercropping - maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.**(Coriander, Fenugreek, Cumin and Fennel)**
16. **Tree spices** - climate and soil - varieties - propagation, nursery management and planting - nutrient, water and weed management- training and pruning practices- cropping system- special horticultural practices maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.**(Clove, Nutmeg and Cinnamon)**
- Tamarind, Curry leaf and herbal spices** - climate and soil- varieties - propagation,
17. nursery management and planting- nutrient, water and weed management- canopy management - maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.

### Practical schedule

4. Layout of kitchen garden.
5. Seed treatment and sowing practices in direct sown vegetables
6. Nursery management of transplanted ,bulb and tuber vegetable crops
7. Grafting in vegetable crops
8. Water and nutrient management – fertigation in vegetable crops
9. Practices in use of plant growth regulators in vegetable crops
10. Special horticultural practices in vegetable production
11. Identification of physiological disorders in vegetable crops
9. Study of maturity standards and harvesting of vegetables
10. Practices in protected cultivation of vegetable crops
- 11. Visit to vegetable nurseries/protected vegetable cultivation unit**
12. Black pepper and cardamom- identification and description of varieties – seed propagation and vegetative propagation – fertilizers application - preparation of plant bio regulators and application – pests and diseases- harvest and post harvest practices.
13. Turmeric and ginger- identification and description of varieties- propagation, fertilizers application - preparation of plant bio regulators and application – pests and diseases- harvest and post harvest practices.
14. Coriander and Fenugreek - identification and description of varieties - seed treatment, sowing fertilizer application - pests and diseases- harvest and post harvest practices.
22. Clove, Nutmeg and Cinnamon - identification and description of varieties – seed collection and extraction - propagation – fertilizer application – training and pruning – pests and diseases- harvest and post harvest practices.
23. Tamarind and curry leaf - identification and description of varieties – seed collection and extraction - propagation – fertilizer - application – canopy management – pests and diseases- harvest and post harvest practices.
24. Visit to spice gardens or commodity boards and working out cost economics of spice crops.

## REFERENCES

- Gopalakrishnan, T.R. 2007. Vegetable Crops. Horticultural Science Series (Series Editor K.V.Peter). New India Publishing Agency.
- Mandal, R.C. 2006. Tropical root and tuber crops. Agrobios (India) Peter.K.V. 2000. Genetics and Breeding of Vegetables, ICAR, Publication.
- Singh, P.K., S.K. Dasgupta and S.K. Tripathi, 2006. Hybrid Vegetable Development. International Book Distributing Co.
- Mini, C. and Krishnakumar, K. 2004. Leaf Vegetables. Agro tech Publishing Academy, Udaipur Thamburaj, S. and Narendra Singh .2001. Vegetables, Tuber crops and Spices, Directorate of information and publications of agriculture, ICAR, New Delhi.
- Veeraragavaththam ,D., M.Jawaharlal and Seemanthini Ramadas 2000 “ Vegetable Culture”
- Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
- Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India Publishing Agency, New Delhi.
- Veeeraragavathatham, D and et al.,2004. Scientific fruit culture, Sun Associates, Coimbatore.
- Henry Louis, I. 2002. Coconut- The wonder palm. Hi - Tech Coconut Corporation, Nagercoil.

## E-References

1. <http://www.jhortscib.com>
2. <http://journal.ashspublications.org>
3. <http://www.actahort.org/>
4. <http://www.aphorticulture.com/crops.htm>
5. <http://cpcrri.nic.in/> <http://indiancoffee.org>

## ENS 201 Environmental Studies and Disaster Management (2+1)

### Theory

**Unit 1:** Multidisciplinary nature of environmental studies Definition, scope and importance

**Unit 2:** Natural Resources: Renewable and non-renewable resources Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

**Unit 3:** Ecosystems • Concept of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem. a. Forest ecosystem. b. Grassland ecosystem. c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Unit 4:** Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**Unit 5 :** 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. g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

**Unit 6:** Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

**Unit 7:** Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value

Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

## **DISASTER MANAGEMENT**

**Unit 8:** Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

**Unit 9 :** Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

**Unit 10 :** Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community - based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

### **Practical**

Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site -Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

### **Lecture Schedule**

22. Multidisciplinary nature of environmental studies - Definition, scope and importance - Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems
23. Forest resources: Use and over-exploitation, deforestation, case studies - Timber extraction, mining, dams and their effects on forest and tribal people
24. Water resources: Use and over-utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefits and problems
25. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing
26. Effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies.
27. Land resources: Land as a resource, land degradation, man induced landslides - Soil erosion and desertification - Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles
28. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids
7. Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem and Desert ecosystem
8. Introduction, types, characteristic features, structure and function of Aquatic ecosystems : ponds, streams, lakes - Rivers, oceans, estuaries
9. Biodiversity and its conservation - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
10. Biodiversity at global, National and local levels - India as a mega-diversity nation - Hotspots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
11. Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
12. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution

13. Definition, cause, effects and control measures of Water pollution and Soil pollution
14. Definition, cause, effects and control measures of Marine pollution, Thermal pollution and Nuclear hazards
15. Solid Waste Management: Causes, effects and control measures of urban and industrial wastes

#### **16. Mid Semester Examination**

17. Role of an individual in prevention of pollution - Pollution case studies - Social Issues and the Environment - From Unsustainable to Sustainable development - Urban problems related to energy
18. Water conservation, rain water harvesting, watershed management - Environmental ethics: Issues and possible solutions, climate change, global warming
19. Acid rain, ozone layer depletion, Nuclear accidents and holocaust - Wasteland reclamation-Consumerism and waste products
20. Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act
21. Issues involved in enforcement of environmental legislation - Public awareness - Human Population and the Environment: Population growth, variation among nations, population explosion, Family Welfare Programme
22. Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case Studies
23. **Disaster Management** - Natural Disasters - Meaning and nature of natural disasters, their types and effects - Floods, drought
24. Cyclone, earthquakes, Landslides, avalanches
25. Volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion
26. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, Building fire, coal fire, forest fire, oil fire
27. Air pollution, water pollution, deforestation, industrial waste water pollution
28. Road accidents, rail accidents, Air accidents, sea accidents
29. Disaster Management - Effect to migrate natural disaster at national and global levels
30. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements
31. Role of NGOs, community - based organizations and media in disaster management
32. Central, state, district and local administration in disaster management
33. Armed forces in disaster response - Disaster response; Police and other organizations.

#### **Practical schedule**

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

#### **34. Practical Examination**

#### **References**



13. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
14. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (*Concepts, Connections, and Solutions*). Brooks/cole, Cengage learning publication, Belmont, USA
15. P.D. Sharma, 2009, Ecology and Environment, Rastogi Publications, Meerat, India
16. De. A.K., 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13-978 81 224 2617 5. 384 pp

#### **E-References**

1. Dhar Chakrabarti. P.G., 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
20. Proceedings of 2<sup>nd</sup> India disaster management congress, New Delhi. Organized by National Institute of Disaster Management, New Delhi during 4 – 6, November 2009.

## AMP 201 Livestock and Poultry Management (2+1)

### Theory

#### Unit I: Introduction to Livestock Management

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry census – Different livestock development programs of Government of India and Tamil Nadu- Various systems of livestock production-extensive – semi intensive - intensive- mixed- Integrated and specialized farms.

#### Unit II: Dairy Cattle Management

Important White and Black cattle breeds-classification-indigenous and exotic – Breed characteristics – Breeding - Cross breeding- Upgrading - Economic traits of cattle –Culling - Estrus Cycle – Artificial Insemination – Introduction to Embryo transfer – Housing – Space requirement calf and adult stock – System and types of housing - Feeding and Management of Calf, Heifer, Pregnant, Milch animal and working animals – Nutrition – Ration – Balanced Ration - Characteristics of ration and classification of feed and fodder –Total Mixed Ration – composition of concentrate mixture for different stage - Milking methods - Clean milk production – Factors affecting milk composition – Common diseases of cattle – classification – symptoms - preventing and control measures.

#### Unit III: Sheep and Goat Management

Breeds - Sheep and goat classification — Economic traits - system of rearing - Housing Management – Floor space requirement - Care and Management of young and adult stock – Nutrition – Feed and fodders of Small ruminants – Flushing - Common diseases – prevention and control.

#### Unit IV: Management of Swine

Classification of breeds – Economic traits - Housing - Nutrition – creep feeding - Care and Management of Adult and Young Stock - Common disease- prevention and control.

#### Unit V: Poultry Management

Classification of breeds - Commercial Strains of broilers and layers – Housing – brooding – deep litter and cage system – care and Management of broilers and layers -Nutrition of Chick, grower, Layer and broiler – Incubation and Hatching of Eggs - Common Diseases - Control and prevention.

#### Practical

Study of external parts of Livestock - Identification of livestock and poultry-Tattooing-ear tags-wing and leg bands-Common restraining methods-Disbudding (or) Dehorning-Different methods of castration-Dentition-Study of type design of animal and poultry houses-Selection of dairy cow and work bullock-Determination of specific gravity, fat percentage and total solids of milk- Demonstration of cream separation, - Identification of feeds and fodder- Economics Dairy, Goat and Swine farming - Study of external parts of Fowl - Preparation of Brooder House - Brooder management-Identification of layer and non layer- Debeaking, delousing and deworming of poultry-Vaccination schedule for broiler and layer-Dressing of broiler chicken - Economics of Broiler and Layer Farming - Visit to a modern Dairy and commercial layer and broiler farms - Demonstration of incubator and setter.

#### Lecture schedule:

18. Significance of livestock and poultry in Indian economy-livestock and poultry census. Different livestock development programmes of Government of India and Tamil Nadu - [www.indiastat.com](http://www.indiastat.com), Livestock census 2012, Dairying in Tamil Nadu 2014 by NDDB
2. Various systems of livestock production-extensive – semi intensive, intensive- mixed- integrated and specialized farms. -357- 396 Handbook of Animal Husbandry – ICAR
3. Definition of breed-classification of indigenous white and black cattle-breed characteristics of Tamil Nadu cattle breeds and Indian breeds -Sindhi, Gir and Sahiwal. - 1-53- Handbook of Animal Husbandry – ICAR
4. Breed-characteristics of exotic cattle -Jersey and Holstein Friesian – Indian Buffaloes- Murrah, Surti and Toda. - 1-53- Handbook of Animal Husbandry - ICAR
5. Breeding-cross breeding-upgrading-economic traits of cattle-culling importance and methods - 1-53- Handbook of Animal Husbandry – ICAR.

6. Estrous cycle – signs of estrous - artificial insemination-merits and demerits-Principles and outline of embryo transfer -722-723 Handbook of Animal Husbandry - ICAR
3. Housing management-farm site selection and floor space requirement for calves, heifer, milch animal and work bullocks. - 364-379 Handbook of Animal Husbandry – ICAR
4. Systems of housing-single row system-double row system- head to head and tail to tail-merits and demerits - Type design of house. - 364-379 Handbook of Animal Husbandry – ICAR
5. Care and management of new born calf and heifers -358-362 Handbook of Animal Husbandry – ICAR
6. Care and management of pregnant animal and lactating animals. - 362-363 Handbook of Animal Husbandry – ICAR
7. Care and management of dry cows and work bullock. - 756-757 Handbook of Animal Husbandry - ICAR
8. Nutrition-definition-ration-balanced ration-desirable characteristics of a ration. Classification of feed stuffs- concentrate and roughage-comparison, Total Mixed Ration - 395-447 Handbook of Animal Husbandry – ICAR
9. Model composition of concentrate mixture of young and adult stock-age wise feed and fodder requirement-Importance of green fodder. - 395-447 - Handbook of Animal Husbandry – ICAR
10. Milking methods-clean milk production-factors affecting milk yield and composition - 363 Handbook of Animal Husbandry – ICAR
15. Diseases-classification-viral, bacterial and metabolic-general control and preventive measures. - 448-551 Handbook of Animal Husbandry – ICAR
7. Viral diseases-foot and mouth disease, bacterial diseases, anthrax, hemorrhagic septicemia- black quarter - metabolic- tympanites, acidosis, ketosis and milk fever - 448-551 Handbook of Animal Husbandry – ICAR
8. **Mid semester examination**
9. Sheep and goat farming-classification of breeds of Indian and exotic origin – economic traits. - 54-120 Handbook of Animal Husbandry – ICAR
10. Systems of rearing-housing management - type design- floor diagram-space requirement for adult and young stock. - 101 Handbook of Animal Husbandry – ICAR
11. Care and management of ram, ewe and lamb-nutrition- feeds and fodder for small ruminants. - 99-101 Handbook of Animal Husbandry – ICAR
12. Care and management of buck, doe and kid- nutrition- flushing. -102 Handbook of Animal Husbandry – ICAR
13. Common ailments of sheep and goat-sheep pox-foot and mouth-blue tongue- PPR- enterotoxaemia-Ecto and endo parasites. - 448-551 Handbook of Animal Husbandry – ICAR
14. Swine husbandry –Common breeds of exotic origin-Large White Yorkshire, Landrace and Duroc - economic traits- housing of Swine. -256-271Handbook of Animal Husbandry – ICAR
15. Care and management of sow, boar and piglets-nutrition- creep feeding. - 256-271Handbook of Animal Husbandry – ICAR
16. Disease prevention and control of swine diseases –hog cholera, foot and mouth, ecto and endo parasites. - 448-551 Handbook of Animal Husbandry – ICAR
17. Classification of breeds - commercial strains of layer and broiler. - 206-255 Handbook of Animal Husbandry – ICAR
18. Care and management of Chicks-brooder management. - 206-255 Handbook of Animal Husbandry – ICAR
19. Systems of housing- deep litter and cage system- floor space requirement-common litter material-litter management-merits and demerits. - 206-255 Handbook of Animal Husbandry – ICAR
20. Care and management of Grower and Layers- vaccination schedule. - 206-255 Handbook of Animal Husbandry – ICAR
21. Care and management of broilers-vaccination schedule. - 206-255 Handbook of Animal Husbandry – ICAR
22. Incubation and hatching of eggs. - 206-255 Handbook of Animal Husbandry – ICAR
23. Nutrition-feed formulation-composition of chick, grower, layer broiler- starter and Finisher mashes-Feed Conversion Ratio /dozen egg or kg of meat production. - 206-255 Handbook of Animal Husbandry – ICAR

24. Classification of disease –viral – bacterial - protozoan- causative organisms, symptoms and prevention – viral diseases- Ranikhet – IBD-avian flu - 448-551 Handbook of Animal Husbandry – ICAR
25. Bacterial disease-E.coli-coryza-salmonellosis-protozoan–coccidiosis-casulative organism, symptoms and preventive measures. Management of dead birds and manure - 448-551 Handbook of Animal Husbandry - ICAR

### **Practical Schedule**

37. Study of external parts of livestock
38. Identification of livestock and poultry
39. Common restraining methods of livestock
40. Disbudding, Dehorning, Castration and Dentition of livestock
41. Study of type design of animal and poultry houses
42. Selection of dairy cow and work bullock
43. Determination of specific gravity, fat %, total solids, solids not fat
44. Demonstration of cream separation
45. Identification of feed & fodder
46. Economics of dairy, goat and swine Farming
47. Study of external parts of fowl. Preparation of brooder house
48. Identification of layer and non- layer
49. Debeaking, delousing, deworming of poultry Vaccination schedule for broiler and layer
50. Demonstration of dressing of broiler. Economics of layer and broiler farming
51. Visit to a modern dairy and commercial layer and broiler farms
52. Demonstration of incubator and setter
53. **Practical examination**

### **Reference:**

ICAR (2002) Hand of Animal Husbandry, ICAR, New Delhi.

### **E- Eeference:**

1. <http://www.elearnvet.net/>
2. [http://agridr.in/expert\\_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html](http://agridr.in/expert_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html)

## **AEC 201 Farm Management, Production and Resource Economics (1+1)**

### **Theory**

#### **Unit 1: Production Economics and Farm Management - Nature and Scope**

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.

#### **Unit 2: Factor – Product, Factor – Factor and Product – Product Relationships**

Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm. Factor-Product relationship. Meaning, Definition – Laws of Returns. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship - shut down and break-even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum. Factor – Factor relationship: Least Cost Combination of inputs; Product – Product relationship: Optimum Combination of Products – Principle of Equi – Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.

#### **Unit 3: Farm Planning and Budgeting**

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

#### **Unit 4: Risk and Uncertainty in Agriculture Production**

Concept of risk and uncertainty occurrences in agriculture production, nature and sources of risks and their management strategies, Crop / livestock / machinery insurance. Weather based crop insurance - Features and determinants of compensations.

#### **Unit 5: Resource Economics**

Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources. Natural Resources - Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions; Important issues in economics and management of common property resources of land, water, pasture and forest resources.

### **Practical**

Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns / opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crops – Estimation of costs and returns of livestock products. Preparation of farm plan and budget, farm records and accounts and profit and loss accounts. Break – even analysis- Graphical solution to Linear Programming problem. Collection and analysis of data on various resources in India.

### **References**

- Sankayan, P.L. 1983. Introduction to Farm Management. Tata McGraw Hill Publishing Company Ltd. New Delhi.
- Johl, S.S & Kapoor, T.R. 1973. Fundamentals of Farm Business Management. Kalyani Publishers. Ludhiana.
- Kahlon, A.S and Singh K. 1992. Economics of Farm Management in India. Allied Publishers. New Delhi.
- Doll, J.P. and F. Orazem. 1983. Theory of Production Economics with Applications to Agriculture. John Wiley, New York.
- Debertin, D.L. 1986. Agricultural Production Economics. Macmillan. New York.
- Heady, E.O. and H.R. Jensen. 1954. Farm Management Economics. Prentice – Hall. Englewood Cliffs.
- Kay, Ronald D., and William M. Edwards, and Patricia Duffy. 2004. Farm Management. Fifth Edition. McGraw–Hill Inc. New York.
- Panda, S.C. 2007. Farm Management and Agricultural Marketing. Kalyani Publishers. Ludhiana. India.

### **Theory lecture schedule**

6. Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms.
7. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.
8. Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm.
9. Factor - Product relationship: Meaning, Definition – Laws of Returns: Classical production function and its characteristics.
10. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship -shut down and break even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income.
11. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum.
12. Factor – Factor relationship: Least Cost Combination of inputs.
13. Product – Product relationship: Optimum Combination of Products – Principle of Equi –Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.
14. **Mid Semester Examination.**
10. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.
11. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts.
12. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.
13. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies.
14. Crop / livestock / machinery insurance. Weather based crop insurance - Features and determinants of compensations.
15. Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources.
16. Natural Resources Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights – Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture,
17. Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources.

### **Practical Schedule**

1. Preparation of farm layout. Determination of cost of fencing of a farm.

2. Computation of depreciation and cost of farm assets: Valuation of assets by different methods.
3. Application of equi - marginal returns / opportunity cost principle in allocation of farm resources.
4. Determination of most profitable level of inputs use in a farm production process.
5. Determination of least cost combination of inputs.
6. Selection of most profitable enterprise combination.
7. Application of cost principles including CACP concepts in the estimation of cost of cultivation and cost of production of agricultural crops.
8. Estimation of cost of cultivation and cost of production of perennial crops / horticultural crops.
9. Estimation of cost of returns of livestock products.
10. Preparation of farm plan and budget.
11. Farm records and accounts: Usefulness, types of farm records: farm production records and farm financial records.
12. Preparation of Cash flow statement
13. Preparation and Analysis of Net worth Statement and Profit and Loss statement
14. Estimation of Break – even analysis.
15. Graphical solution to Linear Programming problem.
16. Collection and analysis of data on various resources in India.
17. **Final Practical Examination.**

## **SAC 201 Soil Resource Inventory (1+1)**

### **Theory**

#### **Unit-I**

Soil Survey: Importance-Definition-Purpose of soil survey- Standard soil survey - Scope and objectives - Fundamental and Applied. Soil systematics- pedon and polypedon, control section and three dimensional nature of soil body. Soil mapping units: Soil series, soil association, soil complex, variants, inclusions and miscellaneous land types.

#### **Unit II**

Methods of soil survey: Base maps, Traversing: Grid survey and Free survey. Types of soil survey: Detailed, Reconnaissance, Detailed- Reconnaissance and Semi-Detailed soil survey. Soil mapping.

#### **Unit-III**

Soil Classification -Purpose -Early and modern systems -USDA system of soil classification and its advantages. Soil taxonomy - Diagnostic horizons: surface and sub surface-structure and differentiating characteristics and limitations. Soil orders – description. Distribution of Soil orders in world. Soils of India and Tamil Nadu.

#### **Unit-IV**

Soil survey reports - Soil Survey Interpretations - Land Capability Classification - Soil and Land Irrigability Classification - Storie Index Rating - Productivity potential - Fertility Capability Classification - Crop suitability: Field crops, horticultural crops and forest trees. Delineation of soils for fertility – Nutrient indexing. Land Use Planning concepts and objectives.

### **Practical**

Site characteristics and Soil Profile description - Morphological study of soil profiles - Estimation of CEC in soil - Estimation of cations and free  $\text{CaCO}_3$  - Study of base maps- Interpretation of soil survey data and maps - Interpretation of soil data for land capability,

crop suitability - Interpretation of soil data for fertility capability classes - Interpretation of soil data for productivity rating - Interpretation of soil data for Nutrient Indexing.

### **Lecture schedule**

1. Soil Survey: Importance-Definition-Purpose of soil survey.
2. Standard soil survey - Its scope and objectives. Fundamental and Applied.
3. Soil systematics - pedon and polypedon, control section and three dimensional nature of soil body.
4. Soil mapping units: Soil series, soil association, soil complex, variants, inclusions and miscellaneous land types.
5. Methods of soil survey: Base maps, Traversing: Grid survey and Free survey.
6. Types of soil survey: Detailed, Reconnaissance, Detailed- Reconnaissance and Semi-Detailed soil survey. Soil mapping.
7. Soil Taxonomy – Purpose. Early and modern systems. USDA system of soil classification and its advantages.

### **18. Mid semester examination.**

19. Diagnostic horizons: surface and sub surface.
20. Soil taxonomy – Structure and differentiating characters and limitations.
21. Soil orders, characteristics and their distribution in world.
22. Soils of India and Tamil Nadu.
23. Soil maps, kinds of soil maps and their preparation.
24. Interpretative groupings of soils. Land capability classification and Fertility Capability Classification.
25. Land irrigability classification, Storie index and productivity potential.
26. Land suitability classification for field crops, horticultural crops and forest trees.
27. Land Use Planning - Concepts and objectives - Tropical, subtropical and temperate regions.

### **Practical schedule**



1. Site characteristics and Soil Profile description
2. Morphological study of soil profile 1 (Red soil)
3. Morphological study of soil profile 2 (Black soil)
4. Morphological study of soil profile 3 (Alluvial / Laterite soil)
5. Estimation of CEC in soil
6. Estimation of cations and free CaCO<sub>3</sub>
7. Study of base maps- Topo sheets and cadastral maps.
8. Study of base maps- Aerial photographs or satellite imageries.
9. Interpretation of soil survey data and maps.
10. Interpretation of soil data for land capability.
11. Interpretation of soil data for crop suitability for field crops.
12. Interpretation of soil data for crop suitability for horticultural crops.
13. Interpretation of soil data for crop suitability for forest trees.
14. Interpretation of soil data for fertility capability classes.
15. Interpretation of soil data for productivity rating.
16. Interpretation of soil data for Nutrient Indexing.

### 17. Practical Examination

### References

1. Buol, S.W., Hole, F.D., McCracken, R.J., (1973). Soil genesis and classification. Oxford and IBH publishing Co., New Delhi.
2. Lillesand, T.M. and Kiefer, R.W., 1987. Remote sensing and image interpretation, John Wiley and sons, inc, New York.
3. Sehgal, J.2005. Pedology concepts and applications, Kalyani Publishers, New Delhi.
4. Soil Survey Division Staff 1999. Soil Survey Manual, USDA publication.
5. Steven, M.D. and Clark, J.A. 1990. Applications of Remote Sensing in Agriculture, Cambridge University, UK.
6. USDA 1954. Diagnosis and improvements of Saline and alkali soils. (Ed) L.A.Richards. Handbook No.60. USDA Washington DC.
7. Anji Reddy, M., 2002. Remote sensing and geographical information systems, BS publication, Hyderabad.
8. Somani, L.L. and K.L.Totawat 1993. Management of Salt Affected Soils and Water.

### E-references

10. <ftp://ftp-fc.sc.egov.usda.gov/NSSC/NCSS/Conferences/scanned/>
11. [ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab\\_References/SSIR\\_51.pdf](ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab_References/SSIR_51.pdf)
12. [tp://ftp-fc.sc.egov.usda.gov/NSSC/Lab\\_References/SSIR\\_51.pdf](tp://ftp-fc.sc.egov.usda.gov/NSSC/Lab_References/SSIR_51.pdf)
13. [www.iuss.org/Bulletins/00000096.pdf](http://www.iuss.org/Bulletins/00000096.pdf)
14. [www.oosa.unvienna.org/pdf/sap/centres/rscurrE.pdf](http://www.oosa.unvienna.org/pdf/sap/centres/rscurrE.pdf) -
15. [en.wikipedia.org/wiki/Geographic\\_information\\_system](http://en.wikipedia.org/wiki/Geographic_information_system)
16. [www.annauniv.edu/cia/Curric%20Syllabi/M.../Remote%20Sensing.pdf](http://www.annauniv.edu/cia/Curric%20Syllabi/M.../Remote%20Sensing.pdf)
17. [www.csre.iitb.ac.in/~dd/detail.html](http://www.csre.iitb.ac.in/~dd/detail.html)
18. [www.dvsinstitute.org/forms/pg/M.Sc.%20-%20RS%20&%20GIS-350.pdf](http://www.dvsinstitute.org/forms/pg/M.Sc.%20-%20RS%20&%20GIS-350.pdf)
19. [inkinghub.elsevier.com/retrieve/pii/S0166248197800335](http://inkinghub.elsevier.com/retrieve/pii/S0166248197800335)
20. [www.scribd.com/doc/40246764/Description-Pedon-Copy](http://www.scribd.com/doc/40246764/Description-Pedon-Copy) -
21. [www.angrau.net/BSc\(Ag\)CourseCurriculum.htm](http://www.angrau.net/BSc(Ag)CourseCurriculum.htm)
22. [www.springerlink.com/index/BJG00EL8FLNTFUNL.pdf](http://www.springerlink.com/index/BJG00EL8FLNTFUNL.pdf)
23. [www.eurojournals.com/ejsr\\_42\\_2\\_10.pdf](http://www.eurojournals.com/ejsr_42_2_10.pdf)
24. [inkinghub.elsevier.com/retrieve/pii/S0166248197800335](http://inkinghub.elsevier.com/retrieve/pii/S0166248197800335)
25. [www.springerlink.com/index/R177R74472222UN.pdf](http://www.springerlink.com/index/R177R74472222UN.pdf) - **Similar**
26. [content.alterra.wur.nl/Internet/webdocs/ilri-publicaties/.../Bib10.pdf](http://content.alterra.wur.nl/Internet/webdocs/ilri-publicaties/.../Bib10.pdf)
27. [www-wds.worldbank.org/external/.../INDEX/multi\\_page.txt](http://www-wds.worldbank.org/external/.../INDEX/multi_page.txt) - **Cached**
28. [openaccess.icrisat.org/.../Proceedings-integrated-watershed-management-for-land-Asia.pdf](http://openaccess.icrisat.org/.../Proceedings-integrated-watershed-management-for-land-Asia.pdf)
29. [www.springerlink.com/index/jlu87tk58363.pdf](http://www.springerlink.com/index/jlu87tk58363.pdf)
30. [www.buc.edu.in/sde\\_book/msc\\_soil.pdf](http://www.buc.edu.in/sde_book/msc_soil.pdf)

## **FMP 211 FARM MACHINERY AND POWER (1+1)**

### **THEORY**

#### **Unit I: Farm Power & IC engines**

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 IC engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply.

#### **Unit-II : Tractor & functional components**

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,

#### **Unit –III: Tillage implements**

Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture.

#### **Unit-IV: Sowing & Intercultural implements**

Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, implement for intercultural operations.

#### **Unit-V: Plant Protection and Harvesting equipments**

Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

### **PRACTICALS**

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 board 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.

### **LECTURE SCHEDULE:**

1. Farm power in India - sources of farm power and their use in agriculture
2. Working principles of IC Engines-Two stroke and Four stroke engines - applications – comparison-Engine terminology.
3. Components of IC engine and systems of IC engine – air cleaning, cooling, lubricating and fuel supply systems.
4. Tractors- types - transmission system- clutch, gearbox, differential and final drive - hydraulic system.
5. Cost analysis of tractor with attached implement.
6. Tillage, objectives, types - ploughing methods. Primary tillage- mould board plough, disc plough, chisel plough and subsoil plough - components and functions, types, advantages and disadvantages
7. Secondary tillage equipment – cultivators, harrows, levelers, land forming equipment – rotovators – puddlers - manure trawlers and cage wheels, Implements for Hill agriculture.
8. Sowing methods - seed drills and planters- seed cum fertilizer drills - components and functions- Calibration.
9. Mid semester examination
10. Paddy transplanters, types, working principle, field and nursery requirements
11. Implements for intercultural operations – cultivators, sweep, junior hoe, manual weeders and power operated weeders for wet land and garden land
12. Sprayers and their functions, classification, manually operated sprayers, terminology, Nozzle types.
13. Power operated sprayers – Tractor operated boom sprayer, Knapsack mist blower cum duster – Tall tree sprayer-dusters, types and uses.
14. Tools for horticultural crops – propagation tools, planters and harvesting tools and machinery

15. Threshing of crop, thresher and its principles of operation - threshing losses.
16. Harvesting equipment – reapers - mowers and combine harvesters – types, construction and operation-Balers.
17. Harvesting machinery for groundnut, tuber crops, Cotton and sugarcane

#### **PRACTICAL SCHEDULE:**

1. Study of working of two and four stroke IC engines and their systems with solved problems.
2. Study of Tractor clutch, gearbox, differential and final drive. Study of brake steering, and hydraulic control.
3. Learning driving of tractor and power tiller
4. Study of tractors and power tillers – their operation and maintenance
5. Study of mould board plough, - methods of ploughing- with solved problems.
6. Disc plough and subsoiler and their components- Hitching and adjustment of plough - field operation of different tractor drawn primary tillage machinery.
7. Study of cultivator, disc harrows, Rotavator, bund former, ridger, leveller and puddling implements and their operation.
8. Study of seed drills, planters and seed-cum-fertilizer drills and their components and metering mechanisms - calibration- simple problems on calibration.
9. Study and operation of machinery for rice cultivation - puddling implements- rotary puddlers and cage wheels, tray seeder for rice nursery, transplanters- types operation and maintenance- Drum seeder, conoweeder, power weeder and finger type weeder.
10. Study of different inter-cultivation equipment for uplands - manual, animal drawn, power operated - tractor and power tiller operated - field operation
11. Study of plant protection equipment – manually operated sprayers and dusters, knapsack mist blower cum duster, tractor operated sprayers- their operation, adjustment, calibration and safety requirements
12. Study of tools for Hill agriculture and horticultural crops – propagation tools, vegetable transplanter, harvesting tools -lawn mower, hole diggers, tree climber, shredders for crop residue.
13. Threshing machinery for paddy and identification of its components- different threshing drums - calculation of efficiency and losses.
14. Study of paddy reaper and paddy combine- their systems, method of operation and adjustment.
15. Study of harvesters for root crops - turmeric and tapioca and groundnut diggers
16. Problems on cost of operation of tractor operated machinery.
17. Final practical examination

#### **References:**

1. Jagadishwar Sahay, 2010 - **Elements of Agricultural Engineering**. Standard Publishers Distributers, Delhi. ISBN 978-8180140440
2. Ojha, T. P. and Michael, A.M. **Principles of Agricultural Engineering**. Vol. I, Jain Brothers, 16/893, East Park Road, Karol Bagh, New Delhi – 110005
3. S.C.Jain and C.R.Rai. **Farm Tractor – Maintenance and Repair**. Standard Publishers, 1705-B, Nai Sarak, Delhi – 110006
4. Senthilkumar, T., R. Kavitha and V.M.Duraisamy 2015. **A Text Book of Farm Machinery**, Thannambikkai Publications, Coimbatore . ISBN: 978-9381102305

#### **E- RESOURCES:**

[www.agricoop.nic.in/dacdivision/Machinery1/directory.htm](http://www.agricoop.nic.in/dacdivision/Machinery1/directory.htm)  
[www.farmmachineryshow.org](http://www.farmmachineryshow.org)  
<http://www.hillagric.ac.in/edu/coa/agengg/lecture/243/agriengg-243.htm>  
[http://www.digitalbookindex.org/subject\\_search/search010agricultureequipmenta](http://www.digitalbookindex.org/subject_search/search010agricultureequipmenta)  
<http://ecoursesonline.iasri.res.in/course/view.php?id=540>

### **AGR 202 Study Tour (0+1)**

The students will undertake the short tour during third semester for seven days covering KVK's, Research stations, Sister campuses and ICAR institutes in the southern part of Tamil Nadu. The study tour will provide an exposure to the students to know about the soil, climatic conditions and cropping patterns in the respective agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

#### IV SEMESTER

S. No.	Course code	Course Title	Credit load
1	PBG 201	Fundamentals of Genetics	2+1
2	AEX 201	Communication Skills and Personality Development	1+1
3	STA 211	Statistical Methods	1+1
4	PAT 201	Principles of plant disease management	1+1
5	AEN 202	Management of beneficial and harmful insects	2+1
6	AGR 203	Crop Production Technology – II ( <i>Rabi</i> crops)	1+1
7	AGR 204	Farming System & Sustainable Agriculture	1+1
8	SAC 202	Problematic soils and their management	2+0
9	HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1
10	ANM 201	Introductory Nematology	0+1
11	NST 201	Fundamentals and Applications of nanotechnology	1+0
12	ERG 211	Renewable Energy and green technology	1+1
12	NSS/NCC 101	NSS/NCC	0+1*
13	PED 101	Physical Education	0+1*
		<b>Total</b>	
		<b>1</b>	<b>14+10=24</b>
		<b>*Non-gradual courses compulsory courses</b>	

## PBG 201. Fundamentals of Genetics (2+1)

### THEORY

#### Unit I: Cytology

Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics. Physical basis of heredity. Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes. Cell division – mitosis- meiosis and their significance - Gametogenesis and syngamy in Plants- identical and fraternal twins. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, B chromosomes, ring and isochromosomes. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome; Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, triticale, cotton, tobacco, *Brassica*

#### Unit II: Mendelian laws and modifications of Mendelian laws

Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance, threshold characters. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1). ii.) Recessive epistasis (9:3:4) iii.) Duplicate and additive epistasis (9:6:1). iv.) Duplicate dominant epistasis (15:1). v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i) to (vi). Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in human, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.

#### Unit III: Quantitative inheritance, Linkage and Crossing over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Linkage - coupling and repulsion; Experiment on Bateson and Punnett. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage- Linkage group. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment - Factors controlling crossing over. Strength of linkage and recombination; Two point and three point test cross. Double cross over, interference and coincidence; genetic map, physical map.

#### Unit IV: Sex determination, sex linkage and cytoplasmic inheritance

Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize. Genic balance theory of Bridges – Gynandromorphs. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium

#### Unit V: Modern concept of genetics and mutation

DNA, the genetic material – Griffith's experiment, Avery, McCleod and McCarthy Experiment – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment. Structure of DNA –

Watson and Crick model. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA. Protein synthesis - Regulation of gene expression – Operon model of Jacob and Monod – Lac and Trp operons. Cistron, muton and recon. Mutation – characteristics of mutation – micro and macro mutation – CIB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

## **PRACTICAL**

Study of microscopes – Preparation of fixatives and stains – pre treatment of materials for mitosis and meiosis – study of mitosis and meiosis. Study of genetic ratios of – monohybrid, dihybrid – incomplete dominance. Gene interaction - multiple alleles and multiple factors. Study of linkage, Estimation of strength of linkage and recombination frequency in three point test cross data and F<sub>2</sub> data – Drawing of genetic map – interference and coincidence. Studies on sex linked inheritance in Humans and Drosophila

## **Theory schedule**

- Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics.
  - Physical basis of heredity: Structure and function of cell and cell organelles –
  - Differences between Prokaryotes and Eukaryotes. Cell division – mitosis
  - Cell division - meiosis and their significance
  - Gametogenesis and syngamy in Plants- identical and fraternal twins
  - Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram
  - Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, B chromosomes, ring and isochromosomes.
  - Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications.
  - Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome;
  - Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, *Brassica*
  - Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.
  - Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
10. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.
  11. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance, threshold characters
  12. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1)
  13. ii.) Recessive epistasis (9:3:4) iii.) Duplicate and additive epistasis (9:6:1) iv.) Duplicate dominant epistasis (15:1)
  14. **Mid Semester Examination**
  15. v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i) to (vi).
  16. Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.
  17. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.
  18. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers;
  19. Linkage - coupling and repulsion; Experiment on Bateson and Punnett
  20. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.

21. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
22. Strength of linkage and recombination; Two point and three point test cross.
23. Double cross over, interference and coincidence; genetic map, physical map.
24. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize.
25. Genic balance theory of Bridges - Gynandromorphs
26. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
27. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium
28. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
29. Structure of DNA – Watson and Crick model Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA – Protein synthesis
30. Regulation of gene expression – Operon model of Jacob and Monod – Lac and Trp operons. Cistron, muton and recon.
31. Mutation – characteristics of mutation – micro and macro mutation – CIB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

### Practical Schedule

35. Use of microscopes
36. Principles of killing and fixing; preparation of stains and preservatives.
37. Study of behavior of chromosomes in mitosis.
38. Study of mitotic phases in root tips of onion / *Aloe sp.*
39. Procedure for fixing and observing different meiotic phases in the inflorescence of rice, maize
40. Procedure for fixing and observing different meiotic phases in the inflorescence in pearl millet, sorghum
41. Repetition of meiotic studies in maize/ sorghum/ pearl millet and making temporary and permanent slides.
42. Principles of dominance, recessive, back cross, test cross, incomplete dominance, codominance and lethal factor; Chi square test; Monohybrid genetic ratio with dominance, with incomplete dominance and test cross.
43. Dihybrid ratio with dominance, with incomplete dominance and test cross
44. Simple interaction of genes-comb character in fowls; Dominant epistasis.
45. Recessive epistasis, Duplicate and additive epistasis.
46. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
47. Multiple alleles and polygenic inheritance
48. Estimation of linkage with F<sub>2</sub> and test cross data; Coupling and repulsion.
49. Problems on three point test cross; Working out interference, coincidence and drawing genetic maps.
50. Studies on sex linked inheritance in Humans and *Drosophila*
51. **Final Practical examination.**

### References

1. Gupta P.K., 1997. Cytogenetics. Rastogi Publications, Meerut
2. Verma, P.S. and V.K. Agarwal. 2007. Genetics. S.Chand and Company Ltd./ New Delhi.
3. Stansfield, W.D. 1990. Theory and problems of genetics. Mc-Graw Hill Book Co., New York
4. Pundhansingh. 2014. Elements of Genetics. Kalyani Publishers
5. Benjamin Lewin. 2005. Genes IX Oxford University Press, Oxford.
6. Russel, P.J. 2000. Fundamentals of genetics. Addition Wesley Longman Publishers, USA



7. Daniel Sundararaj, G. Thulasidas and M.StephenDorairaj, 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot, Chennai –15.
8. Strickberger. M.W. 1996. Genetics. Prentice-Hall of India Pvt. Ltd. New Delhi.
9. Singh, B.D. 2004. Fundamentals of Genetics, Kalyani Publishers, Chennai.

**56. E- References**

1. [www.nmsu.edu](http://www.nmsu.edu),
2. [www.biology200.gsu.edu](http://www.biology200.gsu.edu)

## **AEX 201 Communication Skills and Personality Development (1+1 )**

### **Theory**

Communication Skills: meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

**Unit I** Communication Skills: meaning and process of communication, verbal and nonverbal communication

**Unit II** Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

**Unit III** Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting

**Unit IV** Individual and group presentations, impromptu presentation, public speaking **Unit V** Group discussion. Organizing seminars and conferences.

### **Practical**

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations

### **Theory Schedule**

36. Communication – meaning and process –Functions and Types of communication
  37. Communication models - Aristotle, Shannon and Weaver, Schramm, Berlo Westly and Maclean, Leagan, Rogers and Shoemaker, Littererls model and Dance’s Helical Model – Elements of communication – communication barriers
  38. Verbal and Non verbal communication – Verbal communication – definition and meaning – Verbal vs Oral communication – Types – Styles - Barriers to effective verbal communication ;
  39. Non verbal communication – definition and meaning – Proxemics, Chronemics, Movement and body position, Posture, Facial Expression, Gestures and Eye Contact – importance of non verbal communication
  40. Listening – Definition – Listening vs Hearing – Active listening – Types of listening –Guidelines for effective listening – Developing listening skills - Barriers to listening – Listening misconceptions
  41. Writing skill – Importance – Effective writing - Components of writing : Introduction , Audience and format ,Composition and style, Structure, Grammatical errors , Proofing and Conclusion – Ways to improve writing skills – Technical writing
  42. Oral presentation skills – Basics of effective oral presentation : Planning , preparing (Introduction, Body and conclusion), Delivery, Body language and Handling anxiety – Strategies for giving oral presentation
  43. Field diary – Definition – Components to be included – Parts of field diary – Field diary in social sciences
- 
9. Lab record : Definition –Importance of keeping a lab record - Features of a lab record - Contents of lab record – Guidelines for keeping a lab record
  10. **Mid semester examination**
  11. Indexing – Definition – Importance – Types of indexing with advantages and limitations
  12. Footnote and Bibliographic procedure : Footnote system of citation ; Bibliographic procedures : Citation in Text, Citation in Journal, Citation from Book(One author / Multiple authors), Citation from an Edited Book, Citation of Seminar/Conference Proceedings, Citation from Institutional Publication, Citing Government Publications, Abbreviations for Names of Journals, Paraphrasing, Abbreviations in citations (Art of publication)
  13. Reading skills – Definition – Kinds of reading skills – Critical reading skills – Reading readiness skills-Guidelines for effective reading- Extensive reading- Intensive reading. Comprehension : Definition and meaning – Comprehension skills-Readability Index

14. Precise writing – Derivation and Meaning – Skills required – Method or procedure – Guidelines; Summarising – Meaning- Steps to write a summary
15. Abstracting : Definition - Purpose of abstract – Types of abstract - Abstract Styles – Steps for Writing Effective Abstracts- Some Do's Don'ts in preparing abstracts
16. Individual presentation - Meaning –Steps for individual presentation; Group presentation – Meaning – Stages of group presentation ; Impromptu presentation
17. Public speaking : meaning – Points to be considered in public speaking – Effective public speaking: Group Discussion: Meaning –Procedure – Advantages – Limitations ;Seminar Conferences : Definition and meaning – Steps in organizing seminar / conferences / symposium / workshop

### **Practical Schedule**

10. Practicing active listening
11. Exercise on note taking methods
12. Exercise on technical writing and practicing proof correction
13. Practicing oral presentation
14. Exercise on writing field diary and Lab record
15. Visit to library and learn indexing
16. Exercise on preparing foot notes and citations
17. Practice on effective reading skills
18. Comprehension of technical article
19. Comprehension of general article
20. Exercise on precise writing
21. Practice on summarizing articles
22. Practice on preparing abstracts
- 14&15 Developing skill on individual presentation
14. Developing skill on group presentation
15. **Practical Examination**

### **Referecnce**

G.L. Ray and Sagar mondal. 2010. Journalism –Farm journalism and communication skills. Kalyani publishers.

Sagar Mondal. 2016. Agricultural extension , Kalyani publishers

G. L. Ray 2007 Extension Communication and Management , Kalyani publishers

Communication and Instructional Technology, By: Indu Grover, Shusma Kaushik, Lali Yadav, Deepak Grover & Shashikanta Verma

Indu Grover, Lali Yadav & Deepak Grover Extension Management, Agrotech

Everett Rogers, and Floyd Shoemaker, Communication of Innovation – a Cross Cultural Approach, New York Free Press.

Knapp, Mark L., & Hall, Judith A .(2007) Nonverbal Communication in Human Interaction. (8<sup>th</sup> ed.) Wadsworth: Thomas Learning.

Kathleen M. German, Bruce E Gronbeck Principles of Public Speaking

### **e- Referecnce**

1. [www.managementstudyguide.com](http://www.managementstudyguide.com)
2. [www.ajms.co.in](http://www.ajms.co.in)
3. [www.mindtools.com](http://www.mindtools.com)

## STA 201 Statistical Methods( 1+1)

### Theory

#### Unit I: Descriptive Statistics

Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency distribution tables.

Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode – merits and demerits. Measures of dispersion: range, quartile deviation, mean deviation, standard deviation, and coefficient of variation – skewness and kurtosis – merits and demerits.

#### Unit II: Probability Distributions and Sampling Theory

Probability – basic concepts – additive and multiplicative laws (without proof). Probability distributions – Discrete distributions: Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties.

Sampling theory – population – sample – parameter and statistic – sampling distribution – sampling vs complete enumeration – Types of sampling – simple random sampling – selection of simple random sample using random number tables.

#### Unit III: Testing of hypotheses

Null and alternative hypothesis – types of errors – critical region and level of significance – degrees of freedom. Large sample test – single proportion and difference between two proportions – single mean and difference between two means.

Small sample tests – F-test – t-test for testing the significance of single mean – independent t test and paired t test – chi square test for goodness of fit – chi square test for testing the association of attributes by  $m \times n$  contingency table –  $2 \times 2$  contingency table – Yates' correction for continuity.

#### Unit IV: Correlation and Regression

Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

#### Unit V: Analysis of Variance and Experimental Designs

Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) – lay out, analysis, merits and demerits of the above mentioned designs.

### Practical

Formation of frequency distribution tables – Diagrammatic and graphical representation. Computation of different measures of central tendency and computation of various measures of dispersion for raw and grouped data – calculation of coefficient of variation (CV) – measures of skewness and kurtosis. Simple problems in Binomial distribution, Poisson and Normal distribution – Selection of simple random sampling. Large sample test for single proportion and difference between two proportions and Large sample test for single mean and difference between two means. t-test for single mean – t-test for testing the significance of two means for independent and paired samples – chi square test for goodness of fit and test for independence of two attributes in a contingency table – Yates correction for continuity

– calculation of the correlation coefficient – fitting of simple linear regression equation – One way and two way ANOVA – completely randomized design (CRD) – randomized block design (RBD) – Latin square design (LSD).

### Theory Lecture Schedule

50. Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency distribution tables.
51. Measures of Central Tendency – meaning – limitations – properties – mean, median mode geometric mean and harmonic mean for ungrouped and grouped data.
52. Measures of Dispersion – meaning – limitations – properties – range and mean deviation, Quartile deviation, standard deviation, variance and coefficient of variation for ungrouped and grouped data. Skewness and kurtosis – types – uses.
53. Probability – basic concepts – axioms – mathematical and statistical probabilities – additive and multiplicative laws (without proof). Theoretical discrete distributions – Binomial and Poisson distribution and its applications.
54. Theoretical continuous distribution – Normal distribution and its properties and importance – standard normal distribution.
55. Sampling theory – population – sample – sampling vs complete enumeration – parameter and statistic – need for sampling – sampling distribution – standard error.
56. Sampling methods – probability sampling method – simple random sampling – Selection using random number tables and lottery method.
57. Tests of significance – basic concepts – null and alternative hypotheses – critical region – level of significance – degrees of freedom.
58. **Mid Semester Examination**
8. Large sample test – single proportion and difference between two proportions – single mean and difference between two means
23. Small sample tests – F-test – t-test for testing the significance of single mean independent t test and paired t test
24. Chi square test for goodness of fit – chi square test for testing the association of m x n contingency table – 2 x 2 contingency table – Yates' correction for continuity
35. Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties.
36. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.
37. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – randomization, replication and local control.
38. Completely Randomized Design (CRD) – Randomized Block Design (RBD).
39. Latin Square Design (LSD).

### **Practical schedule**

23. Construction of frequency distribution tables.
24. Diagrammatic representation – simple, multiple, component and percentage bar diagrams, pie diagram. Graphical representation – frequency polygon, frequency curve and histogram.
25. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode for ungrouped and grouped data.
26. Computation of range, standard deviation, variance, coefficient of variation for ungrouped and grouped data. Computation skewness and kurtosis for ungrouped and grouped data.
27. Simple problems in Binomial distribution and Poisson distribution.

28. Simple problems in Normal distribution.
29. Selection of simple random sample using simple random sampling method.
30. Large sample test – test for single proportion and difference between two proportions.
31. Large sample test – test for single mean and difference between two means.
25. Small samples test – t-test for single mean – independent t test for difference between two sample means (equal variances only) – Paired t-test.
26. Chi square test for goodness of fit – Chi square test for testing the association of attributes.
27. Computation of Karl Pearson's correlation coefficient.
28. Fitting of simple linear regression equation  $y$  on  $x$ .
29. One way ANOVA – analysis of experimental data using Completely Randomised Design (CRD) (for equal replications only).
30. Two way ANOVA – analysis of experimental data using Randomised Block Design (RBD).
31. Analysis of experimental data using Latin Square Design (LSD).
- 32. Final Practical Examination**

### References

37. Rangaswamy, R. 2000, A Text book of Agricultural Statistics, Wiley Eastern Limited, New Delhi.
38. K.P. Dhamu and K. Ramamoorthy, 2007, Statistical Methods, Agrobios (India), Jodhpur.
39. R. Gangai Selvi and C. Kailasam, 2017, Applied Statistics, Kalyani Publishers, New Delhi.
40. K. M. Palaniswamy and Usha Palaniswamy, 2006, Handbook of Statistics for Teaching and Research in Plant and Crop Science, , IBDC Publishers, , Lucknow.

### References

39. G. Nageshwara Rao , 2007, Statistics for Agricultural Sciences, BS Publications, Andhra Pradesh.
40. Gupta. S.P., 2007, Statistical Methods, Sultan Chand and Sons, New Delhi.
41. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 2003, Sultan Chand and Sons, New Delhi.
42. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, 2003, Sultan Chand and Sons, New Delhi.
43. Gomez, K.A. and Gomez, A.A., 1984, Statistical Procedures for Agricultural Research, John Wiley and Sons, New York.
44. Panse, V.G. and Sukhatme, P.V. 1961, Statistical methods for Agricultural Workers, ICAR, New Delhi.
45. Zar. J.H., 1974, Bio-statistical analysis, Prentice - Hall, Inc., New Jersey.
46. Cochran, W.G. and Cox, G.M. 1962. Experimental Design, Asia Publishing House, New Delhi.
47. M.N. Das and Narayan C. Giri, Design and Analysis of Experiments, New Age Publishers, New
20. D.C. Sanchetti and V.K. Kapoor, 2007, Statistics (Theory, Methods and Application), Sultan Chand and Sons, New Delhi.

### E- References

17. <http://www.statistics.com/resources/glossary/>
18. [www.statsoft.com](http://www.statsoft.com)
19. [http://www.iasri.res.in/ebook/EB\\_SMAR/index.htm](http://www.iasri.res.in/ebook/EB_SMAR/index.htm)
20. <http://www.iasri.res.in/design/analysis of data/analysis of data.html>
21. [www.stats.gla.ac.uk/steps/glossary/index.html](http://www.stats.gla.ac.uk/steps/glossary/index.html)

22. <http://davidmlane.com/hyperstat/>
23. <http://www.stattrek.com/>
24. [http://www.businessbookmall.com/Statistics Internet Library.htm](http://www.businessbookmall.com/Statistics%20Internet%20Library.htm)
25. <http://www.stat-help.com/>
18. [www.statsci.org/jourlist.html](http://www.statsci.org/jourlist.html)

## PAT 201 Principles of Plant Disease Management (1+1)

### Theory

**UNIT I: Epidemiology and Diagnosis of Plant Diseases:** Classification of plant diseases - Disease triangle/ Disease Pyramid - Epidemiology of plant diseases- role of weather factors in disease development - survival and dispersal of plant pathogens- Disease surveillance, assessment and forecasting– Diagnosis of plant diseases- Seed health tests- chemodiagnosis, serodiagnosis and Molecular diagnosis

**UNIT II: Principles - Avoidance & Exclusion :** Avoidance- Role of cultural practices in plant disease management. Exclusion- Plant quarantine – domestic, International and Embargo - Phytosanitary certificate- Quarantine in India- Post Entry Quarantine- Exotic diseases introduced into India

**UNIT III: Eradication :** Eradication of pathogens from seed and Planting materials – Eradication of diseased plants- Surgery and Rouging – Eradication of Alternate and Collateral host- different methods of eradication- Mechanical, physical , chemical and Biological methods.

**UNIT IV: Protection :** Protection of crops from air borne, seed borne, soil borne and vector borne plant diseases-Physical methods- soil solarization, Hot water treatment, Incineration. Chemical control of plant diseases- fungicides- Different group of fungicides and antibiotics in plant disease management-Biological control of plant diseases - Plant products, Plant activators and Antiviral principles- method of application- plant protection appliances.

**Unit V: Immunization and Biotechnological approaches:** Immunization - cross protection and host plant resistance – Types of resistance - vertical and horizontal resistance – resistance breeding and Resistant varieties. Mechanism of resistance- structural and bio chemical resistance in plants -Biotechnological approaches for crop disease management.

### Practical

Survey and Assessment of important plant diseases- Diagnosis of Plant diseases- Classification and grouping of fungicides- Preparation of Bordeaux mixture (1%) and Bordeaux paste (10%), Calculation of fungicides quantity and methods of application of fungicides – Special methods of application. Mass multiplication of *Trichoderma viride*, *Pseudomonas fluorescens* and *Bacillus subtilis* and method of application-Preparation of leaf extracts, oil emulsion of neem and antiviral principles. Cross protection-Tissue culture –meristem tip culture technique. Visit to commercial biocontrol production unit/seed Testing Laboratory and pesticide testing laboratory

### Theory lecture schedule

11. Plant diseases – Abiotic , Biotic diseases, Classification based on mode of infection, multiplication of inoculum , spread, symptoms, occurrence & Distribution
9. Epidemiology – Disease triangle/ Disease Pyramid - Role of weather factors in plant disease development. Boom and burst cycle in disease outbreak
10. Survival and dispersal of Plant Pathogens
11. Disease surveillance –Different methods- surveillance report-Disease surveillance programme in Tamil Nadu.
12. Assessment of Plant Diseases- different methods- Measurement of disease growth rate by Area under disease Progressive curve (AUDPC)
13. Diagnosis of plant diseases-Seed health tests, Chemodiagnosis, serodiagnosis and Molecular diagnosis
14. Exclusion- Plant quarantine – domestic, International and Embargo -phytosanitary certificate-Quarantine in India. Post entry quarantine. Exotic diseases introduced into India.
15. Role of cultural practices in plant disease management- Different methods of Eradication of Plant Diseases

### 16. Mid semester examination

17. Protection –Physical methods of protection- Chemical fungicides – Ideal characters- formulations and adjuvants



18. Sulphur and Copper fungicides,- classification -Phytotoxicity, mode of action and uses
19. Mercury fungicides, Heterocyclic Nitrogen compounds , Organo tin, Quinone, Benzene and Miscellaneous compounds , Mode of action and Uses
20. Systemic fungicides including antibiotics – classification – mode of action - uses.  
New generation fungicides, Plant activators/ SAR inducing chemicals in Plant disease management
21. Methods of application of fungicides: seed treatment, foliar spray, soil drenching and special methods of application
22. Biological control – Definition - mechanism of action – Mass production of *Trichoderma viride* , *Pseudomonas fluorescens* & *Bacillus subtilis* - methods of application - Plant products – antiviral principles – preparation – methods of application
23. Disease Resistance- Types- Resistant varieties. Methods of developing resistant varieties- Mechanisms of resistance- structural and bio chemical resistance in plants- cross protection
24. Biotechnological approaches in plant diseases management: Tissue culture techniques- meristem tip culture, somoclonal variation and transgenic plant production by genetic engineering.

### **Practical Schedule**

35. Survey and Assessment of important plant diseases
36. Diagnosis of Plant diseases: Tetrazolium test, Iodine test , ELISA test and Ooze test, paraquat test
37. Seed health tests for diagnosis of seed borne pathogens - dry seed examination, seed washing, Blotter tests
38. Classification and grouping of fungicides.
39. Preparation of Bordeaux mixture (1%) and Bordeaux paste (10%),
40. Calculation of spray fluid and methods of application of fungicides – Seed (wet and dry) soil, foliar and post harvest dipping.
41. Special methods of application: swabbing, acid delinting, pseudostem injection, capsule application
42. Special methods of application: Corm injection, Paring and prolinage, root feeding and trunk injection.
43. *In vitro* assay of fungicides against fungal pathogens
44. *In vitro* assay of biocontrol agents and their compatibility with agrochemicals
45. *Trichoderma viride* -Mass production and methods of application
23. *Pseudomonas fluorescens* and *Bacillus subtilis* -Mass production & methods of application
24. Visit to commercial biocontrol production unit /seed and pesticide testing laboratories
25. Preparation of leaf extracts, oil emulsion of neem and antiviral principles.
26. Cross protection: production of pre immunized citrus seedlings against tristeza virus.
27. Tissue culture – Production of virus free plants through meristem tip culture technique.

### **28. Practical Examination**

### **Reference**

26. Prakasam, V., T. Raguchander and K. Prabakar, 2006. Applied Plant Pathology, A.E. publications, Coimbatore.
27. Dinakaran, D, Arjunan, G and Karthikeyan, G. 2003. Biological control of crop diseases

### **E references:**

26. Agrios, G.N. 2005. Plant Pathology – (5<sup>th</sup> Edition). Academic Press, New York.
27. Richard N. Strange. 2003. Introduction of Plant Pathology - John Wiley & Sons Ltd, London
28. Dale Walters (2009). Disease control in crops. Blackwell Publishing Ltd, UK

## AEN 202 MANAGEMENT OF BENEFICIAL AND HARMFUL INSECTS (2+1)

### Theory

**Unit I:** Classification of insects based on economic importance - [Apiculture - Bee species – comparison- castes of bees, bee behaviour and bee dance](#); [Apiary management practices – bee pasturage, foraging, seasonal variations](#); [Bee products – properties and uses](#); [Effect of agricultural inputs on bee activity – pesticide poisoning](#).

**Unit II:** [Moriculture; Silkworm rearing](#); Lac insect- biology-strains-natural enemies of lac insect and lac products; Weed killers, pollinators, scavengers and soil builders; Balance of life in nature – population dynamics – role of abiotic and biotic factors. Life table – interspecific and intraspecific relationships

**Unit III:** Pests – definition and categories – pest outbreak – factors governing pest outbreak– pest monitoring, surveillance and forecasting. Economic Threshold Level – Economic Injury Level- [Integrated Pest Management – history, principles and strategies – requirements for successful pest management programme](#); Cultural, physical, mechanical, ecological engineering methods and host plant resistance in pest management

**Unit IV:** Parasitoids, predators and microbial agents in pest management. [Legal methods – definition – pest introductions – quarantine – phytosanitary certificate – pest legislation](#). Pesticides – history, classification – mode of action of insecticides. Pesticides compatibility, safety and hazards in the use of pesticides – pesticide poisoning - impact of pesticides in agro-ecosystem.

**Unit V:** Insecticide act. Insecticides residues and resistance. Semiochemicals – allomones – kairomones – pheromones- semiochemicals in pest management. Sterile male technique – chemosterilants, insect growth regulators – moult inhibitors – Juvenile Hormone mimics – antifeedants and repellents. Natural pesticides. Biotechnology in pest management. Bio safety of transgenic plants. Impact of global warming on pests. [Bio-intensive/Bio-rational/ Eco-friendly Integrated Pest Management – Indigenous/traditional technologies in Integrated Pest Management](#)

### Practical

Identification, morphology and structural adaptations in honey bees. Bee keeping appliances, bee enemies and diseases. Sericulture. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products. Study of useful insects- Pollinators, weed killers, scavengers and soil builders. Symptoms and types of damage caused by insect pests. Assessment of insect population and their damage in field crops. Cultural, mechanical and physical control of insects. Identification and mass culturing of different types of parasitoids, predators and entomopathogens. Behavioral approaches in pest management – Pheromone traps, light traps, sticky traps and others. Pesticide formulations and toxicity parameters. Pesticide application techniques. Preparation of spray fluids and botanicals for field application. Plant protection appliances.

### Theory lecture schedule:

1. Economic classification of insects
2. [Bee species – comparison – castes of bees – bee behaviour and bee dance](#)
3. [Apiary management practices – bee pasturage – foraging – seasonal variations](#).
4. [Bee products – their properties and uses](#)
5. [Effect of agricultural inputs on bee activity – pesticide poisoning](#)
6. Ecological requirements for mulberry cultivation – soil type – mulberry varieties – Methods of propagation – merits and demerits – selection of semi hard wood cuttings
7. Pests and diseases of mulberry
8. Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultnism, geographical distribution and genetic nature – Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids – double hybrids– suitability for rearing in different seasons.
9. Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use.
10. Lac insect- biology-strains-Natural enemies of lac insect and lac products
11. Weed killers, pollinators, scavengers and soil builders
12. [Insect ecology – definition – balance of life in nature – reproductive potential and environmental](#)

- [resistance](#)
13. [Population dynamics – role of biotic factors – competition – parasitoids and predators. Life table – Interspecific and intraspecific relationship](#)
  14. [Abiotic factors – physical, nutritional and host plant associated factors on insect population.](#)
  15. [Pests – definition, categories and causes for outbreak of pests. Losses caused by pests](#)
  16. [Pest monitoring – pest surveillance and forecasting – objectives, survey, sampling techniques and decision making. Economic Threshold Level and Economic Injury Level. Factors influencing Economic Injury Level and Economic Threshold Level](#)
  17. [Midsemester examination](#)
  18. [Integrated Pest Management – history, principles and strategies – requirements for successful pest management programme. Components of pest management](#)
  19. [Cultural methods – definition – characteristics, requisites – farm level practices and community level practices, advantages and disadvantages- Ecological Engineering in pest management](#)
  20. [Physical methods – definition – use of heat, moisture, light, electromagnetic energy and sound energy – Mechanical methods – definition – mechanical destruction and exclusion – merits and demerits](#)
  21. Host plant resistance – types and mechanisms of resistance and role of host plant resistance in pest management
  22. Biological control – definition, parasitoids and predators and their role in pest management
  23. Microbial control – viruses, bacteria, fungi, protozoa and nematodes and their role in pest management
  24. [Legal methods – definition – pest introductions – quarantine – phytosanitary certificate – pest legislation](#)
  25. [Chemical control – definition – history of insecticide development – toxicity parameters – ideal qualities of an insecticide](#)
  26. [Classification of insecticides based on mode of entry, mode of action and chemical nature](#)
  27. [Mode of action of organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, diamides and avermectins](#)
  28. [Pesticide compatibility, safety and hazards – pesticide poisoning - antidotes – safe handling – impact of pesticides on agroecosystems](#)
  29. [Insecticides Act 1968 – insecticide residues and waiting periods, role of pesticides in pest management, insecticide resistance management](#)
  30. [Semiochemicals – definition – intraspecific semiochemicals – allomone, kairomone, synomone and apneumone - Interspecific semiochemicals – pheromone, sex pheromone, alarm and trail marking pheromone. Pheromones in Integrated Pest Management](#)
  31. [Sterility methods – definition – principles – methods – requirements and limitations](#)
  32. [Insect growth regulators – moult inhibitors – Juvenile Hormone mimics – mode of action and uses. Insect antifeedants and repellents – mode of action, groups and uses](#)
  33. Botanicals and Biotechnological approaches in pest management – bio safety of transgenic plants
  34. [Impact of global warming on pests. Integrated Pest Management : Issues and options. Bio-intensive/Bio-rational/ Eco-friendly Integrated Pest Management – Indigenous/traditional technologies in Integrated Pest Management](#)

#### **Practical schedule:**

1. Identification, morphology and structural adaptations in honey bees
2. Bee keeping appliances, bee enemies and diseases
3. Mulberry nursery bed preparation – methods of planting - Pruning methods – leaf / shoot harvest– preservation of leaves.
4. Identification of damage symptoms of insects, diseases and nematodes of mulberry
5. Chawki rearing and shoot rearing
6. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products
7. Study of useful insects-Pollinators, weed killers, scavengers and soil builders
8. Symptoms and types of damage caused by insect pests , Assessment of insect population and their damage in rice, cotton and brinjal

9. Cultural, mechanical and physical control of insects
10. Identification and mass culturing of different types of parasitoids
11. Identification and mass culturing of different types of predators
12. Identification and mass production of entomopathogens
13. Behavioral approaches in pest management – Pheromone traps, light traps, sticky traps and others
14. Pesticide formulations and toxicity parameters
15. Pesticide application techniques, Preparation of spray fluids and botanicals for field application
16. Plant protection appliances
17. Final Practical examination

**References:**

1. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
1. Pedigo, L.P. and M.E.Rice.1996. *Entomology and Pest Management*. Prentice-Hall of India Pvt Ltd, New Delhi. 812p. {ISBN-978-8120338869}
2. Dhaliwal, G.S. and R.Arora. 2001. *Integrated Pest Management – Concepts and approaches*. Kalyani publishers, New Delhi. 427p. {ISBN: 81-7663-904-4}
3. Dandin, S.B., J.Jayaswal and K. Giridhar.2003. *Hand book of Sericulture Technologies*. Central Silk Board, Bangalore, 287 p.

**e resources**

1. <http://www.sristi.org/hbnew>
2. <http://www.ncipm.org.in/recent-publications.htm>
3. <http://www.ipmnet.org>
4. [www.silkbase.org](http://www.silkbase.org)
5. [www.papilo.ab.a.u.tokyo.ac.jp](http://www.papilo.ab.a.u.tokyo.ac.jp)

## **AGR 203 Crop Production Technology- II (Rabi crops) (1+1)**

### **Theory**

#### **Unit I : Cereals**

Wheat, barley, Oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### **Unit II : Pulses**

Chickpea, lentil, peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### **Unit – III Oilseeds**

Rapeseed, mustard and sunflower- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### **Unit -IV: Sugar Crops**

Sugarcane - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### **Unit V: Forage crops**

Berseem, Lucerne , Fodder maize : Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices.

#### **Practical:**

Identification of rabi cereals, pulses, oilseeds, sugarcane, and forage crops - nursery preparation and management for sugarcane - main field preparation; Seed treatment techniques - Sowing and manuring  
35. Seeding equipment's - Estimation of population - After cultivation practices - Study of growth and yield parameters and yield estimation, harvesting of above crops; Fodder preservation techniques - Silage and hay making, Cost and returns - Visit to institutes and industries - Farmers' fields

#### **Lecture Schedule:**

17. Wheat- Origin, geographic distribution, economic importance, soil and climatic requirement,
18. Wheat - varieties, cultural practices and yield.
19. Barley and oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
20. Chickpea- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
21. Lentil and peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
22. Peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
23. Rapeseed and Mustard - Origin, geographic distribution, economic importance, Classification , soil and climatic requirement, varieties
24. Rapeseed and mustard - cultural practices, yield.

#### **25. Mid semester examination**

26. Sunflower- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
21. Sugarcane - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties,
22. Sugarcane - cultural practices and yield.
23. Sugarcane- package of practices for SSI
24. Sugarcane - Crop logging, maturity and ripening
25. Sugarcane - Gur manufacture , Value addition and byproduct utilization.
26. Berseem and Lucerne - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

27. Fodder maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
19. Identification of rabi crops and recording their importance in the crop cafeteria.
20. Acquiring skill in field preparation, sowing and manuring of rabi crops under pure and intercropping situations.
21. Acquiring skill in different seed treatment techniques and foliar nutrition of rabi crops.
22. Estimation of plant population per unit area for rabi crops.
23. Nursery preparation for Sugarcane.
24. Acquiring skill in after - cultivation practices in sugarcane - detrashing, and Propping.
25. Study on growth parameters of sugarcane.
26. Study on yield parameters and estimation of yield in sugarcane.
27. Study on yield parameters and estimation of yield in rabi crops.
28. Estimating Cost and returns of important rabi crops.
29. Visit to Sugarcane Breeding Institute/ Research Station to study cultivation of sugarcane and its by products.
30. Visit to - nearby sugar mill, for observing juice extraction, quality assessment, sugar manufacture and by products.
31. Silage making.
32. Practicing field preparation and sowing Lucerne.
33. Practicing field preparation and sowing for fodder maize.
34. Visit to Wheat research station, Wellington to study rabi crops – wheat, barley, rye, oats.
35. **Practical Examination.**

#### **References:**

- Rajendra Prasad. 2012. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi. Ahlawat,I.P.S., Om Prakash and G.S. Saini. 2010. Scientific Crop Production in India. Rama publishing House, Meerut
- Chidida Singh, Prem Singh and Rajbir Singh. 2011. Modern Techniques of Raising Field Crops. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
- Reddy,S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
- Crop production guide.2012. Directorate of Agriculture, Chennai
- ICAR 2015. Hand book of Agriculture. Indian Council of Agriculture, New Delhi

#### **E.References:**

1. <http://sugarcane.tn.nic.in>
2. <http://fibre.tn.nic.in> ,
3. [www.tnau.ac.in/agriportal](http://www.tnau.ac.in/agriportal)

## AGR 204 Farming System and Sustainable Agriculture (1+1)

### Theory :

#### Unit - I: Cropping System

Cropping systems - Definition - Principles - Concepts - Classification - mono cropping - intensive cropping

6. cropping systems of India and Tamil Nadu - Interaction between different cropping systems - Cropping system management - Resource management - land, nutrient, water and weed.

#### Unit - II: Evaluation of Cropping System

Index for evaluation of cropping systems - Land use - yield advantages - Economic evaluation - sustainability.

#### Unit - III: Farming System

Farming systems - Definition - Principles - Concepts - Enterprises selection and management - interaction between different enterprises with cropping - scope and advantages of Integrated Farming system - Integrated farming system models for different agro eco-systems - interaction between enterprises.

#### Unit - IV: Evaluation of Farming System

Resource recycling in IFS - Evaluation indicators of integrated farming system - LEISA & HEIA - concepts and principles - Conservation agriculture - principles, concept and scope.

#### Unit - V: Resource and labour management in farming system

Resource management under constraint situation - Cost reduction strategies in crop production - Non-monetary inputs and low cost technologies - Labour management - farming system and environment.

### Practical:

Preparation of cropping scheme - working out input requirements for crops, cropping systems - preparation of calendar of operations for wetland, irrigated upland and dry land cropping system - visit to cropping system experiments - working out indices for evaluation of cropping systems - visit to different units: dairy, goat, poultry, fishery. Mushroom, sericulture and biogas - study on evaluation indicators on farming system - preparation of integrated farming system models for different eco-systems - on farm field visit - analysis of farming system models.

### Lecture Schedule

11. Cropping system: Definition, Principles and basic concepts.
12. Classification of cropping system - Mono cropping, intensive cropping, multiple cropping, mixed cropping.
- 3 Major cropping systems prevailing in India and Tamil Nadu for different agro eco systems.
16. Complementary and competitive interaction in different cropping system - light, nutrient, water and weed.
17. Cropping system management: agronomic requirement for crops and cropping system selection of crops and varieties, tillage and land shaping, plant population and crop geometry.
18. Cropping system management: agronomic requirement for crops and cropping system - water management, soil fertility management and plant protection.
19. Indices for evaluation of cropping system - land use, yield advantage and economics.
20. Farming system: definition, principles and concepts and factors influencing choice and size of enterprises
- 26. Mid Semester Examination.**
27. Scope and advantages of integrated farming system.
28. Allied enterprises for wetland, irrigated upland and dryland - selection and management and their interaction.
29. Resource recycling in integrated farming system.
30. Integrated Farming System evaluation indicators.
31. Integrated farming system - models for wetland, irrigated upland and dryland eco system.
32. LEISA and HEIA - principles and concepts and Labour management in integrated farming system.

33. Conservation agriculture and environmental impact of integrated farming system.
34. Cost reduction technologies and non monetary inputs in integrated farming system.

#### **Practical Schedule:**

54. Visit to cropping system experiments in wetland.
55. Visit to cropping system experiments in irrigated upland and dryland.
56. Preparation of cropping scheme for wetland and working out input requirement.
57. Preparation of cropping scheme for irrigated upland and working out input requirement.
58. Calendar of operations for wet land and irrigated upland cropping system.
59. Working out indices for evaluating the cropping system - land use, yield advantage.
60. Working out indices for evaluating the cropping system - Economics, sustainability.
61. Visit to dairy, goat and poultry units.
62. Visit to mushroom unit.
63. Visit to sericulture and biogas unit.
64. Preparation of integrated farming system models : wetland eco-system.
65. Preparation of integrated farming system models : irrigated upland and dryland eco systems.
66. Resource recycling in integrated farming system models of different eco systems.
67. Evaluation of integrated farming system models : wetland eco-system.
68. Evaluation of integrated farming system models : irrigated upland and dryland eco systems.
69. On-farm visit to cropping fields and integrated farming system units.
70. **Practical examination.**

#### **References:**

1. Palaniappan, SP and K. Sivaraman.1996. Cropping systems in the tropics Principles and management.
2. New Age International (P) Ltd., New Delhi.
3. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House.Delhi.
4. S.C. Panda. 2003. Cropping and Farming Systems. Agrobios Publishers. Jodhpur. Jana, B.L. 2014. Farming Systems. Agrotech Publishing Academy, Udaipur Shagufta. 2015. Cropping and Farming Systems. APH Publishing Corporation

#### **E references:**

1. [www.agriinfo.in](http://www.agriinfo.in)
2. [www.fao.org](http://www.fao.org)
3. [www.agritech.tnau.ac.in](http://www.agritech.tnau.ac.in)



## SAC 202 Problematic Soils and their Management (2+0)

### Theory

#### Unit-I

Soil quality and health, Distribution of Waste land and problem soils in India and Tamil Nadu. Categorization of waste lands based on properties.

#### Unit-II

Characteristics, reclamation and management of soil physical and chemical constraints - Eroded and Compacted soils, Flooded soils, Saline and sodic soils, Acid soils, Acid Sulphate soils, degraded alkali soils and Polluted soils. Effect of salts on soil and plants.

#### Unit-III

Remote sensing and GIS in assessment and management of problem soils. Irrigation water – quality and standards. Utilization of saline water in agriculture.

#### Unit-IV

Multipurpose tree species, bio remediation of soils through MPTs, land capability classification, land suitability classification. Problematic soils under different Agro ecosystems - Soil fertility improvement through carbon build up.

### Lecture Schedule:

15. Soil health - Definition - Soil Quality Indices – Physical indicators
16. Soil Quality Indices - Chemical and biological indicators
17. Distribution of waste lands and problem soils in India and Tamil Nadu
18. Categorization of waste lands based on properties
19. Soil physical constraints – slow permeable, excessively permeable soils and fluffy paddy soils - Characteristics and management
20. Soil crusting, soil compaction, sub soil hard pan, sand dunes and shallow soils – characteristics and management
21. Eroded soil – Genesis, types and characteristics: water- sheet, rill, gully, ravines, wind – Aeolian, loess, saltation, suspension , soil creep
18. Universal soil loss equation and erosion control measures
19. Flooded soils – Formation, characteristics and management
20. Acid soil and acid sulphate soil – Genesis and characteristics.
18. Lime requirement of acid soil, liming materials, reclamation and management of acid soil
19. Formation and classification of Saline, Sodic and saline sodic soils
20. Effects of Salts on soils- Physical: Clay swelling and Dispersion, permeability, Infiltration, Crust, Water transmission. Chemical: pH and EC. Biological : Microbial activity.
21. Effects of Salts on plants – Plants response to saline and sodic conditions, Factors affecting salt tolerance, crop response to salinity, ratings of crop salt tolerance.
22. Salts and plant mineral nutrition- Salinity and nutritional effects: Salinity and N, P, K, Ca, Mg, S, and Micronutrients. Alkalinity and nutritional effects.
23. Saline, Sodic, saline sodic, and degraded alkali soils- characteristics and their management
  
8. Saline soil-reclamation – Leaching requirement. Sodic soil – reclamation -gypsum requirement – calculations.
9. **Mid semester examination**
10. Polluted soils- industrial effluent s- Characteristics, reclamation and management
11. Polluted soils- mine spoils- Characteristics, reclamation and management
12. Irrigation water – quality and standards - EC, SAR, RSC, RSBC SSP, PSI and PS
13. Irrigation water – quality and standards -USDA system and specific ion toxicity-USSL system
14. Factors affecting suitability of irrigation water and Management of poor quality water in agriculture
15. Remote sensing and GIS in assessment of wastelands and problem soils

16. Remote sensing and GIS in monitoring and management of wastelands and problem soils
17. Multipurpose tree species for waste lands and problem soils
18. Bio remediation through MPTs of soils
19. MPTs - Nutrient cycling under waste lands and problem soils
20. Land capability and classification
21. Land suitability classification
22. Problematic soils under different Agro ecosystems- coastal salinity, inland salinity
23. Problematic soils under different Agro ecosystems- marshy, swampy soils, red sand dunes (Theri soils) Tsunami affected soils.
24. Agricultural Ecosystem services- Soil fertility improvement in problem soils
25. Potential of agro forestry systems in management of problem soils
26. Carbon sequestration and its role in problem soil management

## REFERENCES

28. Sehgal, J. 2005. Pedology concepts and applications, Kalyani Publishers, New Delhi.
29. Gupta, S.K. and I.C. Gupta 2014. Salt affected soils: Reclamation and Management. Scientific Publishers.
30. Richards, L.A. 2012. Diagnosis and improvement of saline and alkali soils. Scientific Publishers.
31. Soil Survey Staff. 2006. Keys to Soil Taxonomy. United States Department of Agriculture, Natural Resources Conservation Service.
32. Maliwal, G.L. and L.L. Somani. 2010. Nature, Properties and Management of saline and alkali soils. Agrotech publishing academy, Udaipur.

## E-REFERENCES

18. <ftp://ftp-fc.sc.egov.usda.gov/NSSC/NCSS/Conferences/scanned/>
19. <ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab References/SSIR 51.pdf>
20. [ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab\\_References/SSIR 51 .pdf](ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab_References/SSIR 51 .pdf)
21. [www.iuss.org/Bulletins/00000096.pdf](http://www.iuss.org/Bulletins/00000096.pdf)
22. [www.oosa.unvienna.org/pdf/sap/centres/rscurrE.pdf](http://www.oosa.unvienna.org/pdf/sap/centres/rscurrE.pdf)
23. [www.csre.iitb.ac.in/~dd/detail.html](http://www.csre.iitb.ac.in/~dd/detail.html)
24. [www.dvsinstitute.org/forms/pg/M.Sc.%20-%20RS%20&%20GIS-350.pdf](http://www.dvsinstitute.org/forms/pg/M.Sc.%20-%20RS%20&%20GIS-350.pdf)
25. [inkinghub.elsevier.com/retrieve/pii/S0166248197800335](http://inkinghub.elsevier.com/retrieve/pii/S0166248197800335)
26. [www.scribd.com/doc/40246764/Description-Pedon-Copy-](http://www.scribd.com/doc/40246764/Description-Pedon-Copy-)
9. [www.angrau.net/BSc\(Aq\)CourseCurriculum.htm](http://www.angrau.net/BSc(Aq)CourseCurriculum.htm)
10. [www.eurojournals.com/ejsr 42 2 10.pdf](http://www.eurojournals.com/ejsr 42 2 10.pdf)
11. [www.springerlink.com/index/R177R74472222UN.pdf-Similar](http://www.springerlink.com/index/R177R74472222UN.pdf-Similar)
12. [content.alterra.wur.nl/Internet/webdoc\\$/ilri-publicaties/.../Bib10.pdf](http://content.alterra.wur.nl/Internet/webdoc$/ilri-publicaties/.../Bib10.pdf)
13. [www-wds.worldbank.org/external/.../INDEX/multi\\_..page.txt-Cached](http://www-wds.worldbank.org/external/.../INDEX/multi_..page.txt-Cached)
14. [openaccess.icrisat.org/.../Proceedings-integrated-watershed-management-for-land-Asia.pdf](http://openaccess.icrisat.org/.../Proceedings-integrated-watershed-management-for-land-Asia.pdf)

## **HOR 212 Production Technology for Ornamental Crops, MAPs and Landscaping (1+1)**

### **Theory**

#### **Unit I: Landscaping**

Importance and scope of ornamental crops landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers.

#### **Unit II: Production technology of cut flower crops under protected conditions**

Production technology of important cut flowers like rose, gerbera, carnation, lily and orchids under protected conditions

#### **Unit III: Production technology of flowers under open conditions and value addition in ornamental crops**

Production technology of important cut flowers like gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Processing and value addition in ornamental crops.

#### **Unit IV: Production technology of medicinal crops**

Medicinal crops- importance and scope – current status - soil and climate – varieties – propagation– planting methods – nutrient, irrigation and organic practices – harvest – post-harvest handling – storage, packaging of Periwinkle, Asparagus, Aloe, Costus, Isabgol, Glory lily, extraction and value addition of medicinal crops.

#### **Unit V: Production technology of aromatic crops**

Aromatic crops - importance and scope – current status -- soil and climate – varieties – propagation– planting methods – nutrient, irrigation and organic practices – harvest – post-harvest handling – storage, packaging of Ocimum, Mint, Geranium, Citronella, Lemon grass, Palmarosa and Vetiver – Distillation of oil and value addition.

### **Practical**

Identification of Ornamental plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Protected structures – care and maintenance. Intercultural operations in flowers. Harvesting and post harvest handling of cut and loose flowers. Visit to commercial flower unit.

### **Medicinal and Aromatic Plants**

Identification of Medicinal and Aromatic Plants- varieties-propagation-special practices - nutrient management, extraction and distillation of essential oil - Periwinkle, Asparagus, Aloe, Costus, Isabgol, Glory lily, Ocimum, Mint, Geranium, Citronella, Lemon grass, Palmarosa and Vetiver – visit to commercial medicinal and aromatic plants fields and processing units

### **Theory lecture schedule**

31. Importance and scope of ornamental crops and landscaping.
32. Principles of landscaping
33. Landscape uses of trees, shrubs and climbers.
34. Production technology of cut rose under protected conditions
- 2 Production technology of gerbera and carnation under protected conditions
- 3 Production technology of lily and orchids under protected conditions
- 4 Production technology of gladiolus and tuberose under open conditions
- 5 Production technology of chrysanthemum and marigold under open conditions
- 6 **Mid Semester Examination.**
- 7 Production technology of jasmine under open conditions.
- 8 Processing and value addition in ornamental crops.
- 9 Scope and Importance of medicinal & aromatic crops– current status - conservation methods

- 10 Periwinkle, Asparagus and Aloe - varieties — soil and climate – propagation- sowing and planting, nutrient, water management – harvest and processing
- 11 Costus, Isabgol and Glory lily - Propagation- soil and climate – propagation and planting- standards - pollination-nutrient, irrigation management – harvest, yield and processing
- 12 Ocimum, Mint, Geranium - varieties – soil and climate- propagation - planting - nutrient, water management – harvest - distillation of essential oil
- 13 Citronella, Lemon grass, Palmarosa and Vetiver - varieties – soil and climate- propagation - planting – nutrient- water and weed management – harvest- distillation of essential oil.
- 14 Processing and value addition in medicinal and aromatic plants.

### **Practical schedule**

18. Identification, planting, care and maintenance of trees, shrubs and climbers used in garden
19. Identification of varieties in cut flowers under protected conditions.
20. Identification of varieties in flowers under open conditions.
21. Practices of nursery bed preparation, seed sowing in ornamental plants.
22. Training and pruning and intercultural operations in Ornamental plants
23. Planning and layout of garden.
24. Protected structures – care and maintenance.
25. Harvesting and post harvest handling of cut and loose flowers.
26. Identification of medicinal and aromatic plants –economic parts
27. Propagation techniques, planting, cultural operations in Periwinkle, Asparagus and Aloe.
28. Propagation techniques, planting, cultural operations in Costus, Isabgol and poppy.
29. Propagation techniques, planting, cultural operations in Ocimum, Mint, Geranium
30. Propagation techniques, planting, cultural operations in lemon grass, palmarosa, vetiver and citronella
31. Extraction and distillation of medicinal & Aromatic crops.
32. Visit to commercial floriculture and floral oil extraction units
33. Visit to commercial medicinal and aromatic crops field and extraction unit.

### **References**

- 15 Bhattacharjee, S.K and De L.C (2003) Advanced Commercial Floriculture Vol. (1) Aavishkar publishers, Distributors, Jaipur.
- 16 Bhattacharjee, S.K and De L.C (2005) Medicinal Herbs & Flowers, Aarishkar, Jaipur.
- 17 Bhattacharjee, S.K., 2004. Hand book of medicinal plants, Pointer publications, Jaipur.
- 18 Bose, T.K., Yadav, L.P., Pal. P., Parthasarathy, V.A., Das. P., 2003. Commercial flowers. Vol. I and II. Naya udyog, Kolkata-6.
- 19 Ravindrasharma (2004) Agro techniques of Medicinal plants. Daya publishing, New Delhi.
3. Trivedi, P.C. (2004) Medicinal Plants: Utilization and Conservation, Aavishkar Publisher, Distributors, Jaipur.
4. Allan M. Armitage and Judy M. Laushman “Speciality Cut Flowers” , Second Edition, Published by Timber press 2003, ISBN - 0881925799
5. Atal. C. K. and B. M. Kapur. 1992. Cultivation and utilisation of medicinal plants RRL. CSIR, Jammu – Tawi.
6. Bose, T.K., Yadav, L.P., Pal. P., Das. P. and Parthasarathy, V.A., (2002) Commercial Flowers. Vol.1, Naya Prakash, Calcutta.
7. Chadha, K.L.1994. Advances in Horticulture, Vol.10. Malhotra Publishing house, New Delhi.
8. Chadha, K.L.1994. Advances in Horticulture, Vol.11. Malhotra Publishing house, New Delhi.
9. Farooqi, M., M. M. Khan and M. Vasundhara. 2004. Production technology of medicinal and aromatic crops. Natural Remedies Pvt. Ltd., Bangalore – 561229.
10. Surendraprasad and Updesh Kumar (1998), Commercial floriculture, Agrobotanica, Bikaner.
11. Kumar, N. Introduction to Horticulture. 2010. Oxford and IBH Publications, New Delhi.
12. Kumar, N. Introduction to Spices, Plantation, Medicinal and Aromatic crops. 1995. Oxford and IBH Publications, New Delhi.

## **E- References**

1. <http://www.theflowerexport.com>
2. [http:// www.intuxford.tripod.com](http://www.intuxford.tripod.com)
3. <http://www.webct.uark.edu>
4. <http://www.pubmed.com>
5. <http://www.bestgarden.net/>
6. <http://www.indiaagronet.com/>
7. <http://www.intuxford.tripod.com/>
8. <http://www.lawngrasses.com/>
9. <http://www.frlht.org>
10. [www.herbs.org](http://www.herbs.org)

**ANM 201 INTRODUCTORY NEMATOLOGY (0+1)  
SYLLABUS**

**PRACTICAL**

Usage and handling of microscopes (binocular, trinocular, zoom and compound microscopes) -Soil and root sampling – Extraction of active nematodes and cysts from soil and roots (Cobb's sieving and decanting technique, Baermann funnel technique, conical flask technique, Sugar floatation technique, Fenwick can method, Incubation and Blender technique) – Nematode processing techniques (preservation, slow and rapid method of processing, making semi permanent and permanent slides) – Morphology of orders *Tylenchida* (*Hoplolaimus*), and *Dorylaimida* (*Xiphinema*) – Identification of important nematodes (*Tylenchorhynchus*, *Helicotylenchus*, *Pratylenchus*, *Hirschmanniella*, *Hemicriciconemoides* / *Criconema* *Heterodera* / *Globodera*, *Tylenchulus*, and *Aphelenchoides*) – Life stages of sedentary and migratory endoparasites – symptoms of important nematode diseases – Nematicides and their application – Biocontrol agents-bacteria and fungi.

**PRACTICAL**

1. Soil and root sampling. Extraction of nematodes by Cobb's sieving method; Baermann funnel Technique and modified Baermann funnel technique.
2. Extraction of nematodes by sugar flotation technique; Extraction of cysts by conical flask technique and fenwick can method.
3. Extraction of nematodes from roots and staining of roots infested with endoparasitic and semi – endoparasitic nematodes.
4. Preservation of nematodes and preparation of temporary and permanent slides.
5. Observing morphology of the order Tylenchida (*Hoplolaimus*) and Dorylaimida (*Xiphinema*, *Longidorus*).
6. Identification of nematodes – *Tylenchorhynchus*, *Helicotylenchus*.
7. Identification of nematodes – *Pratylenchus*, *Hirschmanniella*.
8. Identification of nematodes – *Hemicriciconemoides* – *Criconema*, *Heterodera* – *Globodera*.
9. Identification of nematodes – *Tylenchulus*, *Aphelenchoides*.
10. Study of life stages of *Meloidogyne*, *Rotylenchulus*.
11. Study of life stages of *Radopholus*.
12. Study of Entomopathogenic nematodes
13. Study of life stages of Nematodes diseases of rice (White tip and rice root nematode)
14. Damage caused by root – knot and reniform nematodes indifferent crops.
15. Symptoms of damage caused by citrus nematode; the lesion nematode and the burrowing nematode of banana.
16. Study of types of nematicides, application methods and calculation of dosages; study of biocontrol agents.
17. Practical examination.

## **NST 201 Fundamentals and Applications of Nanotechnology (1+0)**

### **Theory**

**Unit I - Principles of Nanoscience (4 Lecture)** : History, definition, terminologies in nanoscience - Importance of Moore's law- Introduction to nanomaterials – Semiconductor – Diode – Quantum Dots- Buckyball - CNT - Polymers- types – PLGA – coreshell nanoparticles - micelle - Introduction to nanobiosensor- types- properties and applications

**Unit II - Synthesis of Nanomaterials (3 Lectures)**: Top-down and bottom-up approaches - Physical, Mechanical, Chemical and Biological synthesis of nanomaterials

**Unit III - Properties and Characterization of Nanomaterials (4 Lectures)**: Physical, Mechanical, optical, magnetic, thermal and electrical properties – Characterization – SEM, TEM, AFM, FT-IR, XRD

**Unit IV - Application of Nanotechnology (2 Lectures)** : Agriculture and Food Systems

**Unit V - Application of Nanotechnology (3 Lectures)**: Energy, Environment, Health – Social, Economic and Ethical issues – Nanotoxicology

### **Lecture schedule**

#### **Unit 1 Principles of Nanoscience (4 lectures)**

1. History, definition, terminology in nanoscience and importance of Moore's law.
2. Nanomaterials – Semiconductor – Diode – Quantum Dots - Buckyball - CNT – - characteristics – Applications
3. Polymers - Types – PLGA – Coreshell nanoparticles - Micelles - characteristics – Applications
4. Biosensors – Principle, Components, Types, Applications

#### **Unit 2 Synthesis of Nanomaterials (3 lectures)**

5. Top down and Bottom up approaches - Physical method, Physical Vapour Deposition (PVD), Etching - Molecular Beam Epitaxy – Sputtering – Lithography - Mechanical synthesis - Ball milling – Types - Mechanical alloying
6. Chemical synthesis – Sol-gel Method – Chemical Vapour Deposition (CVD) – electro-deposition- thin film
7. Biological synthesis using Microorganisms and Plants

#### **Unit 3 Properties and Characterization of Nanomaterials (4 lectures)**

8. Mechanical, magnetic and thermal properties of nanomaterials
9. Optical and electrical properties of nanomaterials
10. *Principle, components and application of nanotechnology equipments*: Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM)
11. *Principle, components and application of nanotechnology equipments*: X-ray Diffraction (XRD) – Fourier Transform Infra Red Spectroscopy (FT-IR) – Atomic Force Microscope (AFM)

#### **Unit 4 Applications of Nanotechnology in Agriculture & Food Systems (2 Lectures)**

12. Agriculture – Nano fertilizers – Nano-herbicides – Nano-pesticides – Seed technology
13. Nanotechnology in Food Systems – Nano foods, Nano-encapsulation of functional foods, Nano-packaging, Quality assessment.

#### **Unit 5 Applications of Nanotechnology in Energy, Environment, Health (3 Lectures)**

14. Nanotechnology applications in Energy and Environment

15. Applications in Health Sciences and Nanotoxicology
16. Social, Economic and Ethical Issues in Nanotechnology

**References:**

3. Nano: The essentials understanding nanoscience and Nano- T.Pradeep - 2009 - Mc Graw Hill.
4. Nano materials - B.Viswanathan - 2009 -Narosa.
5. Introduction to nanotechnology - Charles P. Poole; Frank J. Owens – 2008 – Wiley.
6. Fundamentals of biomems and medical microdevices - Steven S.Saliterman – 2006 - Wiley Interscience.
7. Instrumental methods of analysis - Hobart H. Willam; Lynne L. Merrit – 2006 -CBS.
8. Fundamentals of physics - David Halliday; Robert Resnick – 2007 – Willey.
9. Chemistry Raymond Chang – 2009 - Tata Mcgraw Hill.
10. Nanomaterial chemistry - C.N. Rao, A. K . Chettam, A. Muller – 2007 – Wiley – VCH.
11. Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.



**THEORY****Unit I- Introduction to Renewable energy Sources**

Energy crisis – classification of energy sources – renewable energy – significance – potential - achievements in India. Biomass – methods of energy conversion.

**Unit-II Biochemical Energy Conversion**

Biofuels – importance – biodiesel and bioethanol production method – flowchart – by products utilization. Biogas technology – classification - types - factors affecting biogas plants- alternate feedstocks – applications - biodigested slurry and enrichment.

**Unit III – Thermochemical Energy Conversion**

Briquetting –methods- advantages and disadvantages -combustion –definition- Improved chulhas – types – construction features - applications. Pyrolysis – methods for charcoal /biochar production- comparison of slow and fast pyrolysis. Gasification – chemistry – types – updraft gasifier -downdraft gasifier – working principles – operation and applications.

**Unit IV – Solar Energy Conversion**

Solar Energy – characteristics - types of radiation – solar constant-solar thermal devices – solar water heater – solar cooker – solar pond – solar distillation – working principles and applications. Solar PV systems – principle – solar lantern - water pumping. Solar driers – natural and forced convection types – solar tunnel drier – working principles and operation.

**Unit V- Wind and other Renewable Energy Sources**

Wind – formations - Wind mills – types – horizontal and vertical axis – components – working principles – applications. Geothermal energy – wave energy – tidal energy – ocean energy – principle and operation - types – advantages and disadvantages

**PRACTICAL**

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 photovoltaic system: solar light, solar pumping, solar fencing. To study solar cooker, To study solar drying system. To study solar distillation and solar pond.

**Lecture Schedule**

1. Energy crisis – renewable energy sources – significance – potential and achievements in India – energy requirements of agricultural and horticultural crops. **TB-1:** 1-10
2. Biomass – methods of energy conversion – biochemical conversion methods – thermochemical conversion methods. **TB-1:** 12-26
3. Biofuels – importance – biodiesel and bioethanol production method – flowchart – by products utilization **TB-1:** 164-177; 182-183
4. Biogas technology – classification - types of biogas plants – KVIC and Deenabandhu model biogas plants – factors affecting biogas plants. **TB-1:** 30-43
5. Alternate feedstocks for biogas production – applications of biogas cooking, lighting and engine operations - biodigested slurry and enrichment. **TB-1:** 45-49
6. Briquetting – MED – VED – methods – need for briquetting - benefits of biomass briquettes. **TB-1:** 92-99
7. Combustion – improved chulha – single pot – double pot – conventional chulha – biomass gas stove – constructional features – principles and applications. **TB-1:** 52-57; 64-67
8. Pyrolysis – methods for charcoal production –biochar production– comparison between slow and fast pyrolysis. **TB-1:** 67-73
9. Mid semester examination
10. Gasification – chemistry – types – updraft gasifier – working principles operations – application **TB-2:** 395-411
11. Downdraft gasifier – working principles – operation and applications.

- |     |  |   |
|-----|--|---|
| 12. | Solar energy – characteristics of solar radiation - types of radiation – solar constant  | <b>TB-1:</b> 101-105                                  |
| 13. | Solar thermal devices – solar water heater – solar cooker – solar pond – solar distillation – working principles and applications. | <b>TB-1:</b> 105-114<br><b>TB-2:</b> 138-142, 195-197 |
| 14. | Solar PV systems – principle – solar lantern - water pumping applications.   | <b>TB-1:</b> 117-123                                  |
| 15. | Solar driers – natural and forced convection types – solar tunnel drier – working principles and operation.                        | <b>TB-1:</b> 115-117                                  |
| 16. | Wind mills – types – horizontal and vertical axis – components – working principles – applications.                                | <b>TB-1:</b> 136 - 144                                |
| 17. | Energy from ocean, waves, tides. Geothermal energy sources – principles and operation.   | <b>TB-1:</b> 189-205                                  |

### Practical schedule

1. Basic principles of working of renewable energy gadgets
2. Experiments on biodiesel production
3. Experiments on bioethanol production process
4. Construction and working principle of KVIC biogas plant
5. Construction and working principle of deenbandhu biogas plant
6. Experiments on biogas applications
7. Experiments on briquetting technology
8. Performance evaluation of improved chulha
9. Evaluation of biochar production systems
10. Experiments on biooil production method
11. Performance evaluation of producer gas production system
12. Performance evaluation of solar dryers
13. Experiments on solar cookers and distillation systems
14. Performance evaluation of solar water heaters
15. Experiments on solar water pumping system
16. Performance assessment of solar street light and fencing
17. Final practical examination

### References:

- S. Pugalendhi, R. Shalini, J. Gitanjali and P. Subramanian. 2017. Introduction to Renewable Sources of Energy. TNAU, Coimbatore
- G.D. Rai. 2012. Nonconventional Energy Sources. Khanna Publishers, New Delhi.
- C.S. Solanki, 2009. Renewable Energy Technologies : A Practical Guide for Beginners. PHI Learning Pvt. Ltd., New Delhi.
- S. Rao and B.B. Parulekar. 2007. Energy Technology: Non-Conventional, Renewable and Conventional. Khanna Publishers, Naisarak, Delhi.
- G.D. Rai. 1993. Solar Energy Utilisation. Khanna Publishers, New Delhi.
- J. F. Manwell, J. G. McGowan and A. L. Rogers. 2009. Wind Energy Explained: Theory, Design and Application. Wiley & Sons Ltd.,

### V SEMESTER

S. No.	Course code	Course Title	Credit load
1	PBG 301	Fundamentals of Plant Breeding	2+1
2	AEC 301	Agricultural Marketing Trade & Prices	2+1
3	AGM 301	Agricultural Microbiology	1+1
4	PAT 301	Diseases of Field and Horticultural crops and their management - I	1+1
5	ARM 301	Entrepreneurship Development and Business Management	1+1
6	AGR 301	Practical Crop Production - I ( <i>Kharif</i> crops)	0+2
7	HOR 311	Post harvest management and value addition of fruits and vegetable crops	1+1
8	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1
9	APE 311	Protected Cultivation and Secondary Agriculture	1+1
10	AGR 302	Rainfed Agriculture & Watershed Management	1+1
11	AEN 301	Pests of Field crops and stored produces and their management	1+1
11	NCC 101	NCC*	
		<b>Total</b>	<b>13+12=25</b>
		<b>*Non-gradual courses compulsory courses</b>	

## **PBG 301 Fundamentals of Plant Breeding (2+1)**

### **THEORY**

#### **Unit I: Reproductive systems in plant breeding**

Objectives and role of plant breeding - historical perspective – activities in Plant Breeding. Centres of origin – contribution of Vavilov, Harlan, Zhukovsky – law of homologous series. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine. Modes of reproduction – sexual – asexual – mechanisms promoting self and cross pollination – significance of pollination. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance and applications. EGMS - TGMS, PGMS, Gametocides, Transgenic Male sterility and applications. Apomixis – introduction – classification - applications; Parthenocarpy and its types.

#### **Unit II: Breeding methods of self pollinated crops**

Polygenic variation-components of variance - phenotypic, genotypic and environmental variance-heritability and genetic advance. Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits. Genetic basis of self pollinated crops – Vilmorin's principle of progeny selection - Johannsen's pure line theory. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection– procedure - types – merits and demerits-achievements- comparison of mass and pureline selection. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection – objectives – steps in hybridization - choice of parents – kinds of emasculation – hybridization-transgressive breeding. Handling segregating generations- Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits. Backcross breeding – genetic basis — procedures for transferring dominant and recessive genes. Back cross breeding – merits – demerits – multilines- types- procedure-merits and demerits.

#### **Unit III: Breeding methods of cross pollinated crops and clonally propagated crops**

Genetic structure of a population in crosses pollinated crops – Hardy Weinberg law – gene frequencies in random mating population. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – Grid selection – progeny selection. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression. Heterosis breeding – procedure – development of inbreds- evaluation of inbred lines – top cross method and single cross method-prediction of double cross performance- hybrids – single cross- double cross- three way cross hybrids. achievements – merits and demerits. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits. Genetic characters of asexual reproduction – clonal selection – hybridization and clonal selection – merits and demerits – achievements.

#### **Unit IV: Special breeding methods**

Polyploidy breeding – classification – induction of polyploidy - achievements – limitations. Wide hybridization-importance-barriers and techniques for overcoming barriers-utilization- Pre-breeding. Mutation breeding: mutation – types – mutagens – breeding procedure – achievements – limitations. Concepts in biotic stress resistance breeding- diseases and pests - gene for gene hypothesis-mechanisms of resistance - sources of resistance- multilines-gene pyramiding-gene deployment-Breeding methods. Concepts in abiotic stress resistance breeding- drought- mechanisms of drought resistance – basis of drought resistance- morphological and physiological characters- sources of drought resistance- Breeding methods.

#### **Unit V: Varietal Release, Seed Production, Markers and IPR**

Procedure for release of new varieties-stages in seed multiplication-steps in nucleus and breeder seed production. Introduction to markers – morphological – biochemical- DNA markers – advantages and disadvantages- marker assisted selection in plant breeding. Participatory plant breeding- Intellectual Property Rights- Patenting- Plant Breeders and Farmers Rights.

#### **PRACTICAL**

Reproduction in plants - Alternation of generation and life cycle. Mode of pollination - Mechanisms enforcing self and cross pollination in crops- Working out extent of natural out crossing. Breeder's kit and its components. Basic techniques for selfing and crossing in crop plants. Emasculation and pollination techniques in field crops. Emasculation and pollination techniques in horticultural crops. Handling of segregating populations- Layout of different yield trials-maintenance of records. Study of Cytoplasmic genic male sterility system in Rice/horticultural crops. Study of Genic male sterility system in Redgram. Mutagenesis study using physical and chemical mutagens. Germplasm collection and conservation. Experimental designs used in plant breeding-RBD analysis. Calculation of mean, range, PCV, GCV, heritability, genetic advance. Estimation of heterosis and prediction performance of double cross hybrids. Screening techniques for biotic stresses in rice. Screening techniques for abiotic stresses in rice

#### **Theory schedule**

52. Objectives and role of plant breeding - historical perspective – activities in Plant Breeding.
  53. Centres of origin – contribution of Vavilov, Harlan, Zhukovsky – law of homologous series.
  54. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation.
  55. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine.
  56. Modes of reproduction – sexual – asexual – mechanisms promoting self and cross pollination – significance of pollination.
  57. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations.
  58. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance and applications.
  59. EGMS - TGMS, PGMS, Gametocides, Transgenic Male sterility and applications.
  60. Apomixis – introduction – classification-applications; Parthenocarpy and its types.
- 
20. Polygenic variation-components of variance - phenotypic, genotypic and environmental variance- heritability and genetic advance
  21. Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits.
  22. Genetic basis of self pollinated crops – Vilmorin's principle of progeny selection - Johannsen's pure line theory.
  23. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection– procedure - types – merits and demerits-achievements- comparison of mass and pureline selection.

24. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection – objectives – steps in hybridization - choice of parents  
– kinds of emasculation – hybridization- transgressive breeding.
25. Handling segregating generations- Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements.
26. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits.
27. **Mid Semester examination**
28. Backcross breeding – genetic basis — procedures for transferring dominant and recessive genes
29. Back cross breeding – merits – demerits – multilines- types- procedure- merits and demerits.
30. Genetic structure of a population in cross pollinated crops – Hardy Weinberg law – gene frequencies in random mating population.
31. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – Grid selection – progeny selection
32. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits.
33. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression.
34. Heterosis breeding – procedure – development of inbreds- evaluation of inbred lines – top cross method and single cross method- prediction of double cross performance- hybrids – single cross-double cross- three way cross hybrids. achievements – merits and demerits.
35. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits
36. Genetic characters of asexual reproduction – clonal selection – hybridization and clonal selection – merits and demerits – achievements;
37. Polyploidy breeding – classification – induction of polyploidy - achievements – limitations.
38. Wide hybridization-importance-barriers and techniques for overcoming barriers-utilization- Pre-breeding.
39. Mutation breeding: mutation – types – mutagens – breeding procedure – achievements – limitations.
40. Concepts in biotic stress resistance breeding- diseases and pests - gene for gene hypothesis- mechanisms of resistance - sources of resistance- multilines-gene pyramiding-gene deployment- Breeding methods.
41. Concepts in abiotic stress resistance breeding- drought- mechanisms of drought resistance – basis of drought resistance- morphological and physiological characters- sources of drought resistance- Breeding methods.
4. Procedure for release of new varieties-stages in seed multiplication-steps in nucleus and breeder seed production.
5. Introduction to markers – morphological – biochemical- DNA markers – advantages and disadvantages- marker assisted selection in plant breeding.
6. Participatory plant breeding- Intellectual Property Rights- Patenting- Plant Breeders and Farmers Rights.

### **Practical schedule**

44. Reproduction in plants - Alternation of generation and life cycle.
45. Mode of pollination - Mechanisms enforcing self and cross pollination in crops- Working out extent of natural out crossing.
46. Breeder's kit and its components
47. Basic techniques for selfing and crossing in crop plants.
48. Emasculation and pollination techniques in field crops.
49. Emasculation and pollination techniques in horticultural crops.
50. Handling of segregating populations- Layout of different yield trials-maintenance of records.
51. Study of Cytoplasmic genic male sterility system in Rice

52. Study of Genic male sterility system in Redgram
53. Mutagenesis study using physical and chemical mutagens
54. Germplasm collection and conservation.
55. Experimental designs used in plant breeding-RBD analysis
56. Calculation of mean, range, PCV, GCV, heritability, genetic advance
57. Estimation of heterosis and prediction performance of double cross hybrids
58. Screening techniques for biotic stresses in rice
59. Screening techniques for abiotic stresses in rice
- 60. Final Practical examination**

## References

1. Singh, B. D. 2005. Plant breeding - Principles and Methods. Kalyani Publishers, New Delhi.
2. Phundhan Singh. 2001. Essentials of Plant Breeding, Kalyani publishers, New Delhi.
3. Allard, R. 1989. Principles of Plant Breeding. John Wiley and Sons, New Delhi.
4. D. N. Bharadwaj. 2012. Breeding Field Crops. Agrobios (India), Jodhpur
5. Chahal, G. S. and S. S. Gosal. 2002. Principles and Procedures of Plant
6. Breeding: Biotechnological and Conventional Approaches. Narosa Publishing House (India)
7. Daniel Sundararaj, G. Thulasidas and M. Stephen Dorairaj. 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot. Chennai – 15.
8. Chopra, V. L. , 1994. Plant breeding theory and practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi
9. Sharma, J. R. 1994. Principles and practice of plant breeding. Tata McGraw-Hill publishing Co., New Delhi.
10. Chaudhary, H. K. 1980. Elementary Principles of plant breeding. Oxford and IBH publication Co. , New Delhi
11. R. K. Singh and B. D. Choudhary. Biometrical methods in quantitative Genetics. Kalyani Publishers, Ludhiana

## E- References

- a. <http://www.edugreen.teri.res.in/explore/bio/breed.htm>
- b. <http://cuke.hort.ncsu.edu/gpb/>
- c. <http://www.stumbleupon.com/tag/plant-breeding>
- d. <http://www.iaea.org/>

## **AEC 301 Agricultural Marketing, Trade and Prices (2+1)**

### **Theory**

#### **Unit 1: Agricultural Marketing – Nature and Scope**

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; 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. Approaches to the study of marketing - Market functionaries and Market forces. Marketing of agricultural versus manufactured goods.

#### **Unit 2: Marketing Functions, Pricing and Promotion strategies**

Marketing process and functions: Marketing process - concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK); Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking - Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance – Market structure and Price determination under perfect and imperfect competition.

Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.

#### **Unit 3: Marketing Efficiency and Marketing Institutions**

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 over space, time and form: 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; Modern marketing systems versus traditional agricultural marketing systems; Role of Government in agricultural marketing - Public sector institutions - CWC, SWC, FCI and DMI – their objectives and functions; cooperative marketing in India; Market Intelligence -Legal measures for improving agricultural marketing: APMC Act. New EXIM policy of India – Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.

#### **Unit 4: Trade in Agricultural Products**

International Trade: Concept of International Trade and its need - Free trade, Autarky and its needs - Theories of Trade: Absolute and comparative advantage; Present status and prospects of Agricultural exports / imports from India and their share - Barriers to Trade: Tariff and non tariff barriers - Trade policy instruments – Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements – AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies - IPR.

#### **Unit 5: Agricultural Prices and Risk Analysis**

Agricultural Prices and Policy: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP – Price Parity - Procurement of food grains and buffer stock - Risk in marketing: Meaning and Importance - Types of risk in marketing: Speculation and Hedging and Forward and Futures trading; an overview of futures trading; – Role of Contract Farming in risk mitigation.



## Theory Schedule

23. Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing.
  24. Market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets.
  25. Demand and supply of agri-commodities: meaning, nature and determinants of demand and supply of farm products.
  26. Approaches to the study of marketing: Market functionaries and Market forces.
  27. Marketing of agricultural versus manufactured goods. Producer surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri- commodities.
  28. Marketing process and functions: Marketing process - concentration, dispersion and equalization.
  29. Exchange functions – buying and selling; physical functions – storage, transport and processing.
  30. Facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK).
  31. Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking.
  32. Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance.
  33. Market structure and Price determination under perfect and imperfect competition.
  34. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC.
  35. Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing.
16. Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.
  17. 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.
  18. Integration over space, time and form: Meaning, definition and types of market integration.
  19. **Mid-Semester Examination**
  20. 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.
  21. Role of Government in agricultural marketing - Modern marketing systems versus traditional agricultural marketing systems.
  22. Public sector institutions- CWC, SWC, FCI, and DMI – their objectives and functions.
  23. Co-operative marketing in India.
  24. Market Intelligence - Legal measures for improving agricultural marketing: APMC Act. New EXIM policy of India.
  25. Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.
  26. International Trade: Concept of International Trade and its need - Free trade, Autarky and its needs.
  27. Theories of Trade: Absolute and comparative advantage;
  28. Present status and prospects of Agricultural exports / imports from India and their share.

29. Barriers to Trade: Tariff and non tariff barriers - Trade policy instruments.
30. Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements.
31. AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies - IPR.
32. Agricultural Prices: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP.
33. Price Parity - Procurement of food grains and buffer stock.
34. Risk in marketing: Meaning and Importance - Types of risk in marketing.
35. Speculation and Hedging and Forward and Futures trading: an overview of futures trading.
36. Role of Contract Farming in risk mitigation.

### **Practical Schedule**

34. Preparation of farm survey schedule
35. Visit to a farm to collect information on marketing practices of agricultural commodities and marketing problems.
36. Plotting and study of demand and supply curves and calculation of elasticities.
37. Computation of marketable and marketed surplus of important commodities.
38. Visit to a local market / weekly *shandy* / farmers' market to study various marketing functions performed by different agencies.
39. Study of relationship between market arrivals and prices of some selected commodities.
22. Identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins; price spread estimation for major agricultural and allied agricultural products to assess their marketing efficiency; and presentation of report in the class.
23. Visit to market committee and regulated market to study their organization and functioning.
24. Visit to co-operative marketing society to study its organization and functioning.
25. Visit to market institutions – SWC / CWC to study their organization and functioning.
26. Visit to AGMARK Laboratory / Grading institutions.
27. Farm input marketing: Visit to Farm input dealer to study marketing of farm inputs.
28. Visit to Commodity Boards / AEZ / Export oriented units.
29. Time Series Analysis of prices–TCSI Study of price behaviour over time for some selected commodities.
30. Construction of Index Numbers and their uses.
31. Application of principles of comparative advantage of international trade.
32. **Practical Examination.**

### **References**

54. Acharya S. S. and N. L. Agarwal. 2002. Agricultural Marketing in India. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
55. Acharya S. S. and N. L. Agarwal. 1994. Agricultural Prices - Analysis and Policy. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
56. Kahlon A. S. and S. D. Tyagi, 2000. Agricultural Price Policy in India - Allied Publishers Pvt. Ltd. Bombay.
57. SakOnkvisit. John J. Shaw. 1999. International Marketing Analysis and Strategy. Prentice Hall of India. New Delhi.
58. Sivarama Prasad A. 1999. Agricultural Marketing in India. Mittal Publications, New Delhi.
59. Kohls R. L. and N. Uhl. Joseph. 1980. Marketing of Agricultural Products. Collier Macmillan. New York.

## AGM 301 Agricultural Microbiology (1+1)

### Theory

#### Unit I Introduction

Soil microorganisms and their role in soil fertility and crop production. Historical developments in soil microbiology. Diversity of soil microorganisms - culturable (bacteria, actinobacteria, yeasts, molds and algae) and unculturable microorganisms - metagenomic approach; factors influencing soil microbial diversity. Soil enzymes and their role in soil fertility.

#### Unit II Biogeochemical cycling of nutrients

Carbon cycle; organic matter decomposition in oxygenic and anoxygenic environments; humus formation. Nitrogen cycle – ammonification, nitrification, denitrification and biological nitrogen fixation (BNF) – bacterial and algal nitrogen fixers (diazotrophs) ; free living, associative, symbiotic, endophytic and epiphytic diazotrophs; nodulation in leguminous and non-leguminous plants; biochemistry and molecular biology of BNF. Phosphorus cycle – mineralization, phosphate mobilization and solubilization. Microbial transformation of sulphur, potassium, zinc and silica in soil.

#### Unit III Microbial degradation and bioremediation

Role of microbes in reclamation of problematic soils. Microbes in solid waste management. Biodegradation of agricultural residues and chemicals – processes involved in remediation.

#### Unit IV Microbiomes and plant growth

Rhizosphere, spermosphere, phyllosphere, epiphytic and endophytic microbiomes and their significance. Plant growth promoting rhizobacteria. Soil microorganisms and their interactions – positive and negative interactions.

#### Unit V Microbes in human welfare

An overview of industrially important microorganisms and products. Silage production. Bioinoculants (biofertilizers and biopesticides); types of biofertilisers – nitrogen fixers, phosphate, zinc and silicate solubilizers, potassium releasers, phosphate mobilizers, sulphur oxidizers and Pink Pigmented Facultative Methylophilic (PPFM). Biopesticides- types and mechanism of action. Mass production and quality control of bacterial and fungal bioinoculants. Methods of application of bioinoculants. Biofuel production

### Practical

Enumeration of soil microbial population - quantitative and qualitative methods. Organic matter decomposition - CO<sub>2</sub> evolution and BOD. Isolation of symbiotic nitrogen fixing bacteria, free living, associative and endophytic nitrogen fixing bacteria. Isolation of phosphobacteria and sulfur oxidizing bacteria. Isolation of zinc and silicate solubilizing/ potassium releasing bacteria. Isolation of plant growth promoting rhizobacteria (*Pseudomonas* sp) and phyllosphere (PPFM) microbes. Examination of AM fungal infection in plants and recovery of AM spores from soil. Examination of Blue Green Algae (BGA) from soil and azolla. Mass production of bacterial bioinoculants, blue green algae, azolla and AM fungi. Visit to biopesticides, silage production and compost yard.

### Theory schedule

8. Introduction and historical developments in soil microbiology. Contributions of Beijerinck, Hellriegel, Wilfarth, Frank, Winogradsky, Fleming, Waksman, Doberiner and Mosse
9. Soil microorganisms and their role in soil fertility and crop production
10. Assessment of microbial diversity. Factors influencing the activities of soil microorganisms. Role of soil enzymes in nutrient transformation
11. Carbon cycle. Role of soil microorganisms in the decomposition of organic matter in oxygenic and anoxygenic environments; humus formation.
12. Nitrogen cycle – microbiology and biochemistry of mineralization, ammonification, nitrification and denitrification

6. Biological nitrogen fixation – free living, associative, endophytic, epiphytic and symbiotic diazotrophic microorganisms. Nodulation in *Rhizobium*- legume and *Frankia* – actinorhizal symbioses
59. Biochemistry and molecular biology of nitrogen fixation in different types of diazotrophs
60. Phosphorus cycle and microbial transformation of phosphorus – mineralization, phosphate solubilization and translocation
61. **Mid Semester Examination**
62. Sulphur cycle - sulphur oxidizers; microbial transformation of K, Zn and Si.
63. Role of microbes in reclamation of problem soils. Microbes in solid waste management
64. Biodegradation of agricultural residues and chemicals- processes involved in remediation
65. Importance of soil and plant microbiomes– rhizosphere, spermosphere, phyllosphere, epiphytic and endophytes. Plant growth promoting microbes-types and mechanism of action.
66. Soil microorganisms and their interactions – positive and negative interactions. An overview of industrially important microorganisms and products.
67. Silage production. Bioinoculants – types; biofertilisers - bacterial, fungal (AMF) and algalbiofertilisers. Biopesticides – types and mechanism of action
68. Mass production and quality control of bacterial and fungal bioinoculants. BIS standards– methods of application of bioinoculants.
69. Biofuel production – methane, hydrogen, alcohol and biodiesel production

#### **Practical schedule**

- Enumeration of soil microorganisms - quantitative Conn's direct microscopic method – qualitative buried slide technique
25. Enumeration of rhizosphere and bulk soil microorganisms and determination of R:S ratio
  26. Studying organic matter decomposition by measurement of CO<sub>2</sub> evolution
  27. Isolation of *Rhizobium* from root nodules and *Azotobacter* from soil
  28. Isolation of *Azospirillum* by MPN technique
  29. Isolation of *Gluconoacetobacter* from sugarcane phyllosphere/rhizosphere and PPFM from phyllosphere
  30. Isolation of phosphobacteria, potassium releasing and zinc solubilizing bacteria from soil
  31. Isolation of PGPR (*Pseudomonas* sp) and sulphur oxidizing bacteria from soil
  32. Examination of AM infection in roots and recovery of spores from soil
  33. Mass production of bacterial bioinoculants and AM fungi
  34. Examination of blue green algae from soil and azolla
  35. Mass multiplication of blue green algae and azolla
  40. Methods of application of different bioinoculants
  41. Antibiosis in soil – Crowded plate technique
  42. Visit to biopesticides production unit
  43. Visit to silage production and compost yard
  44. **Practical Examination**

#### **Text Books**

32. Alexander, M. 1977. Soil Microbiology. John Wiley and Sons. New York
33. Paul, E. A. 2014. Soil Microbiology, Ecology and Biochemistry. 4<sup>th</sup> Ed. , Academic Press, USA
34. e book: Waksman, S. A 1952. Soil Microbiology John Wiley & Sons, Inc.
35. e book: Paul, E. A. 2007. Soil Microbiology, Ecology and Biochemistry. 3<sup>rd</sup> Ed. , Academic Press, USA.

#### **Reference :**

33. Rangaswamy, G. and Bagyaraj, D. J. 1992. Agricultural Microbiology, Asia Publishing House, New Delhi.
34. Subba Rao, N. S. 1999. Soil Microorganisms and plant Growth. Oxford and IBH, New Delhi
35. Osborn, M. , Smith, C. J. 2005. Molecular Microbial Ecology. Taylor and Francis.

**E- Reference**

1. fire. biol. ww. edu/hooper/416\_05Ncycle1. ppt
2. www. fao. org/docrep/009/a0100e/a0100e05. html

## **PAT 301 Diseases of Field and Horticultural crops and their management-I (1+1)**

### **Theory**

#### **Unit-I Diseases of cereals and Millets**

**Cereals:** rice and maize; **Millets:** sorghum, bajra, finger millet and small millets

#### **Unit- II Diseases of Pulses and Oilseeds**

**Pulses :** pigeon pea, urd bean, mung bean, soyabean, cowpea; **Oilseeds:** ground nut, castor and Sesame

**Unit- III Diseases of Cash crops:** tobacco, jute and mulberry

#### **Unit- IV Diseases of Fruits and vegetables crops**

**Fruits:** banana, guava, papaya, pomegranate; **Vegetables:** tomato, brinjal, okra , cruciferous vegetables, beans, colacasia and sweet potato

#### **Unit- V Diseases of Plantation crops**

**Plantation:** coconut, arecanut, tea, coffee, rubber and cocoa

### **PRACTICAL**

Study of symptoms and host parasite relationship of rice, maize, sorghum, bajra, finger millet, small millets, pigeon pea, urd bean, mung bean, soyabean, cowpea, ground nut, castor Sesame, tobacco, jute , mulberry, banana, guava, papaya, pomegranate, tomato, brinjal, okra , cruciferous vegetables, beans, colacasia , sweet potato, coconut, arecanut, tea, coffee, rubber and cocoa

### **THEORY**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of

41. Diseases of rice
42. Diseases of maize and sorghum
43. Diseases of pearl millet, finger millet and small millets,
44. Diseases of pigeonpea, urdbean, mungbean, soybean and cowpea
45. Diseases of groundnut , sesame and castor
46. Diseases of tobacco, jute and mulberry
47. Diseases of banana
48. Diseases of guava , papaya and pomegranate
- 49. Mid semester examination**
50. Diseases of tomato
51. Diseases of brinjal and okra
52. Diseases of crucifers
53. Diseases of sweet potato and beans
54. Diseases of coconut and arecanut
55. Diseases of tea
56. Diseases of coffee
57. Diseases of rubber and cocoa

### **PRACTICAL**

**Study of symptoms and host-parasite relationship of:**

48. Diseases of rice
49. Diseases of maize and sorghum
50. Diseases of pearl millet, finger millet and small millets,
51. Diseases of pigeonpea, urdbean, mungbean, soybean and cowpea
52. Diseases of groundnut , sesame and castor
53. Diseases of tobacco, jute and mulberry
54. Diseases of banana

55. Diseases of guava, papaya and pomegranate
56. Diseases of crucifers
57. Field visit/ exposure visit to hilly fruits , vegetables and plantation crops
58. Diseases of tomato, brinjal and okra
59. Diseases of sweet potato and beans
60. Diseases of coconut and arecanut
61. Diseases of tea
62. Diseases of coffee
63. Diseases of rubber and cocoa
- 64. Final practical examination**

#### **Reference Books**

21. Arjunan. G. Karthikeyan, G, Dinakaran ,D. Raguchander,T. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
22. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd. , New Delhi
23. Prakasam, V. , Valluvaparidasan, V. , Raguchander, T. and K. Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.
26. Agrios, G. N. 2008. Plant Pathology, Academic Press, New York.
27. Rangaswami, G. 2005. Diseases of Crop plants in India. Prentice Hall of India Pvt. Ltd. , New Delhi. Thakur, B. R. 2006. Diseases of field crops and their management

## **ARM 301 Entrepreneurship Development and Business Communication (1+1)**

### **Theory**

#### **Unit I – Entrepreneur and Entrepreneurial Process**

Concept and Types of Entrepreneurship - Characteristics of Entrepreneurs and Entrepreneurial Skills - Entrepreneurial process – Importance of Entrepreneurship.

#### **Unit II – Entrepreneurship Opportunities**

Innovation - principles of innovation - Sources of innovative opportunities - Business environment – Micro and Macro environment - MSME Classification and Opportunities for rural entrepreneurship - KVIC classification, Startup and Business incubators. Agribusiness – Importance, Opportunities and Challenges.

#### **Unit III – Managerial Functions – Planning and Organizing**

Management Functions – Planning – Types of Plans and Steps in Planning, Organizing – Principles and Departmentation.

#### **Unit IV – Managerial Functions – Staffing, Directing and Control**

Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection, Directing-Principles, Techniques and Supervision, Controlling – Process and Types.

#### **Unit V – Functional Areas of Management**

Operations Management – Meaning and Scope, Supply Chain Management – Drivers and flows and Total Quality Management – Meaning and Principles, Marketing Management – Market Segmentation and Marketing Mix Financial Management – Meaning, Objectives and Scope.

### **Practical**

Assessment of entrepreneurial traits-Identification of new business opportunities-Exercise on SWOC Analysis of Agribusiness Sector in India -Market survey for understanding customer needs-Starting new business - Visit to firms / discussion with entrepreneurs-Documenting Procedure for Establishing Agribusiness Firms-Government programs and institutions for entrepreneurship development-Financing new agribusiness ventures - Visit to banks / discussion-Exercise on Demand Forecasting for Agricultural Inputs/Products-Preparation of Advertisement and Sales Promotion Measures for Agribusiness-Exercise on Inventory Management – ABC Analysis and EOQ Model-Exercise on discounted measures of Capital Budgeting-Calculation of Break Even Point and its Business Implication-Understanding balance sheet and income statement-Financial Performance Analysis - Ratio Analysis.

### **Lecture Schedule**

12. Concept of Entrepreneurship and Types of Entrepreneurship
13. Characteristics of Entrepreneurs and Entrepreneurial Skills
14. Entrepreneurial process – Importance of Entrepreneurship
15. Innovation - principles of innovation - Sources of innovative opportunities
16. Business environment – Micro and Macro environment
17. MSME Classification and Opportunities for rural entrepreneurship - KVIC classification, Startup and Business incubators
18. Agribusiness – Importance, Opportunities and Challenges
19. Management Functions – Planning – Types of Plans and Steps in Planning
- 20. MID SEMESTER EXAMINATION**
21. Organizing – Principles and Departmentation
22. Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection



23. Directing – Principles, Techniques and Supervision
24. Controlling – Process and Types
25. Functional Areas of Management – Operations Management – Meaning and Scope
26. Supply Chain Management – Importance, Drivers and flows and Total Quality Management – Meaning and Principles
27. Marketing Management – Market Segmentation and Marketing Mix
28. Financial Management – Meaning, Objectives and Scope

### **Practicals schedule**

25. Assessment of entrepreneurial traits
26. Identification of new business opportunities
27. Exercise on SWOC Analysis of Agribusiness sector in India
28. Market survey for understanding customer needs
29. Starting new business - Visit to firms / discussion with entrepreneurs
30. Documenting Procedure for Establishing Agribusiness Firms
31. Government programs and institutions for entrepreneurship development
32. Financing new agribusiness ventures - Visit to banks / discussion
33. Exercise on Demand Forecasting for Agricultural Inputs/Products
34. Preparation of Advertisement and Sales Promotion Measures for Agribusiness
35. Exercise on Inventory Management – EOQ Model and ABC Analysis
36. Exercise on discounted measures of capital budgeting
37. Calculation of Break Even Point and its Business Implication
38. Business Plan Preparation
39. Understanding balance sheet and income statement
40. Financial Performance Analysis - Ratio Analysis
41. **PRACTICAL EXAMINATION**

### **References**

46. Chandrasekaran N. and G. Raghuram. Agribusiness Supply Chain Management. 2014. CRC Press, Taylor & Francis Group, Brooklyn.
47. Joseph, L. Massie. 1995. Essentials of Management. Prentice Hall of India Pvt. Ltd. , New Delhi.
48. Mark J Dollinger. 1999. Entrepreneurship Strategies and Resources. Prentice-Hall, Upper Saddle River, New Jersey.
49. Mohanty S K. 2007. Fundamentals of Entrepreneurship. Prentice Hall India Ltd. , New Delhi.
50. Peter F. Drucker, 2006. Innovation and Entrepreneurship. HarperBusiness; Reprint edition, New York.
51. Poornima M. Charantimath 2005. Entrepreneurship Development and Small Business Enterprise, Pearson Education India, New Delhi.
52. Prasanna Chandra, 2007. Financial Management: Theory and Practice, McGraw-Hill Education, New Delhi.
53. Thomas W Zimmer and Norman M Scarborough. 1996. Entrepreneurship. Prentice-Hall, New Jersey.

### **E- References**

29. [www.ediindia.org/](http://www.ediindia.org/)
30. [iie.nic.in/](http://iie.nic.in/)
31. [msme.gov.in/](http://msme.gov.in/)
32. [niesbudtraining.org](http://niesbudtraining.org)
33. [www.nimsme.org/](http://www.nimsme.org/)
34. [www.nsic.co.in/](http://www.nsic.co.in/)
35. <https://www.nabard.org/>

## AGR 301 Practical Crop Production-I ( *Kharif crop*) (0+2)

### Practical Schedule:

29. Rice (*Transplanted rice or Direct sown rice*):

### Transplanted rice:

12. Rice ecosystems - Climate and weather - Seasons and varieties of Tamil Nadu.
13. Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery.
14. Preparation of main field - Application of organic manures - Green manuring - Bio-fertilizers - Pulling out seedlings and transplanting - Rajarajan 1000 (SRI) - Application of herbicides - Water management - Nutrient management - Plant protection measures - Mechanization in rice cultivation - Recording growth, yield attributes and yield.
15. Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

### Practical Schedule:

### Transplanted rice:

- 1&2. Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu.
- 3&4. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery.
- 5&6. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management.
- 7 & 8. Study and Practice of main field preparation and puddling operations.
- 9&10. Practicing of field preparatory operations - sectioning of field bunds and plastering, leveling and basal application of fertilizers.
- 11 &12. Practicing transplanting techniques in lowland rice.
- 13 &14. Estimation of plant population and acquiring skill in gap filling and thinning.
- 15 &16. Study of weeds and weed management in rice.
- 17 &18. Study and practice of green manuring and bio-fertilizer application in rice.
- 19 & 20. Acquiring skill in nutrient management and practicing top dressing techniques.
- 21 & 22. Study of water management practices for lowland rice.
- 23 & 24. Observation of insect pests and diseases and their management.
- 25 & 26. Recording growth and other related characters of rice.
- 27 & 28. Estimation of yield and yield parameters in rice.
- 29 & 30. Harvesting, threshing and
- 31 & 32. Cleaning, drying and calculating the yield of produce
15. Working out cost of cultivation and economics.

### 16. Practical Examination.

### References:

- Ahlawat, I. P. S. , Om Prakash and G. S. Saini. 1998. Scientific Crop Production in India. Rama Publishing House, Meerut.
- Chidida Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd. , New Delhi.
- Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
- Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.
- K Annadurai and B Chandrasekaran. 2009. A Text Book Of Rice Science. Scientific Publishers.

Reddy,S. R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.  
ICAR 2015. Hand book of Agriculture. Indian Council of Agriculture, New Delhi.

**E-References:**

1. [www. irri. org](http://www.irri.org)
2. [www. crrl. nic. in](http://www.crrl.nic.in)
3. [www. drrindia. org](http://www.drrindia.org)

## **HOR 311. Postharvest management and value addition of fruits and vegetables (1+1)**

### **Theory**

#### **Unit I**

Scope and Importance of postharvest technology of fruits and vegetables- factors responsible for postharvest losses – constraints –preharvest factors affecting postharvest quality - postharvest operation – precooling, grading, cleaning, waxing on shelf life of fruits and vegetables.

#### **Unit II**

Physiological and biochemical changes occurring during maturity and ripening- Respiration and factors affecting respiration rate - role of ethylene in regulation of ripening.

#### **Unit III**

Packaging and storage of fruits and vegetables - heat, chilling and freezing injury - storage (ZECC, cold storage, CA, MA and hypobaric) - cold chain management for fruits and vegetables

#### **Unit IV**

Value addition concepts, principles and methods of preservation, intermediate moisture food –Jam, jelly, marmalade, preserve, candy- concepts and standards of fermented and non fermented beverages. Tomato products – Concepts and Standards

#### **Unit V**

Drying and dehydration of fruits and vegetables, concepts and methods, osmotic drying. Canning- concepts-processing of canned products-spoilage and prevention. Packaging of products –quality standards- GMP,HACCP, FSSAI, Codex alimentarius and ISO certification.

### **Practical**

Pre harvest operations to improve postharvest shelf life - assessment of maturity indices and harvest criteria of fruits and vegetables-different types of packaging for shelf life extension- of chilling and freezing injury in vegetables and fruits- estimation of ethylene evolution in fruit crops- Identification of postharvest diseases and disorders- Postharvest machineries -extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products. Quality evaluation of products –physio-chemical and sensory evaluation. Visit to cold storage / packaging unit -visit to processing unit/ industry.

### **Theory schedule**

29. Scope and importance of postharvest technology of fruits and vegetables
30. Factors responsible for post harvest losses.
31. Preharvest factors affecting postharvest life of fruits and vegetables
32. Physiological and biochemical changes during maturity and ripening
33. Respiration and ripening and the factors affecting the ripening of fruits and vegetables
34. Role of ethylene in ripening of fruits and vegetables
07. Preharvest operations to extend shelf life of fruits and vegetable crops
08. Postharvest handling of the produce (washing, fungicide treatment, precooling, grading, sorting waxing and nano coating)
29. **Mid -semester examination**
30. Importance of packaging, types of packaging and packaging materials.
31. Methods of storage of fruits and vegetables viz. , Zero energy cool chamber, cold storage, controlled atmosphere, modified atmosphere and hypobaric storage and management of cold chain for export of high value fruits and vegetables
32. Principles and methods of preservation of fruits and vegetables
33. Preservation and value addition of fruits viz. , jam, jelly, marmalade, preserve and candy

34. Concepts and standards in fermented and non fermented beverages from fruits and vegetables
35. Drying, dehydration and osmotic dehydration of fruits and vegetables- concepts and methods
36. Canning of fruits and vegetables- concepts-processing of canned products-spoilage and prevention
37. Packaging of products and standards in value addition of fruits and vegetables viz. , GMP, HACCP, FSSAI, Codex alimentarius and ISO certification.

### **Practical Schedule**

34. Preharvest operations to improve post harvest shelf life of fruits and vegetable crops
35. Assessment of maturity indices and harvest criteria for fruits and vegetable crops
36. Methods of packaging in fruits and vegetables
37. Identification and causes of chilling and freezing injury in vegetables and fruits
38. Estimations of ethylene evolution in fruit crops
39. Identification of postharvest diseases and disorders of fruits and vegetable crops
40. Postharvest machineries for fruits and vegetables crops
41. Postharvest handling of the produce (washing, fungicide treatment, grading, sorting, precooling, waxing and nano coating).
42. Preparation of jam/Jelly and quality evaluation of products
36. Preparation of RTS, nectar, squash and quality evaluation of products
37. Processing of dried and dehydrated fruits and vegetables
38. Preparation of fruit bar and candy and quality evaluation of products
39. Preparation of tomato products
40. Processing of canned fruits and vegetables
- 15 Quality evaluation of products –physio-chemical and sensory evaluation. .
27. Visit to processing unit/ industry and cold storage / packaging unit
28. **Practical examination**

### **Reference**

1. Adel A. Kader. 2002. Post Harvest Technology of Horticultural Crops. University of California Agrl. And Natural Resources Publication.
2. Ashwani. S. and Goel. 2007. Post harvest management and value addition. Daya publishing house, New Delhi.
3. Swati Barche and K. S. Kirad. 2010. Post harvest handling of fruits, vegetables and flowers. Jain Brothers, New Delhi.
4. Sudheer,K. P. and V. Indira. 2007. Post harvest technology of horticultural crops, New India publishing agency, New Delhi.
5. Bhutani, R. C. 2003 Fruit and Vegetable Preservation. Biotech Books, Delhi. 89
6. Pruthi, J. S. 2000. Major Spices and condiments. Productions and post harvest technologies. ICAR publications, New Delhi.
7. Verma, L. R and V. K. Joshi. 2000. Post harvest technology of fruits and vegetables –Handling, Processing, Fermentation and Waste Management. Indus publishing House.

### **E-References**

[www.fao.org/inpho](http://www.fao.org/inpho)

??

?? [www.postharvest.ucdavis.edu](http://www.postharvest.ucdavis.edu)

?? [www.postharvest.ifas.ufl.edu](http://www.postharvest.ifas.ufl.edu)

?? [www.postharvest.com.au](http://www.postharvest.com.au)

?? [www.ams.usda.gov](http://www.ams.usda.gov)

## SAC 301 Manures, Fertilizers and Soil Fertility Management (2+1)

### Theory

**Unit-I** : Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green manuring and green leaf manuring. Integrated nutrient management. Carbon sequestration- Carbon trading

**Unit-II**: Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers. Mixed/Complex/customized/designer fertilizers, water soluble and liquid fertilizers, nano fertilizers & Soil amendments. Fertilizer Storage and Fertilizer Control Order.

**Unit-III**: 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 soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients.

**Unit-IV** :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.

**Unit-V** L Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions

### Practical

Introduction of analytical instruments and their principles, calibration and applications- Colorimetry, Spectrophotometry, Flame Photometry and Atomic Absorption Spectrophotometry. Estimation of available N in soil. Estimation of available P in soil. Estimation of available K in soil. Estimation of available S in soil. Estimation of available Ca and Mg in soil. Estimation of available Micronutrients in soil. Estimation of N in plant. Estimation of P in plant. Estimation of K in plant. Estimation of S in plant. Fertilizer calculations. Visit to STL and FTL/Fertilizer manufacturing or mixing unit.

### Lecture Schedule

Organic manures-Importance, Definition, classification, properties and sources- Fortified organics.

Methods of preparation of bulky and concentrated manures - Composting techniques- Aerobic and anaerobic (Bangalore & Coimbatore method) enriched FYM and vermicompost.

Composting of organic waste-Sugarcane trash and coir waste. Green manuring and green leaf

35. Soil carbon sequestration and carbon trading.
36. Fertilizers- Definition, classification of N, P and K fertilizers.
37. N fertilizers- Urea, ammonium sulphate, ammonium nitrate, CAN, properties and their reactions in
38. P fertilizers- Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate, triple super phosphate, properties and their reactions in soil.
39. K fertilizers- MOP and SOP- properties and reactions in soil.
40. Secondary nutrient fertilizers and micronutrient fertilizers.
41. Complex fertilizers- definition, manufacture of ammonium phosphate, nitro phosphate and N,P,K complexes.

71. Mixed fertilizers-definition, preparation and compatibility.

72. Customized/designer fertilizers, water soluble, liquid fertilizers and Nano fertilizers.

73. Micro nutrient mixtures and chelated micronutrients. Soil amendments

74. Fertilizer Storage and Fertilizer Control Order

75. History of soil fertility, productivity plant nutrition and criteria of essentiality. Functions, deficiency and toxicity symptoms of N, P and K.

Functions, deficiency and toxicity symptoms of Secondary, micronutrient and beneficial elements

### 22. Mid semester Examination

23. Mechanisms of nutrient transport to plants

24. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil
25. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorous in soil
21. Sources, forms, mobility, transformation, fixation, losses and availability of potassium in soil  
Sources, forms, mobility, transformation, fixation, losses and availability of calcium, magnesium and sulphur in soil  
Sources, forms, mobility, transformation, fixation, losses and availability of micronutrients in soil  
Concepts and approaches of soil fertility evaluation - Liebig's Law, Mitscherlich's law and Bray's nutrient mobility concept. Approaches - Deficiency symptoms, tissue analysis, biological tests and chemical tests.  
Techniques/ methods of soil fertility evaluation: Crop logging, critical level, DRIS, Isotopic nutrient availability techniques.  
Fertilizer application: Soil and foliar application.  
Fertigation - Definition - Types of fertigation and scheduling.  
Fertilizer application- specific methods - Seed coating, pelletization, seedling dipping - Nutriseed pack  
Nutrient management concepts – 4 R concept-Agronomic approach, Inductive(STCR), SSNM and RTNM  
Nutrient management concepts -Deductive, INM, IPNS. Tools - DSSIFER and VDK  
Nitrogen use efficiency - Slow release N fertilizers - Significance and enhancement techniques  
Nutrient use efficiency of P, K and micronutrients and their enhancement techniques  
Nutrient management for dry land and rainfed agriculture.  
Long term effect of fertilization on soil health-PME and LTFE.

### **Practical Schedule**

33. Analytical instruments : Principles, calibration and applications – Colorimetry and Spectrophotometry
34. Flame photometry and Atomic absorption spectroscopy
35. Estimation of available N in soil
36. Estimation of available P (Olsen P and Bray P) in soil
37. Estimation of available K in soil
38. Estimation of available sulphur in soil by turbidimetry
39. Estimation of available Ca and Mg in soils.
40. Estimation of DTPA extractable micronutrients in soil
27. Estimation of N content in plant.
15. Estimation of P content in plant.
16. Estimation of K content in plant.
17. Estimation of S content in plant
18. Estimation of N content in manure
19. Estimation of P content in manure
20. Estimation of K content in manure
21. Colloquium on establishment of soil testing laboratories -Fertilizer calculations-Soil test based fertilizer prescription
22. Visit to STL and FTL / Fertilizer manufacturing or mixing unit
- 23. Practical Examination**

### **References**

35. John L. Havlin, James D. Beaton, Samuel L. Tisdale and Werner L. Nelson. 2011. Soil Fertility and Fertilizers- An Introduction to Nutrient Management. PHL Learning Pvt. Ltd. ,New Delhi



36. Gupta, P. K. 2012. A Handbook of Soil, Fertilizer and Manure. Agrobios (India), Jodhpur.
37. Michael, A. M. 2009. Irrigation Theory and Practice. Second Edition. Vikas Publishing House Pvt. Ltd. , New Delhi.
38. Ramesh Chandra and S. K. Singh. 2009. Fundamental and Management of soil quality. Westville Publishing House, New Delhi.

#### **E - references**

- 15 [www.fspublishers.org/ijab/past-issues/IJAB\\_Vol\\_5\\_No\\_3/47.pdf](http://www.fspublishers.org/ijab/past-issues/IJAB_Vol_5_No_3/47.pdf)
- 16 [www.springerlink.com/index/IQ11256h8t325054.pdf](http://www.springerlink.com/index/IQ11256h8t325054.pdf)
- 17 [www.ipni.net/ppiweb/bcrops.nsf/\\$webindex/.../Better\\_Crops\\_2009-4\\_J\\_.pdf](http://www.ipni.net/ppiweb/bcrops.nsf/$webindex/.../Better_Crops_2009-4_J_.pdf)
- 18 [onlinelibrary.wiley.com/doi/10.1002/9780470431771.index/pdf](http://onlinelibrary.wiley.com/doi/10.1002/9780470431771.index/pdf)
- 19 [agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm](http://agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm)
- 20 [www.uoa.edu.er/academics/graduate/.../courses.html](http://www.uoa.edu.er/academics/graduate/.../courses.html) -
- 21 [www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm](http://www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm)
- 22 [www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm](http://www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm)
- 23 [www.uoa.edu.er/academics/graduate/.../courses.html](http://www.uoa.edu.er/academics/graduate/.../courses.html) -
- 24 [www.ncpahindia.com/articles/article17.pdf](http://www.ncpahindia.com/articles/article17.pdf)-Similar
- 25 [www.energy.ca.gov/process/agriculture/ag\\_pubs/fertigation.pdf](http://www.energy.ca.gov/process/agriculture/ag_pubs/fertigation.pdf) -
- 26 [www.soilandhealth.org/.../010117attraoilmanual/010117attra.html](http://www.soilandhealth.org/.../010117attraoilmanual/010117attra.html)
- 27 [goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html](http://goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html)-

**THEORY****Unit I: Introduction to Protected Cultivation and Green houses**

Protected cultivation – need, advantages and limitations – present status. Green house technology – Introduction – Types of greenhouses- Plant response to greenhouse environment.

**Unit II Design of Greenhouses**

Planning and design of greenhouses - Design criteria of green house for cooling and heating purposes - Green house equipment - Materials for construction of green houses - Irrigation systems used in greenhouses.

**Unit III Applications of Greenhouses**

Typical applications - Passive solar greenhouse - Hot air greenhouse heating systems - Greenhouse drying - Cost estimation and economic analysis.

**Unit IV: Engineering Properties of Food Materials**

Physical properties- size-shape, Aero-hydro dynamic properties, thermal properties- specific heat- thermal conductivity- thermal diffusivity, and their application in PHT equipment design and operation.

**Unit V: Drying and Dehydration**

Drying and dehydration, Moisture determination- direct method and indirect method of moisture determination, drying rate curves- constant rate period, CMC- Falling rate period, EMC, Drying methods- contact type dryers- convective type dryer- radiation dryer, commercial grain dryer -deep bed dryer-flat bed dryer- tray dryer-fluidized bed dryer. -Recirculatory dryer- solar dryer.

**Unit VI: Material Handling**

Introduction- selection of material handling machines, Belt conveyor- belt conveyor idlers- idler spacing- belt material- belt tension, Bucket conveyor- head section-Boot section-elevator legs- elevator belts- bucket drive mechanism. Screw conveyor- Details -various shapes screw trough- capacity – horse power, pneumatic conveyor – advantages and limitations.

**PRACTICAL**

Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Performance evaluation of screen cleaner. Determination of Moisture content of various grains by direct method and indirect method. Determination of capacity of belt conveyor and bucket conveyor.

**LECTURE SCHEDULE**

1	Introduction to protected cultivation – need, advantages and limitations and present status – protected cultivation for horticultural crops	TB 1: 1-9
2	Green house technology – Definition, History and evolution – Advantages and limitations	TB 1: 77-84
3	Types of greenhouses – based on shape, cost, utility and cladding materials	TB 2: 9-24
4	Plant response to greenhouse environment – Sunlight, Temperature, Relative Humidity, Carbon dioxide enrichment – Soil / media	TB 5:61-62 TB 5:118-124
5	Planning and design of greenhouses – Criteria for site selection – orientation – structural design - Design criteria of green house for cooling and heating purposes	TB 2: 25-46
6	Equipment and components of a Greenhouse – Summer cooling and winter cooling, natural ventilation and forced ventilation	TB 2: 96-102
7	Materials for construction of greenhouses – Wood, iron, glass, polyethylene film	TB 3: 16-28
8	Irrigation systems in greenhouses - Rules of watering, hand watering, perimeter watering, overhead sprinklers, boom watering and drip irrigation	TB 4: 61-64 TB 5: 110-116
9	Mid semester examination.	
10	Typical applications of greenhouses – passive solar greenhouse, hot air greenhouse heating system and green house drying- Cost estimation and economic analysis.	TB 4: 37-38, TB 4: 77-87
11	Physical properties – size- shape- sphericity- density- specific gravity, Aero-hydrodynamic properties – Terminal velocity- drag coefficient	TB 1: 6-11, TB 2: 6-10, TB 3: 2-8

12	Thermal properties- specific heat- thermal conductivity- thermal diffusivity, Application of Engineering properties of cereals, pulses and oilseeds in PHT equipment design and operation	TB 1: 1-6, 15-18, TB 2: 7-9 TB 3: 20-23
13	Moisture measurement, direct method and indirect method of moisture measurements, Drying and dehydration, Drying theory, drying rate curves- constant rate period, CMC- Falling rate period , EMC	TB 1: 107-130 TB 2: 25-49
14	Various drying method, contact type dryers- convective type dryer- radiation dryer	TB 1: 132--161 TB 2: 66-70
15	Commercial grain dryer- deep bed dryer-flat bed dryer- tray dryer-fluidized bed dryer, recirculatory dryer- solar dryer.	TB 1: 143-161 TB 2: 71-90
16	Material handling equipment-introduction, screw conveyor working principle, and selection	TB 1: 289-297 TB 3: 317-332
17	Bucket elevator- head section-Boot section-elevator legs- elevator belts- bucket drive mechanism- Screw conveyor and pneumatic conveyor working principle and selection	TB 1: 297-310 TB 3: 332-347

### **PRACTICAL SCHEDULE**

1. Study of different types of green houses based on shape, etc
2. Measurement of weather data in green houses
3. Computing the rate of air exchange in an active summer and winter cooling systems
4. Experiment on determination of shape and size of the cereal grains
5. Experiment on determination of bulk density and porosity of biomaterials
6. Determination of Moisture content of various grains by direct method
7. Determination of Moisture content of various grains by indirect method
8. Experiment on determination of terminal velocity of different grains
9. Performance evaluation of available screen cleaner
10. Performance evaluation of fluidized bed dryer
11. Performance evaluation of tray dryer
12. Determination of Capacity of a belt conveyor and its performance evaluation
13. Determination of Capacity of a bucket conveyor and its performance evaluation
14. Field visit to greenhouse
15. Visit to Horticulture Research Station, Udthagamandalam
16. Visit to food modern rice mill
17. Final Practical Examination

### **TEXT BOOK**

1. Singh Brahma and Balraj Singh., 2014. Advances in Protected Cultivation, New India Publishing Company.
2. Greenhouse Management for Horticulture crops – S.Prasad&U.Kumar., 2013. AGROBIOS (INDIA).
3. Greenhouse Management for Horticulture crops – Sandhya Sharaf., 2012. Oxford Book Company.
4. Greenhouse for Homeowners and Gardeners - John W. Bartok, Jr., 2000. NRAES
5. Greenhouse Engineering - Robert A. Aldrich and John W. Bartok, Jr., 1994. NRAES
6. Sahay K.M and Singh K .K. Unit operations of agricultural processing. Vikas Publishing house Pvt. Ltd. New Delhi.
7. Chakraverty A. Post-harvest technology of cereals, Pulses and Oil seeds. published by Oxford & IBH publishers. New Delhi.
8. M.N.Dabhi and N.K. Dhamsananiya Agricultural Processing and food engineering (A basic approach). published by Kalyani Publisher. New Delhi.

### **REFERENCE BOOKS**

1. Brennan J.G. Food engineering operations. Second edition. Published by applied science Publisher limited, London.
2. Fellows, P. 2000. Food processing technology Principles and Practice. Second Edition. Published by Woodhead Publishing Limited Abington Hall, Abington Cambridge CB1 6AH, England.
3. Kudra, T. and Mujumdar, A.S. Advanced drying technologies. Marcel Dekker, Inc.

### **E – BOOKS**

[A. Chakraverty, Arun S. Mujumdar, G. S. Vijaya Raghavan, H. S. Ramaswamy.2003. Handbook of Postharvest Technology \(cereals, fruits, vegetables, tea and spices\), Marcel Dekker, Inc.New York, USA.](#)

## **AGR 302 Rainfed Agriculture and Watershed Management (1+1)**

### **Theory**

#### **Unit - I:**

Dryland farming - India and Tamil Nadu - Major crops of Dryland in India and Tamil Nadu - rainfed farming - Significance, Characteristics and constraints of dry farming in India - Distribution of Arid and semiarid regions in World, India and Tamil Nadu.

#### **Unit - II:**

Rainfall climatology - Length of growing period - Drought - Definition - Types and effects of Drought on crop production - Mechanism of drought tolerance in plants - Drought management - Contingent crop planning - Mid season correction - Mulching - anti transpirants.

#### **Unit - III:**

Soil moisture conservation approaches: agronomical, engineering and agrostological measures - In-situ water harvesting, storage and recycling - water harvesting - farm pond, percolation pond.

#### **Unit - IV:**

Integrated dry land technologies - Mechanization - Resource management under constraint situation - Cost reduction strategies in crop production - Non-monetary inputs and low cost technologies.

#### **Unit - V:**

Watershed management - alternate land use system - Agro forestry systems - Role of institutions - government policies for promotion of dryland farming.

#### **Practical:**

Zonation of Dry farming regions of Tamil Nadu, India and World - Characteristics of ACZs of Tamil Nadu and cropping pattern - Study of tools, implements and machineries for tillage, sowing and after cultivation - Rainfall analysis - working out economics - Sustainability Indices - working out LGP - Preparation of contingency crop plan for aberrant rainfall situations - Visit to watershed.

#### **Lecture Schedule:**

13. Significance and scope of dry farming in India and history of dryland agriculture.
14. Dry farming and rainfed farming: Definition and Characteristics.
15. Distribution of arid and semi-arid regions in World, India and Tamil Nadu.
16. Major crops of dryland in India and Tamil Nadu.
17. Characteristics of dryland farming and major constraints for crop production.
18. Drought: definition, types and effects of drought on crop production.
19. Drought management strategies and contingent crop planning: mid season correction.
20. Mulching, anti transpirants, in-situ soil moisture conservation techniques and approaches.
- 21. Mid-Semester Examination.**
22. Water harvesting, storage and recycling.
23. Integrated dryland technologies and farm mechanization.
24. Watershed: definition, principles, classification and management.
25. Mechanization in dryland farming.
- 15 Resource management under constraint situations for irrigated and rainfed farming.
- 16 Cost reduction strategies in crop production - cropping system, integrated farming system and dry farming.
- 17 Non-monetary inputs and low cost technologies for crop production.
- 18 Alternate land use systems in dryland - role of institutions – policies.

**Practical Schedule:**

18. Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
19. Agroclimatic, Agro ecological zones and characteristics.
20. Zonation of dry farming regions of Tamil Nadu, India and World.
21. Characteristics of ACZs of Tamil Nadu and cropping pattern.
22. Cropping and farming systems in dryland.
23. Skill development in Seed hardening technique.
24. Input management and efficiency in dryland.
25. Soil erosion and soil conservation practices.
26. Water harvesting structures and their use.
27. Study of methods to reduce evaporation and transpiration.
28. Study of tools, implements, and machineries for tillage, sowing and after cultivation and assessing their efficiencies.
29. Indices in dry farming - working out LGP and planning for cropping system.
30. Drought management technologies in dryland agriculture.
31. Preparation of contingency crop plan for aberrant rainfall situations.
32. Alternate land use system and their merits.
33. Visit to watershed area to study the impact of various soil and moisture conservation methods.
34. **Practical examination.**

**References:**

- Govindan K. and V. Thirumurugan. 2003. Principles and practice of Dryland Agriculture, Kalyani Publishers, Chennai.
- Rengasamy P. 1990. Dry farming Technology in India. Agri publishing Academy, New Delhi.
- Reddy, G. S. , Reddy, Y. V. R. , Vittal, K. P. R. , Thyagaraj, C. R. , Ramakrishna, Y. S. and L. L Somani. 2008. Dryland Agriculture. Agrotech Publishing Academy, Udaipur
- Jat. , Bharkar. , Sharma and Kothari. 2013. Dryland Technology. Scientific Publishers, Jodhpur
- Pradeep, S. 2014. Dryland Agriculture. Discovery Publishing House Pvt. Ltd, NewDelhi
- Widtsøe, J. A. 2012. Dry Farming for Sustainable Agriculture. Agrobios (India), Jodhpur

**E. References:**

- [www.tnau.ac.in](http://www.tnau.ac.in)
- [www.crida.org](http://www.crida.org)
- [www.icrisat.org](http://www.icrisat.org)

## **AEN 301 PESTS OF FIELD CROPS AND STORED PRODUCES AND THEIR MANAGEMENT (1+1)**

### **Theory**

#### **Unit I: Pests of Cereals and Millets**

Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of rice, wheat, maize, sorghum, cumbu, ragi, tenai. Integrated Pest Management - case studies in rice.

#### **Unit II: Pests of Pulses and Oilseeds**

Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of pulses (redgram, green gram, black gram, bengal gram, cowpea.), groundnut, castor, gingelly, sunflower, safflower, jatropha, soybean and mustard. Integrated Pest Management - case studies in groundnut.

#### **Unit III. Pests of Cotton and Sugarcane**

Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of cotton and sugarcane. Integrated Pest Management - case studies in cotton.

#### **Unit IV: Pests of Green Manures, Forage Crops, Stored Products and Non Insect Pests**

Distribution, bionomics, symptoms of damage and management strategies of pests of green manures (Sunnhemp, Sesbania, Daicha. Glyricidia), forage crops (Lucere and Subabul) and stored products. Rodents and birds of agricultural importance and their management. Locusts and their management.

#### **Theory schedule:**

Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of

1. Rice – Sucking pests
2. Rice – Borers and defoliators
3. Maize, sorghum and cumbu
4. Wheat, ragi and tenai
5. Redgram, bengalgram, Blackgram, greengram and cowpea
6. Groundnut, gingelly and sunflower
7. Castor, soybean, safflower, jatropha and mustard
8. Cotton
9. Mid semester examination
10. Sugarcane
11. Green manures- sunnhemp, sesbania, daincha, lucerne, subabul and gliricidia
12. Role of physical, biological, mechanical and chemical factors in deterioration of grain
13. Stored product pests
14. Methods of grain storage and various methods of stored product pest management
15. Mites, slugs and snails, rodents and bird pests
16. Locusts and their management
17. Integrated Pest Management in rice and cotton

#### **Practical schedule:**

#### **Identification of symptoms of damage and life stages of pests of**

1. Pests of rice (sucking pests)
2. Pests of rice (borers and defoliators)
3. Pests of maize, sorghum and cumbu
4. Pests of wheat, ragi and tenai
5. Pests of redgram and bengalgram
6. Pests blackgram, greengram and cowpea

7. Pests of groundnut, gingelly and sunflower
8. Pests of castor, soybean, safflower, jatropha and mustard
9. Pests of cotton (sucking pests)
10. Pests of cotton (bollworms and defoliators)
11. Pests of sugarcane
12. Pests of green manures-sunnhemp, sesbania, daincha, lucerne, subabul and gliricidia
13. Pests of stored products
14. Gadgets for management of stored product insects
15. Rodents and Birds pests in field and storage
16. Visit to FCI godown and farmer's fields
17. Final practical examination

**References:**

**A. Text Books:**

1. Manisegaran, S. and R.P.Soundararajan. 2010. *Pest Management in Field Crops- Principles and Practices*. Agrobios, Jodhpur, India. 316p. {ISBN (10): 81-7754-321-0}
2. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai. 386 p. {ISBN: 978-81-921477-0-3}

**E- RESOURCES:**

1. <http://www.ncipm.org.in>
2. <http://agritech.tnau.ac.in/>
3. <http://www.nbaii.res.in/>
4. <http://www.nrcg.res.in/>

## VI SEMESTER

S. No.	Course code	Course Title	Credit load
1	AEC 302	Agricultural Finance and Co-Operation	2+1
2	PAT 302	Diseases of Field and Horticultural crops and their management -II	2+1
3	COM 311	Agro Informatics	1+1
4	ENS 301	Environmental Pollution and Management	1+1
5	AEN 301	Pests of Crops and Stored grain and their Management	2+1
6	AGR 303	Practical Crop Production - II ( <i>Rabi</i> crops)	0+2
7	AGR 304	Principles of organic Farming	1+1
8	ABT 301	Plant Bio technology	2+1
9	PBG 302	Crop Improvement	2+1
10	OPT 301	Optional course	1+1
11	NCC 101	NCC*	
		<b>Total</b>	<b>13+11=24</b>
		<b>*Non-gradual courses compulsory courses</b>	



## AEC 302 Agricultural Finance and Co - operation (2+1)

### Theory

**Unit 1: Agricultural Finance – Nature and Scope :** Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Sources of credit - advantages and disadvantages - Rural indebtedness- History and Development of rural credit in India.

**Unit 2: Financial Institutions :** Sources of agricultural finance: institutional and non-institutional sources and their roles, commercial banks - social control and nationalization of commercial banks. Micro financing including KCC, Micro finance – SHG Models, Lead Bank Scheme, RRBs, Scale of finance and unit cost. Cost of credit. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Recent development in agricultural credit: Rural credit policies of Government – Subsidized farm credit - Differential Interest Rate (DIR) Scheme – Loan relief measures

**Unit 3: Farm Financial Analysis:** Credit analysis: 4 R's, 7 P's and 3C's of credit. Preparation of bankable projects / Farm credit proposals – Feasibility; Appraisal - Time value of money: Compounding and Discounting - Undiscounted and Discounted measures. Preparation and analysis of financial statements

– Balance Sheet, Income Statement and Cash Flow Statement. Basic guidelines for preparation of project reports - Bank norms – SWOT analysis.

**Unit 4: Co-operation:** Agricultural Cooperation in India – Meaning, brief history of cooperative development in India - Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDRC, NAFED. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.

**Unit 5: Banking and Insurance:** Negotiable Instruments: Meaning, Importance and Types - Central bank:

RBI – functions - Credit control – Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation - Estimation of Crop Yields - Assessment of crop losses, Determination of compensation - Weather based crop insurance, features, determinants of compensation. Livestock Insurance Schemes Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

### Practical

Determination of most profitable level of capital use. 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 / cooperative society to acquire first - hand knowledge of their management, schemes and procedures. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance. Estimation of credit requirement of farm business – A case study. Preparation and analysis of Balance Sheet, and Cash Flow Statement – A case study. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study. Preparation and analysis of income statement – A case study. Preparation of Bankable projects / Farm Credit Proposals and appraisal - Undiscounted methods and Discounted methods. Techno-

economic parameters for preparation of projects for various agricultural products and its value added products. Seminar on selected topics. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.

### **Theory Schedule**

61. Agricultural Finance - meaning, scope and significance, credit needs and its role in Indian agriculture.
62. Agricultural credit: meaning, definition, need and classification.
63. Sources of credit - advantages and disadvantages.
64. Rural indebtedness - History and Development of rural credit in India.
65. Sources of agricultural finance: institutional and non-institutional sources - their roles.
66. Commercial banks - social control and nationalization of commercial banks.
67. Micro financing including KCC, Micro finance – SHG Models, Lead bank scheme.
68. RRBs, Scale of finance and unit cost. Cost of credit.
69. An introduction to higher financing institutions–RBI, NABARD, ADB, IMF and World Bank.
70. Role of Insurance and Credit Guarantee Corporation of India.
71. Recent developments in agricultural credit.
72. Rural credit policies of Government: Subsidized farm credit- Differential Interest Rate (DIR) Scheme – Loan relief measures
73. Credit analysis: 4 R's, 7 P's and 3C's of credit.
74. Preparation of bankable projects / Farm credit proposals – Feasibility.
75. Appraisal: Time value of money: Compounding and Discounting - Undiscounted and Discounted measures.
76. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement.
77. **Mid Semester Examination**
42. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.
43. Agricultural Cooperation in India – Meaning, brief history of cooperative development in India.
44. Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.
45. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing;
46. Role of ICA, NCUI, NCDC and NAFED.
47. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.
48. Negotiable Instruments: Meaning, Importance and Types.
49. Central bank: RBI – functions, Credit control – Objectives and Methods: CRR, SLR and Repo rate.
50. Credit rationing - Dear money and cheap money.
51. Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies.
52. Credit gap: Factors influencing credit gap.
53. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation.
54. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation.
55. Estimation of Crop Yields - Assessment of crop losses, Determination of compensation.
56. Weather based crop insurance, features, determinants of compensation.
57. Livestock Insurance Schemes
58. Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

### **Practical Schedule**

7. Determination of most profitable level of capital use.
8. Optimum allocation of limited amount of capital among different enterprise.
9. Analysis of progress and performance of cooperatives using published data.

10. Analysis of progress and performance of commercial banks and RRBs using published data.
11. Visit to a commercial bank, cooperative bank / cooperative society to acquire first - hand knowledge of their management, schemes and procedures.
12. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance.
13. Guest lecture on Role and functions of Commercial Bank and Lead Bank / NABARD and its Role and Functions.
14. Estimation of credit requirement of farm business – A case study.
15. Preparation and analysis of Balance Sheet and Cash Flow Statement – A case study.
16. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study.
17. Preparation and analysis of income statement – A case study.
18. Preparation of Bankable projects / Farm Credit Proposals and appraisal.
19. Undiscounted methods and Discounted methods.
20. Techno-economic parameters for preparation of projects for various agricultural products and its value added products.
21. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.
22. Seminar on selected topics.
23. **Practical Examination.**

### **References**

32. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.
33. Subba Reddy, S and P. Raghuram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
34. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance. Kalyani Publishers. New Delhi.
35. Mammoria, C.B. and R.D. Saxena. 1973. Cooperation in India. Kitab Mahal. Allahabad. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers. Ludhiana.

## **PAT 302 Diseases of Field and Horticultural crops and their management-II (2+1)**

### **Theory**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of important diseases

#### **Unit-I Diseases of cereals: Wheat**

#### **Unit- II Diseases of Pulses, Oilseeds and Cash crops**

**Pulses:** chick pea and lentil; **Oilseeds:** sunflower and mustard; **Cash crops:** sugarcane and cotton

#### **Unit- III Diseases of Fruits and vegetables crops**

**Fruits:** mango, citrus, grapevine, sapota, jackfruit, pineapple, ber, apple, peach plum and strawberry;

**Vegetables:** cucurbits, peas, potato, beet root, radish, cassava, colacasia and yam

#### **Unit- IV Diseases of Spices, Plantation and Flower crops**

**Spices:** chillies, turmeric, ginger, onion, garlic, coriander, cardamom; **Plantation crops:** black pepper and vanilla; **Flower crops:** rose, Jasmine, marigold, crossandra, chrysanthemum, tube rose, carnation, lillium and orchids

#### **Unit- V Diseases of medicinal crops and mushroom cultivation**

**Medicinal crops:** gloriosa, coleus, stevia and aloe; **Mushroom cultivation:** Importance of mushroom and cultivation of button mushroom, oyster mushroom, milky mushroom and paddy straw mushroom-pest and diseases of mushroom

### **PRACTICAL**

Study of symptoms and host parasite relationship of the important diseases of wheat, chick pea, lentil, sunflower, mustard, cotton, sugarcane, mango, citrus, grapevine, sapota, jackfruit, pineapple, ber, apple, peach, plum, strawberry, cucurbits, potato, peas, beet root, radish, cassava, colacasia, yam, chillies, turmeric, ginger, onion, garlic, coriander, cardamom, black pepper, vanilla, rose, Jasmine, marigold, crossandra, chrysanthemum, tube rose, carnation, lillium, orchids, gloriosa, coleus, stevia and aloe and cultivation of button mushroom, oyster mushroom, milky mushroom and paddy straw mushroom.

### **THEORY**

Etiology, symptoms, mode of spread, survival, epidemiology and integrated management of

61. Diseases of wheat
62. Diseases of chickpea and lentil
63. Diseases of sunflower and mustard
64. Diseases of cotton
65. Diseases of sugarcane
66. Diseases of mango
67. Diseases of citrus
68. Diseases of grapevine
69. Diseases of sapota, jack fruit, pineapple and ber
70. Diseases of apple
57. Diseases of peach, plum and strawberry
58. Diseases of cucurbits
59. Diseases of Potato-I ( Fungal diseases)
60. Diseases of Potato-II ( bacterial and viral diseases)
61. Diseases of peas, beet root and radish
- 62. Mid semester examination**
63. Diseases of cassava, colacasia and yam

64. Diseases of chillies
65. Diseases of turmeric and ginger
66. Diseases of onion and garlic
67. Diseases of cardamom and coriander
68. Diseases of black pepper, betel vine and vanilla
69. Diseases of rose and jasmine
70. Diseases of marigold, crossandra and chrysanthemum
71. Diseases of tube rose and carnation
72. Diseases of lillium and orchids
73. Diseases of gloriosa and coleus
74. Diseases of stevia and aloe
75. Diseases of stored grains and their management
76. Post harvest diseases of fruit and vegetables
77. Mushroom-edible and poisonous mushroom- importance of mushroom
78. Cultivation of button mushroom and oyster mushroom
79. Cultivation of milky mushroom and paddy straw mushroom
80. Pest and diseases of mushroom

## **PRACTICAL**

### **Study of symptoms and host-parasite relationship of:**

44. Diseases of wheat
45. Diseases of chick pea, lentil, sunflower and mustard
46. Diseases of cotton and sugarcane
47. Diseases of mango and sapota
48. Diseases of citrus and grapevine
49. Diseases of jackfruit , pineapple, ber, apple , peach, plum , strawberry
50. Diseases of cucurbits
51. Diseases of potato , peas , beet root and radish
52. Diseases of cassava, colacasia and yam
53. Field visit/ exposure visit to hilly fruits , vegetables and plantation crops / mushroom unit
54. Diseases of chillies, turmeric and ginger
55. Diseases of coriander, cardamom, black pepper and vanilla,
56. Diseases of rose, Jasmine, marigold and crossandra
57. Diseases of tube rose , carnation, lillium and orchids,
58. Diseases of gloriosa, coleus, stevia and aloe
59. Cultivation of oyster , milky and paddy straw mushroom cultivation

### **60. Final practical examination**

### **Reference:**

18. Arjunan.G. Karthikeyan, G, Dinakaran ,D. Raguchander,T. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
19. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi
20. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K.Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.
36. Agrios, G.N. 2008. Plant Pathology, Academic Press, New York
37. Rangaswami, G. 2005. Diseases of Crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi
38. Thakur, B.R. 2006. Diseases of field crops and their management

## COM 311 Agro- Informatics (1+1)

### Theory

#### Unit I: Information and Communication Technology (ICT)

ICT and its importance – Computer Fundamentals - Basic anatomy of the computer system: Input devices, CPU, Output devices, Memory: Primary and secondary - Software – Types: System software, Application software and Utility software – Software terminologies: Firmware, Liveware, Freeware, Shareware, Commercial software, Proprietary software, Semi-free software - Internet - World Wide Web – URL – Domain names - Protocols: HTTP, HTTPS - Internet Applications: Email, File sharing web apps, Social Networks, Online shopping, Video Conferencing – HTML: Introduction, Editor, HTML Documents – Tags: <head>, <body>, <title>, <heading>, <paragraph>, </br>, <table>, <li>, <ul>, <href>, <img>, <hr> and <marquee>.

#### Unit II: Spreadsheet and Database

Electronic spreadsheet – Microsoft Excel - Worksheet manipulation: insert, delete, move, copy and hide worksheet – Cell manipulation: copy, edit and format cell data – Charts - Create Bar and Pie charts - PIVOT table - DBMS: Database terms: Data, Database, DBMS, RDBMS, Row, Column, Table – Database Architecture – Data types: char, varchar(), int, float() – Use of databases in agriculture.

#### Unit III: C Programming

Introduction to Computer Programming – Programming languages - Translators: Compilers and Interpreters - Algorithm – Flowchart - Introduction to C – Structure of C program - Data types, Variables, Constants, Operators: Arithmetic, Relational, Logical, Assignment - Input/Output: scanf(), printf() - Control statements: if, if else – Loop: while, do while, for.

#### Unit IV: Agriinformatics

Agriinformatics – Needs and objectives - e-Agriculture : Concept, Meaning, Terminologies and Importance - e-Agriculture – National and International scenario - ICT for Data collection, formation of development programmes, monitoring and evaluation of programmes - Decision support systems: Taxonomy, Components, Framework, Classification and applications in Agriculture -Expert systems - Concepts and Importance – Components – User Interface – Knowledge Base – Inference Mechanism – Inference Rule - Designing an Expert Systems - Advantages and disadvantages of Expert Systems - Information systems for supporting farm decisions.

#### Unit V: Models and Computer Controlled Devices

Introduction to computer based agricultural models: Model, Simulation, Systems analysis models, Subsystems, Types: Mechanistic process models, Operational models, Statistical models and dynamic simulation models - List of agricultural models - Computer controlled devices – Sensor – Drones – Robots – Internet of Things (IoT) and Cloud Computing for Agriculture.

### Practical

Innards of computer – Booting and shutdown – Practice of DOS commands: dir, cd, mkdir, rmdir, del, cls, attrib, ren, copy, move, ipconfig, ping - Software practices – Installation / Uninstallation – Windows apps: Sticky Notes, Steps Recorder, Snipping Tool – Pin and unpin the programs – System tray customization – Shortcut keys - Microsoft Excel - Entering a formula in a cell, Built-in functions: SUM, AVERAGE, MIN, MAX, COUNT, COUNTIF, IF – Import and export data - Charts - Create Bar and Pie charts – PIVOT table - MS-ACCESS: Creating agriculture database – Entering, editing, deleting data – Creating Forms – Query wizard: select, update, delete – Reports - Internet Applications: Email, File sharing web apps: Dropbox, Google drive - Social Networks, Online shopping, Video Conferencing – Creating a web

page: HTML editor – Tags: <head>, <body>, <title>, <heading>, <paragraph>, </br>, <table>, <li>, <ul>, <href>, <img>, <hr> and <marquee> - Develop algorithms and represent the same in the flowchart for the following problems -To calculate Leaf Area Index (LAI) -To calculate the Crop Growth Rate (CGR) - To find the greatest average seed sales of two districts during samba season - Familiarizing with the Integrated Development Environment of C Editor for coding, saving, compiling, debugging and executing

– C Programs: Display TNAU motto "Till, Toil, Triumph" – Calculate Leaf Area Index (LAI) – Calculate the Crop Growth Rate (CGR) - Find the greatest average seed sales of two districts during samba season - e-Agriculture – Leveraging social media in agriculture (Social networks) - ICT in agriculture – Paperless data collection using google survey tools - Online photo and video editing tools - Simulating crop yield: InfoCrop - Base file creation for rice and maize (Weather, Varietal characters, Agronomy practices, Soil data) – Interpretation - InfoCrop – Climate change impact studies on rice and maize - Smartphone mobile apps in Agriculture for farm advices, crop protection, market price, postharvest management - Decision support systems - Expert systems - Information systems for supporting farm decisions - Crop calendar – Crop planning tool for farmers.

### **Lecture Schedule**

13. Introduction to Computers - Basic anatomy of the computer system: Input devices, CPU, Output devices, Memory: Primary and secondary.
14. Software – Types: System software, Application software and Utility software – Software terminologies: Firmware, Liveware, Freeware, Shareware, Commercial software, Proprietary software, Semi-free software.
3. Internet - World Wide Web – URL – Domain names - Protocols: HTTP, HTTPS - Internet Applications: Email, File sharing web apps, Social Networks, Online shopping, Video Conferencing – HTML: Introduction, Editor, HTML Documents – Tags: <head>, <body>, <title>, <heading>, <paragraph>, </br>, <table>, <li>, <ul>, <href>, <img>, <hr> and <marquee>.
70. Electronic spreadsheet – Microsoft Excel - Worksheet manipulation: insert, delete, move, copy and hide worksheet – Cell manipulation: copy, edit and format cell data – Charts - Create Bar and Pie charts - PIVOT table.
71. DBMS: Database terms: Data, Database, DBMS, RDBMS, Row, Column, Table – Database Architecture – Data types: char, varchar(), int, float() – Use of databases in agriculture.
72. Introduction to Computer Programming – Programming languages - Translators: Compilers and Interpreters - Algorithm – Flowchart.
73. Introduction to C – Structure of C program - Data types, Variables, Constants, Operators: Arithmetic, Relational, Logical, Assignment - Input/Output: scanf(), printf().
74. Control statements: if, if else – Loop: while, do while, for.

### **75. Mid-Semester Examination**

9. Agriinformatics – Needs and objectives - e-Agriculture : Concept, Meaning, Terminologies and Importance
10. e-Agriculture – National and International scenario
11. ICT for Data collection, formation of development programmes, monitoring and evaluation of programmes.
12. Decision support systems: Taxonomy, Components, Framework, Classification and applications in Agriculture.
13. Expert systems - Concepts and Importance – Components – User Interface – Knowledge Base – Inference Mechanism – Inference Rule - Designing an Expert Systems - Advantages and disadvantages of Expert Systems - Information systems for supporting farm decisions.
14. Introduction to computer based agricultural models: Model, Simulation, Systems analysis models, Subsystems, Types: Mechanistic process models, Operational models, Statistical models and dynamic simulation models - List of agricultural models.
15. Computer controlled devices – Sensor – Drones – Robots.
16. Internet of Things (IoT) and Cloud Computing for Agriculture.

## Practical Schedule

36. Innards of computer – Boot and shutdown – Windows apps: Sticky Notes, Steps Recorder, Snipping Tool – Pin and unpin the programs – System tray customization – Shortcut keys.
  37. Software practices – Installation / Uninstallation – Practice of DOS commands: dir, cd, mkdir, rmdir, del, cls, attrib, ren, copy, move, ipconfig, ping.
  38. Microsoft Excel - Entering a formula in a cell, Built-in functions: SUM, AVERAGE, MIN, MAX, COUNT, COUNTIF, IF – Import and export data - Charts - Create Bar and Pie charts – PIVOT table.
  39. MS-ACCESS: Creating agriculture database – Entering, editing, deleting data – Creating Forms – Query wizard: select, update, delete – Reports.
  40. Internet Applications: Email, File sharing web apps: Dropbox, Google drive - Social Networks, Online shopping, Video Conferencing – Creating a web page: HTML editor – Tags: <head>, <body>, <title>, <heading>, <paragraph>, </br>, <table>, <li>, <ul>, <href>, <img>, <hr> and <marquee>.
  41. Develop algorithms and represent the same in the flowchart for the following problems -To calculate Leaf Area Index (LAI) -To calculate the Crop Growth Rate (CGR) - To find the greatest average seed sales of two districts during samba season.
  42. Familiarizing with the Integrated Development Environment of C Editor for coding, saving, compiling, debugging and executing – C Programs: Display TNAU motto "Till, Toil, Triumph" – Calculate Leaf Area Index (LAI) – Calculate the Crop Growth Rate (CGR) - Find the greatest average seed sales of two districts during samba season.
  43. Looping statements: Calculate the average yield of last 10 years Rice yield of our District - Write a C program to find total, maximum, minimum and average rain fall of last five years in our District.
  44. e-Agriculture – Leveraging social media in agriculture (Social networks).
  45. ICT in agriculture – Paperless data collection using google survey tools - Online photo and video editing tools.
  46. Simulating crop yield: InfoCrop - Base file creation for rice and maize (Weather, Varietal characters, Agronomy practices, Soil data) – Interpretation.
  47. InfoCrop – Climate change impact studies on rice and maize.
  48. Smartphone mobile apps in Agriculture for farm advices, crop protection, market price, postharvest management.
  45. Decision support systems
  46. Expert systems - Information systems for supporting farm decisions.
  47. Crop calendar – Crop planning tool for farmers.
- 48. Final Practical Examination**

## Reference:

36. Introduction to Information Technology, 2012, Second Edition, IITL Education Solutions Limited, PEARSON Education.
37. Firuza Aibara, HTML 5 for Beginners, 2012, Shroff Publications.
38. John Walkenbach, Excel 2010 Bible, Wiley publishing, Inc
39. Balagurusamy, E., Programming in ANSI C, 2017, Seventh Edition, McGraw Hill Education.
40. Saravanan, R., Kathiresan, C and Indra Devi, T., 2011. Information & communication technology for agriculture and rural development. New India Publ. Agency.
41. Aggarwal, P.K., Naveen Kalra and Subhash Chander, Infocrop: A generic simulation model for annual crops in tropical environments, Indian Agricultural Research Institute, New Delhi.
42. Malcolm J. Blackie, Information Systems for Agriculture, 2012, Springer Netherlands.
43. Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Editors: Mukhopadhyay and Subhas Chandra (Ed.), Springer
44. John Billingsley, Arto Visala and Mark Dunn, 2008, Robotics in Agriculture and Forestry – 46<sup>th</sup> Chapter from book Springer Handbook of Robotics.



36. Introduction to Expert Systems, 3rd Edition by Peter Jackson
37. Introduction to Artificial Intelligence and Expert Systems, 2007 by Dan W. Patterson.
38. Balagurusamy, E., Computing Fundamentals & C Programming, Second Edition, 2017, McGraw Hill Education.
39. A.S. Sandhu, 2004. Text book on Agricultural Communication Process and Methods. Oxford & TBH.
40. C.J. Date: Data Base Design, Addison Wesley.

### **E-Reference**

65. <https://www.scribd.com/document/249057939/InfoCrop-Help>
66. InfoCrop: A dynamic simulation model for the assessment of crop yields, losses due to pests, and environmental impact of agro-ecosystems in tropical environments. P.K. Aggarwal et al., Agricultural Systems 89 (2006) 47–67.
67. <http://www.sciencedirect.com/science/article/pii/S0168169916303623>
68. Web-based crop model: Web InfoCrop – Wheat to simulate the growth and yield of wheat
69. <http://excelpro.ir/wp-content/uploads/2015/10/Excel-2010-Bible.pdf>
70. [https://www.researchgate.net/publication/226105300\\_Decision\\_Support\\_Systems\\_Concepts\\_Progress\\_and\\_Issues\\_-\\_A\\_Review](https://www.researchgate.net/publication/226105300_Decision_Support_Systems_Concepts_Progress_and_Issues_-_A_Review)
71. [https://www.hindawi.com/journals/js/2015/195308/Applications\\_of\\_Smartphone-Based\\_Sensors\\_in\\_Agriculture:\\_A\\_Systematic\\_Review\\_of\\_Research](https://www.hindawi.com/journals/js/2015/195308/Applications_of_Smartphone-Based_Sensors_in_Agriculture:_A_Systematic_Review_of_Research)
72. <http://ncert.nic.in/ncerts/l/kect214.pdf>
73. <http://teacherlink.ed.usu.edu/tlresources/training2/Google/GoogleForms.pdf>
24. <http://www.fao.org/publications/card/en/c/24f624ea-7891-45e8-9b24-66cbf13f004d/>
25. [http://indiagovernance.gov.in/files/ict\\_in\\_agriculture.pdf](http://indiagovernance.gov.in/files/ict_in_agriculture.pdf)
26. [www.manage.gov.in/studymaterial/AKM-E.pdf](http://www.manage.gov.in/studymaterial/AKM-E.pdf)
27. [https://www.researchgate.net/publication/233910963\\_Application\\_of\\_Cloud\\_Computing\\_in\\_Agricultural\\_Sectors\\_for\\_Economic\\_Development](https://www.researchgate.net/publication/233910963_Application_of_Cloud_Computing_in_Agricultural_Sectors_for_Economic_Development)

## ENS 301 – Environmental Pollution and Management (1+1)

### Theory

**Unit-I-Pollution in Environment-**Introduction-Pollution- Pollutants – Contaminants – Source and types of pollution in Soil-Water-Air-Impact on environment-Pollution Status in India

**Unit- II Waste water Management:** Waste water – Different types of waste water-pollutants and contaminants-Impact of waste water on ecosystem –Eutrophication – Biomagnification – Water borne diseases –Wastewater treatment methods – Physical, chemical and Biological – General water treatments-Wastewater recycling – Constructed wetlands-Reed bed system -Legislation and standards

**Unit-III-Management of polluted soils:** Soil pollutants – Sources – Urban and Industrial – Heavy metal – Pesticides – PAH's and PCB's-E-Waste-Fate of pollutants in Soil - Management of soil pollution – Bio and phyto remediation of polluted soil

**Unit-IV - Air Pollution and its Management:** Air pollutants from industrial and domestic sources – Fate of air pollutants-Air pollution indicators - Monitoring and Control measures – Role of plants in controlling air pollutants-Legislation and Air quality standards - – Noise Pollution – Sources, Effect and Control Measures-Indoor air pollution and control measures

**Unit-V- Solid waste management:** Solid waste –Sources – Sludge from Industry and farm waste-Characteristics – Environmental problems – Management of sludge and farm wastes – Disposal methods – Sanitary land fills – Incineration – Pyrolysis - Recycling –Energy recovery –Composting – Vermicomposting – Maturity indices assessment-Standards and Legislation

**Unit-VI-Environmental standards, Regulation and EIA -** Environmental standards-CPCB Norms for discharging industrial effluents to public sewers- CDM and Carbon foot print-Environmental Impact Assessment: Stages of EIA -Monitoring and Auditing – Environmental clearance procedure in India

### Lecture Schedule:

29. Introduction-Pollution- Pollutants – Contaminants – Source and types of pollution in Soil-Water-Air-Impact on environment-Pollution Status in India
30. Waste water – Different types of waste water-pollutants and contaminants-Impact of waste water on ecosystem –Eutrophication – Biomagnification – Water borne diseases –
42. Wastewater treatment methods – Physical, chemical and Biological – General water treatments-
43. Wastewater recycling – Constructed wetlands-Reed bed system -Legislation and standards
44. Soil pollutants – Sources – Urban and Industrial – Heavy metal – Pesticides – PAH's and PCB's-E-Waste
45. Fate of pollutants in Soil - Management of soil pollution – Bio and phyto remediation of polluted soil
46. Air pollutants from industrial and domestic sources – Fate of air pollutants-Air pollution indicators – Air pollution episodes-Monitoring and Control measures–
47. Role of plants in controlling air pollutants- Legislation and Air quality standards,
- 48. Mid Semester Examination**
49. Noise Pollution, Sources, Effect and Control Measures, Indoor air pollutants and control measures
50. Solid waste –Sources – Sludge from Industry and farm waste-Characteristics – Environmental problems
51. Management of solid waste, Disposal methods, Sanitary land fills, Incineration, Pyrolysis
52. Recycling –Energy recovery –Composting – Vermicomposting – Maturity indices assessment-Standards and Legislation
53. Environmental standards-CPCB Norms for discharging industrial effluents to public sewers
54. Environment Impact Assessment,Introduction, Stages of EIA, -Monitoring and Auditing
55. CDM and Carbon foot print

56. Environmental clearance procedure in India

### **Practical Schedule**

54. Sample collection and preservation from contaminated sites
55. Waste water treatment by physical (column study with vermiculite and activated charcoal) and chemical (Alum treatment)
56. Waste water treatment through constructed wetland system and characterisation
57. Estimation of Chlorides, Phosphates in waste water
58. Analysis of Nitrogen in industrial effluent and sludge
59. Collection of PAH's contaminated soils and analysis by GC-MS
60. Biosorption of heavy metal (Cr) by using Water hyacinth and analysis through AAS
61. Pesticide Residue analysis in contaminated water
62. Analysis of SPM in air, Methane and CO<sub>2</sub> in Municipal dumping site
63. Assessing the efficiency of plants to control Indoor air pollutants
64. Analysis of Organic carbon in Sludge and Organic manure
65. Composting and Vermicomposting of farm wastes
66. Energy recovery from wastes
67. Maturity indices of compost- C:N ratio and Phytotoxicity test
68. Maturity indices of compost: starch iodine test and sulphide test
69. Visit to water treatment plant

### **70. Final practical examination**

### **Reference:**

36. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (*Concepts, Connections, and Solutions*). Brooks/Cole, Cengage learning publication, Belmont, USA
37. P.D. Sharma, 2009, Ecology and Environment, Rastogi Publications, Meerat, India **E-Books:** Chiras D.D., 2016. Environmental Science, Tenth Edition. Jones & Bartlett Learning, Burlington, MA. ISBN: 978-1-284-05705-8, 708 Pages

## AEN 301 Pests of Crops and Stored Produce and their Management (2+1)

### Theory

**Unit I:** Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of rice, wheat, maize, sorghum, cumbu, ragi, tenai, redgram, green gram, black gram, bengal gram, cowpea, groundnut, castor, gingelly, sunflower, safflower, jatropha, soybean and mustard.

**Unit II.** Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of cotton and sugarcane, green manures (Sunnhemp, Sesbania, Daicha. Glyricidia), forage crops (Lucerne and Subabul)

**Unit III:** Distribution, bionomics, symptoms of damage and management strategies of insect and non-insect pests of Brinjal, Bhendi, Tomato, Chillies, Onion, Garlic, Moringa, Amaranthus, Crucifers, Cucurbits, Mango, Citrus, Banana, Guava, Grapevine and Sapota

**Unit IV:** Distribution, bionomics, symptoms of damage and management strategies of insect and non-insect pests of Pomegranate, Papaya, Aonla, Apple, Pine apple, Custard apple and Jack, Potato, Sweet potato, Tapioca, Yam, Colocasia, Coconut, Arecanut, Tea, Coffee, Cashew, Cocoa, Betelvine, Ginger, Turmeric, Coriander, Cardamom, Pepper, Curry leaf and Tamarind

**Unit V:** Distribution, bionomics, symptoms of damage and management strategies of insect and non-insect pests of Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Cut flowers, Glory lily, Coleus, Stonebreaker, Aswagantha, Senna, Periwinkle and Lawn. Distribution, bionomics, symptoms of damage and management strategies of pests of and stored products. Rodents and birds of agricultural importance and their management. Locusts and their management.

### Practical

Identification of symptoms of damage and life stages of important pests of different field crops *vi.*, cereals, millets, pulses, oilseeds, cotton, sugarcane and green manure crops and horticultural crops *viz.*, vegetables, fruits, spices, tubers, plantation crops, flower crops, medicinal plants, lawn and stored products.

#### Lecture schedule:

Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of

35. Rice – Sucking pests
36. Rice – Borers and defoliators
37. Maize, sorghum and cumbu
38. Wheat, ragi and tenai
39. Redgram, bengalgram, blackgram, greengram and cowpea
40. Groundnut, gingelly and sunflower
41. Castor, soybean, safflower, jatropha and mustard
42. Cotton – Sucking pests
43. Cotton – Bollworms, borers and defoliators
38. Sugarcane
39. Green manures and forage crops - sunnhemp, sesbania, daincha, lucerne, subabul and gliricidia
40. Brinjal, bhendi and tomato
41. Chillies, onion, garlic, moringa and amaranthus
42. Crucifers
43. Cucurbits
44. Mango
45. **Mid semester examination**  
Citrus and banana

Guava, grapevine and sapota  
 Pomegranate, papaya and aonla Apple,  
 pine apple, custard apple and jack  
 Potato, sweet potato, tapioca, yam and colocasia  
 Coconut and arecanut  
 Tea and coffee  
 Cashew, cocoa and betelvine Ginger,  
 turmeric and coriander, Cardamom, pepper,  
 curry leaf and tamarind  
 Rose, jasmine, crossandra, chrysanthemum, tuberose and cut flowers Gloriy  
 lily, coleus, stone breaker, aswagantha, senna, periwinkle and lawn  
 Role of physical, biological, mechanical and chemical factors in deterioration of  
 grain Stored product pests  
 Methods of grain storage and various methods of stored product pest management  
 Mites, slugs and snails, rodents and bird pests  
 Locusts and their management

**Practical schedule: Identification of symptoms of damage and life stages of pests of**

43. Pests of rice
44. Pests of maize, sorghum , cumbu, ragi and tenai
45. Pests of pulses
46. Pests of groundnut, gingelly sunflower and castor
47. Pests of cotton
48. Pests of sugarcane
49. Pests of green manures and forage crops -sunnhemp, sesbania, daincha, lucerne, subabul and gliricidia
50. Pests of brinjal, bhendi and tomato
51. Pests of chillies, onion, garlic, moringa and amaranthus
52. Pests of crucifers and cucurbits
53. Pests of mango, citrus, sapota, banana, grapevine and guava
54. Pests of pomegranate, aonla, papaya, jack, pine apple, custard apple, ber and apple
55. Pests of potato, sweet potato and tapioca
56. Pests of coconut , cashew, cocoa , betelvine , coffee and tea
57. Pests of turmeric, ginger, coriander, cardamom, pepper and curry leaf
58. Pests of rose, jasmine, crossandra, chrysanthemum and tuberose
59. Pests of stored products

**References:**

1. Manisegaran, S. and R.P.Soundararajan. 2010. *Pest Management in Field Crops- Principles and Practices*. Agrobios, Jodhpur, India. 316p. {ISBN (10): 81-7754-321-0}
2. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai. 386 p. {ISBN: 978-81-921477-0-3}
3. Muthukrishnan, N., N.Ganapathy, R.Nalini and R.Rajendran. 2005. *Pest Management in Horticultural Crops*. New Madura Publishers, Madurai. 325p. {ISBN: 81-902832-0-0}
4. Awasthi, V.B. 2007. *Agricultural Insect Pests and their Control*, Scientific publishers (India), Jodhpur, 267p. {ISBN 81-7233-491-5}
5. Dhaliwal, G.S. and Ramesh Arora. 2004. *Integrated pest management Concepts and Approaches*, Kalyani Publishers, Ludhiana, 427p. {ISBN: 81-7663-904-4}
6. Regupathy, A. and R.Ayyasamy. 2013. *A Guide on Crop Pests*. Namrutha Publications, Chennai, 368 p. {ISBN: 978-81-921477-1-0}
7. Srivastava, K.P. and G.S. Dhaliwal. 2011. *A text book of Applied Entomology*. Vol. II, Kalyani Publishers, Ludhiana. 368p. {ISBN: 978-81-272-6752-0}

8. Nair, M.R.G.K. 1986. *Insects and mites of crops in India*. Publications and Information Division, ICAR, New Delhi. 408p.
9. Parvatha Reddy. 2010. *Insect, Mite and Vertebrate Pests and their Management in Horticultural Crops*. Scientific Publishers, Jodhpur. 384p. {ISBN: 978-81-7233-628-8}
10. Butani, D.K. and M.G. Jotwani. 2013. *Insects in Vegetables*. Daya Publishing House, New Delhi. 356p.
11. Regupathy, A. and R. Ayyasamy. 2013. *A Guide on Crop Pests*. Namrutha Publications, Chennai. 368p. {ISBN: 978-81-921477-1-0}
12. Nair, M.R.G.K. 1995. *Insects and Mites of Crops in India*. Indian Council of Agricultural Research, New Delhi, 408p.
13. Ayyar, T.V.R. 1963. *Hand Book of Economic Entomology for South India*. Govt. Press Madras. 25. Sivasubramanian, P., K. Samiayyan, N. Ganapathy, K. Bhuvaneshwari and S. Jayaprabhavathi. 2012. *A treatise on Integrated Pest Management*. Associated Publishing Company, New Delhi. 287 p.
14. Srivastava, K.P. and D.K. Butani. 2009. *Pest Management in Vegetables (Vol. I & II)*. Studium Press (India) Pvt. Ltd., New Delhi. 777p. {ISBN: 978-81-907577-3-7}
15. Sathé, T.V. 2012. *Pests of Ornamental Plants*. Daya Publishing House, New Delhi. 199p. {ISBN: 978-81-7035-757-5}

#### **E- References:**

13. <http://www.ncipm.org.in>
14. <http://agritech.tnau.ac.in/>
15. <http://www.nbaii.res.in/>
16. <http://www.nrcg.res.in/>
17. [ipm.illinois.edu](http://ipm.illinois.edu)

## **AGR 303 Practical crop Production – II (Rabi crop) (0+2)**

21. Each student will be allotted a minimum land area of 100/200 m<sup>2</sup> and he / she will do all field operations in the allotted land from field preparation to harvest and processing.
22. Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce.
23. Any irrigated dry crop (maize / sorghum / pearl millet / finger millet / cotton / groundnut / sunflower / sesame)

### **Practical Schedule for Irrigated dry crop (Eg. Maize):**

24. Ecosystem - Climate and weather - Seasons and varieties of Tamil Nadu
25. Selection of field - Main field preparation - seed treatment - Application of manures and fertilizers - Sowing - Weed management and practicing pre- emergence application of herbicides - Thinning and gap filling - Estimation of plant population - Top dressing - Weed management - Water management - Pest management - Observation on nutrient and weeds - Recording growth, yield attributes and yield
26. Harvesting, threshing and cleaning the produce - Cost of cultivation and economics

1 & 2 .Study of ecosystems, climate, weather, seasons and varieties of Tamil Nadu

3 & 4. Selection of field for maize cultivation

5 & 6. Acquiring skill in seed treatment practices

7 & 8. Study and Practice of main field preparation for maize

9 & 10. Practicing of application of manures and fertilizers for maize

11 & 12. Practicing sowing of maize

13 &14. Acquiring skill in pre-emergence application of herbicides

15 &16. Estimation of plant population and acquiring skill in gap filling and thinning

17 & 18. Observation on nutritional deficiency symptoms and corrective measures

19 & 20. Study of weeds and weed management in maize

20 & 21. Recording growth parameters and assessing dry matter production

22 & 23 Study of water management practices for maize

24 & 25. Observation of insect pests and diseases and their management

26 & 27. Estimation of yield and yield parameters in maize

28 & 29. Harvesting, threshing and cleaning of the produce

30 & 31. Harvesting, threshing and cleaning of the produce

32 & 33. Working out cost of cultivation and economics

42. **Practical**

### **References:**

Ahlawat, I.P.S., Om Prakash and G.S.Saini.2010. Scientific Crop Production in India. Rama Publishing House, Meerut.

Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

Rajendra Prasad. 2012. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi. Reddy,S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.

Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

### **E-References:**

[www.cimmyt.org](http://www.cimmyt.org)

## AGR 304 Principles of Organic Farming (1+1)

### Theory:

#### Unit - I: Components and Principles of Organic Cotton

Organic farming: Definition - Scope - principles and concepts - history of organic farming - global scenario - biodiversity: importance and measure to preserve biodiversity - pre requisites for Organic farming:- Soil organic carbon: status and improvement strategies.

#### Unit - II: Organic sources of Nutrients

Organic sources of nutrients - manures and other inputs - on farm and off farm sources - organic waste recycling - methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers.

#### Unit - III: Non - Chemical weed and Pest disease management

Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological measures - Bio-intensive pest and disease management.

#### Unit - IV: Indigenous Technical Knowledge (ITK)

Indigenous Technical Knowledge (ITK) in organic agriculture - scientific rationale - soil, nutrient, weed, water, management - prospects and problems in organic farming.

#### Unit - V: Certification of label

Organic certification - NPOP guidelines - Certification agencies in India - crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities.

### Lecture Schedule:

76. Organic farming; definition - prospects - principles and concepts - History and genesis of organic farming in World and India: Present status in World, India and Tamil Nadu.
77. Introduction to bio - diversity; importance and measures to preserve bio - diversity.
78. Pre-requisites and basic steps for organic farming; conversation to organic farming - planning and processes in practices - IFS approach - Integration of animal components.
79. Organic carbon; status and improvement strategies - conservative tillage systems.
5. Sources of organic manures - plant, animal and microbial origin - on - farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry and vermicompost.
26. Off-farm resources; coir pith, press mud, oilcakes, flyash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations.
27. Organic waste recycling methods and techniques - composting, vermicomposting, *in situ* composting - system approach.
28. Soil and crop management in organic farming; Inter cropping and companion planting, crop rotation green manures and cover crops, mulching.
- 29. Mid semester examination**
22. Weeds - Ecology - habitat management of weeds - Non - chemical weed management methods; preventive, physical, cultural, use of tools and implements and biological measures - good crop husbandry practices.
23. Integrated pest and diseases management - bio control agents, bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations - sanitation.
24. Indigenous technical knowledge (ITK) in organic agriculture - rationale and principles - general, indigenous practices for soil, nutrient, weed, water pest and disease management in farming - ITK's in farmers practice.
25. Benefits and problems in organic farming.
26. Organic farming; Promotional activities; role of government and NGO's - action plan - policy considerations.
27. Economic evaluation of organic production systems - cost - benefit analysis and comparison with conventional systems.



28. Organic certification - procedures - certification agencies in India - labeling, marketing and export opportunities.
29. Crop production standards - NPOP guidelines - principles, recommendations and standards - Quality considerations - assessment methods - premium and export opportunities.

#### **Practical Schedule:**

24. Resource inventory of organic farm- Soil sampling and analysis for organic carbon and pesticide residues / contaminants.
25. Raising of green manures (Sunnhemp / Daincha / Fodder cowpea).
26. Incorporation of green manure - seed treatment and raising of field crop (Rice / Maize / Cowpea / Cotton / Gingelly).
27. Hands on practice on preparatory cultivation; soil and water conservation methods.
28. Hands on experience on recycling techniques; bio-composting and vermicomposting.
29. Quantification of nutrients from organic sources and application of manures and bio- fertilizers.
30. Exposure visit to an organic farm to learn ITK based preparations.
31. Organic crop production and weed management.
32. Skill development in composting farm residues.
33. Organic crop production and pest management.
34. Exposure visit to bio-control agent (*Pseudomonas*, *Trichoderma* etc.,) production units.
35. Organic crop production and diseases management.
36. Skill development in vermicompost preparation.
37. Hands on training on grading, packaging and post-harvest management.
38. Exposure visit to organic market out lets.
39. Exposure visit to organic certification agencies / Directorate of Organic Certification, Tamil Nadu.

#### **40. Practical Examination**

#### **References:**

- Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobros publishers.
- SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.
- Panda, S.C. 2012. Principles and Practices of Organic Farming. Agribios (India), Jodhpur.
- Gehlot, D. 2010. Organic Farming- Components and Management. Agribios (India), Jodhpur.
- Dushyant Gehlot . 2010. Organic farming: Components and management.Agrobios (India), Jodhpur.
- Ranjan Kumar Biswas.2014. Organic farming in India. N.D.Publishers.New Delhi.

#### **E:References:**

1. [www.ifoam.org](http://www.ifoam.org)
2. [www.apeda.org](http://www.apeda.org)
3. [www.cowindia.org](http://www.cowindia.org)
4. [www.ncof.org](http://www.ncof.org)
5. [www.earthfooda.co.uk](http://www.earthfooda.co.uk),
6. [www.newfarm.org/training](http://www.newfarm.org/training)

## **ABT 301 Plant Biotechnology (2+1)**

### **Theory**

#### **Unit I Basics of Plant Tissue Culture**

Plant tissue culture: Concepts, history and scope - Media and Culture Conditions - Sterilization techniques- Regeneration methods - morphogenesis, organogenesis and embryogenesis - culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture; anther and pollen culture; ovule and embryo culture

#### **Unit II Applied Plant Tissue Culture**

Micropropagation - banana and ornamental plants; National certification and Quality management of TC plants- Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids)- Protoplast isolation and fusion- somaclonal variation- synthetic seeds - secondary metabolite production- invitro germplasm conservation

#### **Unit III Basic Molecular Biology**

Genome organization- prokaryotes vs eukaryotes- Central dogma of life - Structure of nucleic acids - DNA replication, aminoacids and their classification- genetic codes- transcription, translation and protein synthesis- Structure of a gene, regulation of gene expression, Operon concept- basic techniques in molecular biology-Blotting techniques- Polymerase chain reaction- DNA sequencing methods.

#### **Unit IV Recombinant DNA Technology and Genetic Transformation**

DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases - Different types of vectors: plasmids, phagemids, cosmids, BAC - Construction of recombinant DNA molecules- Bacterial transformation - Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method - Tissue specific promoters, selectable and scorable markers, reporter genes- Molecular analysis of transgenic plants – Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality- Detection of GMOs – regulations and biosafety.

#### **Unit V Molecular Marker Technology and Molecular Breeding**

DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs - DNA fingerprinting of crop varieties – Development of mapping populations- linkage and QTL analysis-principles, methods and applications of Marker Assisted Selection in crop improvement- Applications of Plant Genomics and genome databases

### **Practicals**

Biotech Laboratory organization, safety regulations – basics of reagents and solution preparation- Plant tissue culture media preparation- shoot tip culture (rose) - Meristem culture (tapioca)- Micro propagation of banana - Callus culture – Culturing of *E. coli* and determination of growth curve-Isolation of bacterial plasmid DNA- Restriction Digestion and Ligation- Competent cell preparation and Bacterial transformation – confirmation of transformation through colony screening - DNA extraction from plants- Quantification of DNA and quality check through Agarose gel electrophoresis - Molecular marker analysis- DNA fingerprinting using RAPD/SSR markers - NTSys- analysis of diversity in crop plants- Visit to tissue culture units /biotech labs in seed industry/Bt cotton field/tissue culture banana fields

## Lecture Schedule

34. Plant tissue culture: Concepts, history and scope
35. Media and Culture Conditions and Sterilization techniques
36. Regeneration methods - morphogenesis, organogenesis and embryogenesis
37. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture
38. Anther and pollen culture; ovule and embryo culture
39. Micropropagation - banana and ornamental plants
40. National certification and Quality management of TC plants
41. Meristem tip culture (virus free plants) and anther culture (doubled haploids)
42. Protoplast isolation and fusion- somaclonal variation-synthetic seeds
43. Secondary metabolite production, *in vitro* germplasm conservation
44. Genome organization- prokaryotes vs eukaryotes
45. Central dogma of life - Structure of nucleic acids
46. DNA replication- Mechanism
47. Transcription and Post transcriptional processing - RNA splicing
48. Translation - Amino acids and their classification, genetic codes and protein synthesis
49. Concept and structure of a gene- classical and modern concept
- 50. Mid semester Examination**
51. Regulation of gene expression, Operon concept
52. Blotting techniques and Polymerase chain reaction
53. DNA sequencing methods
54. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases
55. Different types of vectors: plasmids, phagemids, cosmids, BAC
56. Construction of recombinant DNA molecules- Bacterial transformation
57. Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method
58. Tissue specific promoters, selectable and scorable markers, reporter genes, Molecular analysis of transgenic plants
59. Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant,
60. Transgenic plants: nutritional enhancement and traits for improved quality
61. Detection of GMOs – regulations and biosafety.
62. DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs
63. DNA fingerprinting of crop varieties
64. Development of mapping populations
65. Linkage and QTL analysis
66. Principles, methods and applications of Marker Assisted Selection in crop improvement
67. Applications of Plant Genomics and genome databases

## Practical schedule

- 20 Biotech Laboratory: Organization and Safety Regulations
- 21 Basics of Reagents and Solution Preparation
- 22 Plant Tissue Culture Media Preparation
- 23 Shoot Tip Culture of Rose
- 24 Meristem Tip Culture of Tapioca
- 25 Micropropagation of Banana
13. Callus Culture
14. Isolation of Bacterial Plasmid DNA
15. Restriction Digestion and Ligation
16. Competent Cell Preparation and Bacterial Transformation
17. Confirmation of Transformation through Colony Screening
18. Genomic DNA Extraction from Plants
19. Quantification of DNA and Quality Check through Agarose Gel Electrophoresis

20. DNA Fingerprinting using PCR
21. NTSys- Analysis of Diversity in Crop Plants
22. Visit to Tissue Culture Units /Biotech Lab in Seed Industry/Bt Cotton Field – Lateral Flow Strip Assay
23. **Final Practical Examination**

## Reference

- Chawla, H S. 2009. **Introduction to Plant Biotechnology (3/e)**. CRC Press , London. 730 P ISBN 9781578086368
- Boopathi, N. M. 2013. Genetic Mapping and Marker Assisted Selection - Basics, Practice and Benefits. Springer Publications
- Brown, T. A. 2010. **Gene Cloning and DNA Analysis: An Introduction**, 6th Edition, Wiley-Blackwell- Companion site (Chapters 1 to 12 and 15)
- Chahal, G. S. and Gosal, S. S. 2003. *Principles and Procedures of Plant Approaches Breeding Biotechnological and Conventional*. Narosa Publishing House, New Delhi
- Dubey, R. C. 2014. A textbook of Biotechnology. 5<sup>th</sup> revised Edn. S. Chand Publications. New Delhi
- George, E. F, Hall M. A. and Geert-Jan De Klerk. 2009. **Plant Propagation by Tissue Culture**, 3rd Edition, Springer, The Netherlands. 501p.
- Gupta, P. K. , 2015. *Elements of Biotechnology* 2<sup>nd</sup> Edn. Rastogi and Co. , Meerut.
- Neal Stewart, Jr. C. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications John Wiley & Sons, Inc ISBN: 978-0-470-04381-3
- Nelson, D. S. and M. M. Cox. 2012. **Lehninger's Principles of Biochemistry. Sixth edition. Chapters- 1,3,8,9,25,26,28** (weblinks, tutorials and lecture companion art) W. H. Freeman and
- Razdan M K, 2014. *Introduction to plant Tissue Culture* 2<sup>nd</sup> Edn. Science Publishers, inc. USA.
- Singh, B. D. 2012. *Plant Biotechnology*. Kalyani publishers, Ludhiana
- Tomar, R. S. , Parakhia, M. V. , Patel, S. V. and Golakia, B. A. , 2010. *Molecular markers and Plant Biotechnology*, New Publishers, New Delhi.
- Xu, Y 2010. **Molecular Plant Breeding**. International Maize and Wheat Improvement Centre (CIMMYT). 752 Pages

## E- Reference

1. <http://www.isaaa.org/india/>- Briefs
2. <http://www.nal.usda.gov>.
3. <http://www.agbiotechnet.com>.
4. <http://www.agbioworld.org>
5. <http://www.cropgen.org>.
6. <http://www.agbiosafety.unl.edu/>.

## **PBG 302 Crop Improvement (2+1)**

### **THEORY**

#### **Unit I: Cereals**

Place of origin – putative parents – related wild species – breeding objectives–breeding methods–conventional and innovative methods-heterosis breeding and important varieties in following cereals: Rice, Wheat, Maize, Sorghum, Pearl millet, Finger millet

#### **Unit II: Pulses and Oilseeds**

Place of origin – putative parents – related wild species – breeding objectives–breeding methods–conventional and innovative methods-heterosis breeding and important varieties in following crops  
Pulses: Redgram, Bengal gram, Greengram, Blackgram, Cowpea, Soybean. Oilseeds: Groundnut, Sunflower, Gingelly, Castor, Rape and Mustard.

#### **Unit III: Cash crops, Fodder and Horticultural crops**

Place of origin – putative parents – related wild species – breeding objectives–breeding methods–conventional and innovative methods-heterosis breeding and important varieties in following crops

Fibres: Cotton; Sugars: Sugarcane; Starch: Potato; Fumitories: Tobacco, Fodder: Guinea grass, Napier, Cumbu – Napier, Lucerne, *Stylosanthes*; Horticultural crops: Bhendi, Tomato, Brinjal, Papaya, Banana

#### **Unit IV: Breeding for Biotic and Abiotic stresses and Quality**

Breeding for insect resistance – mechanisms, basis, genetics of insect resistance - suitable breeding methods- merits and demerits of resistance breeding; Breeding for disease resistance – horizontal and vertical resistance- Gene for gene hypothesis – mechanisms, genetics of disease resistance; Suitable breeding methods for disease resistance- exploitation of vertical resistance in plant breeding- multilines, gene pyramiding, gene deployment.

Breeding for Abiotic stress – drought – mechanisms, basis, genetics of drought resistance - suitable breeding methods -limitations of drought resistance breeding; Breeding for Abiotic stress – salinity and alkalinity;

Breeding for quality traits- Important quality traits in different crops- nutritional quality of cereals and pulses-Genetics of nutritional traits-breeding methods- Breeding for low toxic substances- limitations of breeding for enhanced nutritional quality

#### **Unit V: Hybrid seed production techniques and ideotype breeding**

Hybrid seed production techniques in rice, maize and redgram

Ideotype breeding- main features-difference between traditional and ideotype breeding- - crop ideotypes in rice, wheat, cotton- steps in ideotype breeding- merits and demerits of ideotype breeding

### **PRACTICAL**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops- Rice, Maize and Sorghum, Pearl millet and Finger millet, Redgram, Bengal gram, Green gram, Black gram, Cowpea and Soybean, Groundnut and Sunflower, Sesame and Castor, Cotton, Sugarcane, Guinea grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*, Bhendi, Brinjal, Tomato, Papaya and Banana, Study of quality characters in rice, Study of donor parents for different characters, General seed production techniques in field crops, Visit to AICRP and seed production plots of different field crops

## Lecture schedule

Place of origin – putative parents – related wild species – breeding objectives–breeding methods–conventional and innovative methods-heterosis breeding and important varieties in following crops:

27. Cereals: Rice.
28. Cereals: Rice.
29. Cereals: Rice.
30. Cereals: Wheat
31. Cereals : Maize
32. Cereals: Sorghum
33. Cereals: Pearl millet, Finger millet,
34. Pulses: Redgram
35. Pulses: Greengram, Blackgram,
36. Pulses: Soybean, Bengal gram
37. Pulses: Cowpea
38. Oilseeds: Groundnut
39. Oilseeds: Gingelly, Rapeseed and Mustard
40. Oilseeds: Castor and Sunflower
41. Fibres: Cotton
42. Sugars: Sugarcane
43. **Mid Semester Examination.**
44. Starch: Potato
45. Fumitories: Tobacco
46. Forage grasses and legumes: Guinea grass, Napier, Cumbunapierhybrid, Lucerne, *Stylosanthes*
47. Breeding for sexually propagated horticultural crops- Bhendi, Tomato
48. Breeding for sexually propagated horticultural crops- Brinjal, Papaya
49. Breeding for clonally propagated horticultural crops- Banana
50. Breeding for insect resistance – mechanisms, basis, genetics of insect resistance- suitable breeding methods- merits and demerits of resistance breeding
51. Breeding for disease resistance –horizontal and vertical resistance- Gene for gene hypothesis – mechanisms, genetics of disease resistance
52. Suitable breeding methods for disease resistance- exploitation of vertical resistance in plant breeding- multilines, gene pyramiding, gene deployment.
53. Breeding for Abiotic stress – drought – mechanisms, basis, genetics of drought resistance - suitable breeding methods-limitations of drought resistance breeding
41. Breeding for Abiotic stress – salinity and alkalinity
42. Breeding for quality traits- Important quality traits in different crops- nutritional quality of cereals and pulses-
43. Genetics of nutritional traits-breeding methods- Breeding for low toxic substances-limitations of breeding for enhanced nutritional quality
44. Hybrid seed production techniques in rice
45. Hybrid seed production techniques in maize
46. Hybrid seed production techniques in redgram
47. Ideotype breeding- main features-difference between traditional and ideotype breeding- - crop ideotypes in rice, wheat, cotton- steps in ideotype breeding- merits and demerits of ideotype breeding

## Practical schedule

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops.

28. Rice

29. Maize and Sorghum
30. Pearl millet and Finger millet
31. Red gram, Bengal gram and Soybean
32. Green gram, Black gram and Cowpea
33. Groundnut and Sunflower.
34. Sesame and Castor
35. Cotton
36. Sugarcane
37. Guinea grass, Cumbu – Napier hybrids Lucerne and *Stylosanthes*
38. Bhendi, Brinjal, Tomato
39. Papaya and Banana
40. Study of quality characters in rice
41. Study of donor parents for different characters
42. General seed production techniques in field crops
43. Visit to AICRP and seed production plots of different field crops
- 44. Final Practical Examination**

## References

- Singh, B.D. 2007. Plant breeding - Principles and methods.
- Phundan Singh. 2015. Essentials of Plant Breeding. Kalyani Publishers, New Delhi
- Harihar Ram and HariGovind Singh, 1994. Crop breeding and Genetics. Kalyani Publishers, New Delhi.
- D.N.Bharadwaj.2012. Breeding Field Crops. Agrobios (India),Jodhpur - 342002
- HariHar Ram,2011. Vegetable Breeding– Principles and Practice, Kalyani Publishers, New Delhi.
- N.Kumar.2006. Breeding of horticultural crops- Principles and Practices. New India Publishing Agency. New Delhi
- D.A.Sleper and J.M.Poehlman. 2007. Breeding Field Crops. Blackwell Publishing Professional (USA)
- H.H.Ram. 2011. Crop Breeding and Biotechnology. Kalyani Publishers (India)
- Chopra, V.L. 1990. Plant Breeding. Theory and Practice. Oxford and IBH Publishing Co., New Delhi.
- Daniel Sundararaj, D., G.Thulasidas, and M. Stephan Dorairaj. 1997. Introduction to Cytogenetics and Crop improvement. Popular Book Depot, Chennai - 15.
- Sharma, J.R. 1994. Principles and practice of Plant Breeding. Tata McGraw - Hill Publishing Co. Ltd., New Delhi.
- Singh, R.B., R.M. Singh and B.D. Singh, 1984. Advances in Cytogenetics and crop improvement. Kalyani Publishers, New Delhi.

## E- References

1. [www.cimmyt.org](http://www.cimmyt.org)
2. [www.nbgr.nic.in](http://www.nbgr.nic.in)
3. [www.irri.org](http://www.irri.org)
4. [www.icrisat.org](http://www.icrisat.org)

## VII SEMESTER

<b>S No.</b>	<b>Course code</b>	<b>Course Title</b>	<b>Credit Load</b>
1	AEX 401	Student READY programme (Rural Agricultural Work Experience and Agro-industrial Attachment)	0+20
2	AGR 401	Project Report Preparation, presentation and Evaluation	0+1
3.	AEX 402	All India Study Tour*	0+1

Non gradial compulsory



## **AEX 401 Rural Agricultural Work Experience (RAWE) (0+20)**

### **UNIT I Village Resource Inventory and Planning** (using PRA tools, Rich pictures, GIS maps, secondary data, interview, etc.)

- Describe the Natural Resources - Village boundaries, topography, historical background, water resources (river, canal, tank, etc.), soil resources, vegetation (trees, crops, etc.), fodder, animal
  - husbandry (milch cattle, poultry, goatery, fishery, etc.), wild animals, climate, land utilization pattern, etc.
- Describe the Agricultural scenario - Cropping pattern, cropping systems, farming systems, area, production and productivity of crops, adoption pattern of recommended varieties / hybrids,
- technologies and machinery / implements, organic farming, contract farming, etc.
- Explain the Demographic details – population, literacy, land holdings, farmers, farm women, youth, caste, labour, etc.
- Analyze the Social factors – social structure, social stratification, social change, social groups, culture, social control, leadership, social processes, migration, social customs, social issues, etc.
- Study the Socio-psychological factors – group processes / dynamics, attitude towards innovations, etc.
- Assess the Village Infrastructure - Educational institutions, Government institutes / offices, private firms / offices, NGOs, Societies, Banks, Panchayat Union / Grama Panchayat, Clubs, SHGs, FPOs,
- Associations, Communication facilities, transport facilities, railway station, police station, hospitals, clinics, veterinary hospital, post office, markets, community centers, religious places of worship, etc.
- Analyze the Problems / Constraints – Problem / Constraints related to farming, marketing, processing, transport, communication, access to extension and other services, etc.
- Prepare village development plans in consultation with different stakeholders.

### **Unit II Farm Resource Inventory and Planning** (using maps, Rich pictures, farm system modeling, family tree charts, flow diagrams, interview, etc.)

- Describe the Farm boundaries, topography, water resources, soil resources, vegetation, animal enterprises, etc.
- Describe the cropping pattern, cropping system, farming system, agri-business, etc.
- Explore Farmers Practices – Indigenous Technical Knowledge (ITK). Identify the constraints of the system environment (natural, economic, social, political, legal).
- Assess the linkages with Extension agencies, Markets, Input agencies, Media, Development departments, etc.

- Identify and describe all the people involved in the farm, their work, roles, visions, needs, values, interests and relationships.
- Analyze the system in terms of satisfying current needs. What are the critical factors that need to be managed to sustain the system? Are there opportunities for growth and development to satisfy the
- future needs of the system? Are there threats that also need to be managed?
- Describe the different sub-systems viz., production sub-system, management sub-system, marketing sub-system, human activity sub-system, landscape and natural sub-system, etc., and their relationships.
- Identify the linkages with the Supra System viz., economic, political, legal and social.
- Find out the adoption pattern of recommended varieties / hybrids, technologies, machinery / implements, etc.
- Analyze the financial status and performance of the system - Economics of production (area, production, productivity, yield gaps, net returns, cost benefit ratio, etc).
- Prepare farm development plans for different types of farmers, by involving them so as to improve
- their systems.

### **Unit III Studying activities of State Department of Agriculture**

Visit to Office of Assistant Director of Agriculture to study the organizational structure, functions, duties and responsibilities of extension personnel, ATMA, schemes implemented, extension activities conducted, etc. Involve in different extension activities such as village meetings, demonstrations, campaigns, exhibition, radio / TV programmes and record observations and lessons learnt.

### **Unit IV Studying activities of an NGO**

Visit to an NGO to study the organizational pattern, functions, projects, duties and responsibilities of staff, extension activities, schemes implemented, funding sources, etc.

### **Unit V Studying activities of an Agri Business Firm**

Visit to an Agri-business firm to study the business activities, projects, managerial functions viz., planning, supervision, delegation, communication, budgeting, and related aspects.

**AEX 402**

**All India Study Tour**

**Syllabus**

59. Visit to important National and International institutes related to agriculture, horticulture, forestry and allied fields in various regions of the country. Exposure to varied agro-climatic zones, crops grown, cultivation practices, socio-economic and cultural features of the farming community in different parts of the country.

### VIII SEMESTER

<b>(Experiential Learning Programme/ HOT)</b>	
<b>Module</b>	<b>Credit Hrs.</b>
1. Module-I	0+10
2. Module-II	0+10
<b>Total</b>	<b>0+20</b>

S. No.	Course code	Titles of the module	Credits
1.	AGM 451	Bio-inoculant production technology	0+10
2.	HOR 451	Hybrid Seed Production in Vegetable Crops	0+10
3.	SAC 451	On Farm Advisory for Soil Health, Water Quality & Plant Nutrition	0+10
4.	AEN 451	Commercial Beekeeping	0+10
5.	SER 451	Commercial Cocoon Production	0+10
6.	ABT 451	Commercial Plant Tissue Culture	0+10
7.	HOR452	Commercial Nursery Technology of Horticultural Crops	0+10
8.	HOR 453	Commercial Landscape Gardening	0+10
9.	PAT 451	Commercial production of Bio-control agents	0+10
10.	PAT 452	Commercial mushroom production	0+10
11.	AMP 451	Commercial broiler and layer production	0+10
12.	SST 451	Commercial seed production	0+10
13.	PBG 451	Hybrid pearl millet seed production	0+10
14.	PBG 452	Hybrid rice parental line seed production	0+10
15.	ARM 451	Managerial skills for Agribusiness	0+10
16.	AGR 451	Development of Integrated Farming system Model	0+10
17.	HOR 454	Protected cultivation of Vegetable crops	0+10
18.	ENS 451	Composting technology	0+10
19.	AGR 452	Organic Agriculture	0+10

## AGM 451 Bioinoculants Production Technology (0+10)

Week	Activities
	<ul style="list-style-type: none"><li>- Biofertilizers - types, production and demand in India; Importance and contribution of biofertilizers in Agriculture and allied sectors. Economics of biofertilizer production. Calculation of commercial production cost – fixed cost- cost of building, equipments and glasswares and variable cost - raw materials, maintenance, labour cost <i>etc.</i>,</li><li>- Exposure visit to biofertilizer production unit. Facilities and equipments required for laboratory scale, pilot scale and large scale biofertilizer production (liquid and carrier) – principles and specifications. Raw materials required-glass wares, chemicals, printed poly bags and carrier material - specifications of raw materials. Isolation, purification and characterization of nitrogenous biofertilizers – <i>Azotobacter</i>, <i>Azospirillum</i>, <i>Rhizobium</i> and <i>Gluconoacetobacter</i>.</li><li>- Isolation and purification of nitrogenous biofertilizers – Azolla and Blue Green Algae (BGA). Screening of nitrogen fixers - plant nodulation tests for <i>Rhizobium</i>. Use of Gas Chromatography for nitrogenase assay. Nitrogenase activity by ARA (nodule and broth cultures of <i>Azotobacter</i>, <i>Azospirillum</i> and <i>Gluconoacetobacter</i>).</li><li>- Isolation, purification and characterization of phosphate solubilizing and potassium releasing (silicate solubilizing) bacteria. Selection of efficient strains by testing their ability under <i>in vitro</i> conditions. Isolation of AM spores from soil and morphological characterization of AM spores.</li><li>- Selection of efficient AM fungi by plant infection tests. Isolation, purification and characterization of sulphur oxidizing and zinc solubilizing microbes. Screening of efficient sulphur oxidizing and zinc solubilizing microbes.</li><li>- Isolation, purification and characterization of plant growth promoting bacteria - Pink Pigmented Facultative Methylophiles (PPFM) and screening of PPFM. Development of markers for easy identification-application of real time PCR in strain identification.</li><li>- Preparation of medium and carrier material for large scale production. Mass production of <i>Azotobacter</i>.</li><li>- Mass production of <i>Rhizobium</i>.</li><li>- Mass production of <i>Azospirillum</i>.</li></ul>
36.	Mass production of phosphate solubilizer.
37.	Mass production of <i>Gluconoacetobacter</i> and potassium releasing bacterium (silicate solubilizing bacterium).
38.	Mass production of PPFM.
39.	Mass production of AM fungi, Azolla and BGA.
40.	BIS standards / Fertilizer Control Order – Specifications and quality control measures for various biofertilizers. Storage and preservation of various microbial cultures – sub culturing, lyophilization <i>etc.</i> , Establishment of Ideal biofertilizer unit; Shelf life and storage of biofertilizers. Constraints in mass production of various biofertilizers. Biofertilizers - Organic certification – processes to be followed – Agencies for Certification. <i>Rhizobium</i> , <i>Azospirillum</i> and <i>Azotobacter</i> . Quality control laboratories in India.
41.	Application techniques– form, dose, method and time of application of biofertilisers – <i>Rhizobium</i> , <i>Azospirillum</i> , <i>Azotobacter</i> , <i>Gluconoacetobacter</i> , phosphate solubilizers, potash releasers and sulphur oxidizers, Azolla, BGA, AM fungi and PPFM. Exposure to advanced techniques in biofertilizer production - Tangential Flow Filtration, lyophilized cells production and automatic packing unit. Visit to biofertilizer inoculated fields in university, farmer's holding and interaction. Evaluation of plant response to biofertilizer application.
42.	Financing - credit facilities – assistance – facility available for establishing biofertilizer production & 17 units- licensing required <i>etc.</i> , Formulation and presentation of a bankable project for production of fixed quantity of various biofertilizers.

### References

78. Motsara, M.R., Bhattacharyya, P., and Beena Srivatsava. 2004. Biofertiliser Technology, Marketing and Usage – A source book- Cum -Glossary

79. [Somani L.L.](#), 2011. Biofertilisers: Commercial Production Technology and Quality Control  
Publishers:  
ATPA. (ISBN-10: 8183211968, ISBN-13: 978-8183211963)
80. NIIR 2012. The Complete Technology Book on Biofertilizer and Organic Farming NIIR Project  
Consultancy Services, New Delhi. P. 608. (ISBN: 9789381039076)
81. Reeta Khosla 2017. Biofertilizers and Biocontrol Agents for Organic Farming, Publishers: Kajo  
press.  
(ISBN-10: 8192756793,ISBN-13: 978-8192756790)

## **AGR 451 Development of integrated farming system model (0+10)**

### **Conceptual understanding of IFS in the course**

Farming system: concepts, scope, objectives and advantages

Cropping systems for different agro climatic zones of India and Tamil Nadu  
Crop diversification and intensification in farming system perspective

Integrated Farming Systems

Enterprises selection in Integrated Farming Systems

Integrated Farming System models for wetland ecosystem  
Management of different enterprises of wetland IFS

Integrated farming system models for irrigated dry land ecosystem  
Management of different enterprises of irrigated dry land IFS

Integrated farming system models for dry land ecosystem  
Management of different enterprises of dry land IFS

Interaction between different components of IFS  
Resource recycling in integrated farming system  
IFS research methodology and evaluation

Carbon foot-printing and green house gas emission studies in IFS models  
Farming system characterization for up scaling IFS models to field / farm. Preparation of bankable projects in IFS under wetland eco-system.

Preparation of bankable projects in IFS under irrigated dry land ecosystem  
Preparation of bankable projects in IFS under dryland ecosystem.

## ABT 451 Commercial Plant Tissue Culture (0+10)

### Practicals (Weekly Schedule)

#### 81. Basics and establishment of Plant Tissue Culture Laboratory

Organization for a plant tissue culture laboratory - Sterilization methods -Equipments and instruments in PTC - Surface sterilization of explants - Handling tissues in aseptic conditions under laminar flow chamber

#### 2. Medium and stock solution preparation-I

Familiarization of different chemicals- inorganic nutrients – carbon sources, vitamins and growth regulators –solidifying agents - Stock solutions preparation for MS medium and B5 medium

#### 3. Medium and stock solution preparation-II

Stock solutions preparation for WPM medium - Medium preparation- MS medium, B5 medium, WPM medium - Sprouting of tubers in potato

#### 4. Meristem and Micropropagation in cassava, rose and chrysanthemum

Meristem tip culture- medium preparation - Meristem tissue culture – cassava - Media preparation for micropropagation in rose and chrysanthemum - Micropropagation in rose and chrysanthemum

#### 5. Micropropagation of banana and neem

Media preparation for micropropagation in banana, neem, eucalyptus, *Aloe vera*, *Phyllanthus* and potato - Micropropagation in banana and neem

#### 6. Micropropagation of eucalyptus, *Aloe vera* and *Phyllanthus*

Micropropagation in eucalyptus, *Aloe vera*, *Phyllanthus* - Media preparation for micropropagation in sugarcane and bamboo - Inoculation of potato sprouts

#### 7. Micropropagation of Sugarcane, bamboo and sub culturing

Micropropagation- sugarcane, Bamboo - Medium preparation for subculturing in rose, chrysanthemum, banana, neem, eucalyptus and *Phyllanthus*

#### 8. Sub culturing -I

Medium preparation for subculturing- meristem tip culture, sugarcane and *Aloe vera*, bamboo, microtuber induction in potato - Subculturing in rose and chrysanthemum

#### 9. Sub culturing -II

Subculturing in banana, neem and eucalyptus -**Mid semester Examination-** Subculturing in *Phyllanthus*, *Aloe vera* and cassava

#### 10. Callus induction in *Phyllanthus* and *Coleus* and rooting

Subculturing in sugarcane and bamboo - Medium preparation for callus induction in *Phyllanthus* and *Coleus* - Inoculation of explants for callus induction in *Phyllanthus* and *Coleus* - Medium preparation for rooting in rose and chrysanthemum

#### 11. Media preparation and inoculation for rooting of microshoots

Medium preparation for rooting in banana, neem, eucalyptus, *Aloe vera*,*Phyllanthus*, bamboo, cassava and sugarcane - Inoculation of micro shoots for rooting in rose, chrysanthemum, banana and neem



## 12. Inoculation for rooting of microshoots and hardening

Inoculation of microshoots for rooting in eucalyptus, aloe vera, phyllanthus, bamboo, cassava and sugarcane - Observations on microtuber induction in potato - Hardening chambers- mist-chamber, glasshouse, polyhouse and tunnel house - Hardening procedures, visit to any hardening facility

## 13. Synthetic seed preparation and Establishment of cell suspensions

Subculturing for proliferation of callus-medium preparation - Synthetic seed preparation-stocks preparation - Subculturing of callus and synthetic seed preparation. Cost-effective methods in PTC - Establishment of suspensions-medium preparation

## 14. Secondary metabolite production and analysis

Suspension culture in *Phyllanthus* and *Coleus*- Hairy root cultures with *Agrobacterium rhizogenes* - Preparation of stocks, medium for hairy root infection - Growth parameters for suspension- Fresh and dry weight, PCV and viability assay - Extraction of secondary metabolites and analysis through HPLC-GC-MS. Bioassay of secondary metabolites- anti-bacterial and anti-fungal activity.

## 15. Field transfer of TC plants

Field transfer of tissue culture plants – Hardening procedures and maintenance of regenerated plants. National certification system for tissue culture plants-application procedures. Visit to a field planted with TC plants. Visit to an Accredited Test Lab/National Certification Centre- NRCB, Trichy.

## 16. Entrepreneurship development I

Visit to a commercial tissue culture laboratory - Meeting the entrepreneur - Guest lecture from experts from financial institutions-funding opportunities.

## 17. Project preparation

Project preparation for Plant tissue culture - **Practical Examination**

### References

1. Razdan, M.K. 2003. **Introduction to Plant Tissue Culture**. Enfield: Science Publishers Inc. USA
2. Dixon, R. A. 2003. **Plant Cell Culture – A Practical Approach**, IRL Press. Oxford. London
3. *Gamborg OL, Phillips GC (2004) Plant cell tissue and organ culture. Fundamental methods. Narosa Publishing House, New Delhi*
4. George E.F., Hall, M.A. and De Klerk, G.J. 2008. **Plant Propagation by Tissue Culture. Volume 1. The Background**. 3rd edition. Springer. Netherlands
5. Robert N. Trigano and Dennis J. Gray, 2000. **Plant Tissue Culture. Concepts and laboratory exercises**. Second edition. CRC press. London.

### E-References

1. [www-pub.iaea.org/mtcd/publications/pdf/te\\_1384\\_web.pdf](http://www-pub.iaea.org/mtcd/publications/pdf/te_1384_web.pdf)
2. [dbtindia.nic.in/NCS/Guideliness.pdf](http://dbtindia.nic.in/NCS/Guideliness.pdf)
3. [dbtmicropropagation.nic.in/surveytcp.pdf](http://dbtmicropropagation.nic.in/surveytcp.pdf)
4. [www.agritechpublications.com/article.htm](http://www.agritechpublications.com/article.htm)

## **AGR 452 Organic Agriculture (0 +10)**

### **Organic nutrient and weed management**

Quantification of cow dung and cow urine recovery per animal - analysis their nutrients constituents- Methods of storing of cow dung - analysis of temperature, nutrients and microbial load in different layers of manure pit -Quantification of yield and nutrient content of fodder crops grown organically- Quantification of biomass for different green manures and green leaf manures grown organically- Experiencing mulching and other techniques in weed management.

### **Biofertilizers preparation**

Introduction to biofertilizers and equipments – Isolation of bacterial biofertilizers – Method of application of biofertilizers – Arbuscular Mycorrhizal Fungi – Production and Assessment of infective propagules – Cyanobacterial biofertilizer – PPFM and liquid bioinoculants

### **Organic manure preparation**

Biological wastes, farm wastes: collection, segregation, pre digestion of wastes, Biocompost preparation in pit method and vermicompost bed formation - Preparation of Panchagavya, Jeevamruth and EM and characterization – Harvest of biocompost and vermicompost – Compost maturity indices – FAO standard – Enriched compost preparation – Preparation of bankable project on establishment of organic input production unit.

### **Eco-friendly Pest Management**

Establishment of model pest repellants cafeteria - Preparation and application of herbal leaf extracts in pest management - Monitoring of insect pests through traps and lures - Fruit fly trapping survey in horticultural crops - Case study on Agro-Eco System Analysis (AESA) - Push and Pull Strategies in organic crop protection.

### **Non chemical diseases management**

Diagnosis of disease symptoms and pathogens ,Preparation of enriched farm yard manure and methods of application of bio control agents - Cultural methods of disease management-Disease assessment and scoring - Removal of pathogens like ergot by mechanical methods- Preparation and foliar spraying of Arappu butter milk extract - Preparation and foliar spraying of pseudomonas butter milk extract- Preparation and foliar spraying of garlic vasambu extracts - Preparation and foliar spraying of cowdung 20% extract for BLB management- Preparation and foliar spraying of anti viral principles - Role of milk, curd and buttermilk in disease management.

### **Organic Certification and Preparation of Bankable Projects**

Organic certification – Importance and scope – Procedure for obtaining certification — Post harvest management and value addition, supply chain management -Preparation of bankable projects – Visit to Tamil Nadu Organic Certification Department and organic outlets – Visit to Nationalized Banks to learn about funding for projects.

## Experiential Learning –Organic Agriculture (0 +10)

### Class Schedule

1 week	Quantification of cow dung and cow urine recovery per animal and analysis their nutrients constituent. Methods of storing of cow dung and analysis of temperature, nutrients and microbial load in different layers
2 week	Quantification of yield and nutrient content of fodder crops grown organically. Quantification of biomass for different green manures and green leaf manures grown organically.
3 week	Experiencing mulching techniques in weed management
4 week	Introduction to biofertilizers, equipments and Good Laboratory practices Preparation of culture media for biofertilizers Isolation of <i>Rhizobium</i> from root nodules of leguminous plants Isolation of <i>Azospirillum</i> from roots of cereal crops/ grasses Isolation of phosphobacteria from soil Microscopic observation of biofertilizer cultures
5 week	Population assessment of bacterial biofertilizers Method of application of bacterial biofertilizers Mass production of Arbuscular Mycorrhizal Fungi Identification of AM propagules in roots and soil Mass production of <i>Azolla</i> and method of application PPFM and Liquid bioinoculants
6 week	Collection, segregation, shredding and quantification of biological wastes/ farm wastes for biocompost and vermicompost preparation and initiating the pre digestion process (15 days)
7 week	Procuring inputs for preparing the formulations of <i>Panchagavya</i> , Jeevamruth and Effective Microorganisms (EM) -EM to be prepared from mother culture obtained from progressive organic farmers for multiplication Formation of beds and digging of compost pit of required size based on the availability of the farm wastes. Filling the pit and bed for biocompost
8 week	Vermicompost process respectively. Release of earthworms onto the compost bed Monitoring the composting process for moisture and temperature for efficient composting. Sampling of partially decomposed material for determining the nutritive value especially carbon build up
9 week	Harvest of matured composts, quantification and assessment of compost maturity indices and comparing with FAO standards for marketability. Characterization of <i>Panchagavya</i> , Jeevamruth and EM formulations Preparation of enriched biocompost, vermicompost and FYM using <i>Azospirillum</i> and <i>Azotobacter</i> or <i>Azophos</i>
10 week	Establishment of model pest repellants cafeteria. Preparation and application of herbal leaf extracts in pest management.
11 week	Monitoring of insect pests through traps and lures. Fruit fly trapping survey in horticultural crops.

12 week	Case study on Agro-Eco System Analysis (AESAs). Push and Pull Strategies in organic crop protection.
13 week	Preparation of a bankable project on Establishment of a pilot scale organic manure production unit for obtaining bank loans Diagnosis of disease symptoms and pathogens and cultural methods of disease management Disease assessment and scoring.
14 week	Removal of pathogens like ergot by mechanical methods. Preparation and foliar spraying of Arappu butter milk extract and foliar spraying of pseudomonas butter milk extract Preparation and foliar spraying of garlic vasambu extracts Preparation and foliar spraying of cowdung 20% extract for BLB management
15 week	Organic certification – Importance and scope Procedure for obtaining certification Post harvest management and value addition
16 week	Supply chain management in Organic Farming Exposure visit to Tamil Nadu Organic Certification Directorate and organic outlets
17 week	Preparation of bankable projects Evaluation of individual and group assignments and report submission Visit to Nationalized Banks to learn about funding for projects.
	<b>Final Practical Examination</b>

## **PBG 452 Hybrid rice: Parental line seed production technique (0+10)**

### **Activities:**

21. 1<sup>st</sup> week : Studying botany of Rice, Hybrids and their development , breeding methods used in hybrid rice parental line development, Impact of Hybrid Rice in Tamil Nadu.
22. 2<sup>nd</sup> week : Selection of field based upon the land with adequate fertility, drainage, irrigation, sun light and free air with adequate isolation distance (100 m distance isolation or 25 days time isolation).
23. 3<sup>rd</sup> week and 4<sup>th</sup> week: Seed treatment with Carbendazim, *Pseudomonas fluorescens* and *Azospirillum*

### **Staggered sowing of A x B line seed production in CORH 3 rice Hybrid**

CORH 3

A - Female (Male  
sterile) TNAU CMS 2A

B - Male (Maintainer  
line) TNAU CMS 2B

### Staggered sowing of parents

First sowing of Male line (B1) 3 days before A line sowing – 3kg

Single sowing of the entire female (A) line seeds - 20kg and second sowing of male line (B2) 3kg  
on the same day

Third sowing of Male line (B3) 3 days after A line sowing – 4kg

### A line seed production in CORH 3

37. 5<sup>th</sup> week

Seedlings pest and disease management in nursery

Main field preparation

6<sup>th</sup> week

Transplanting the seedlings in the main field

A x B

Ratio - Female: Male	=	6 : 2
Seedlings/hill for Female (A) line	=	1 (with two to three tillers)
Seedlings / hill for Male (B) line	=	2-3
Spacing in Female (A) line	=	10 x 15 cm
Spacing in Male (B) line	=	30 x 15 cm
Spacing between 'A' and 'B' lines	=	20 cm

7<sup>th</sup> week and 8<sup>th</sup> week

Weedicide application : Three days after planting, application of Butacholor @ 2.5 litres / hectare with 50 kg sand retaining 1 cm water in the main field. After weedicide application, the water should not be drained from the field for two days

Gap filling : Within 7 - 10 days after planting.

Fertilizer application

40. 9<sup>th</sup> week and 10<sup>th</sup> week

Crop protection measures to be followed

Fertilizer application (Top dressing)

### Panicle initiation and flowering

Flowering: 'A' line should be earlier by one or two days.

### Adjustment of flowering date

If the flowering is to be delayed, spray 2% urea solution with Knapsack sprayer to induce vegetative growth.

If the flowering is to be hastened, apply 2% DAP solution to arrest vegetative growth.

**By this method 3-4 days difference in flowering can be adjusted.**

Copious irrigation hastens the flowering in Male (B) line

Draining the water will delay the flowering in Male (B) line

If there is early flowering in Male (B) line than the Female (A) lines those ear heads may be jerked (removed)

15. 11<sup>th</sup> week and 12<sup>th</sup> week Fertilizer application ( Top dressing)

### **Rogueing**

Genetically different plants in both 'A' and 'B' lines should be removed periodically from tillering stage onwards  
Pollen shedders in 'A' line should be removed from flowering to grain filling stage daily

### **GA3 application**

Panicle exertion is incomplete in 'A' line

Two times of GA3 spray with Knapsack sprayer is needed to make the complete panicle exertion

First spray of 60g GA3 in 500 litres of water/ha at the time of 20 percent flowering

Second spray 40g in 500 litres of water/ha on the next day within 24 hours after the first spray

Dissolve GA3 first in Methyl alcohol 1g in 10 cc and then in water

Spray the solution at 8.00 to 10.00 a.m. or 4.00 to 6.00 p.m.

49. 13<sup>th</sup> week

### **Supplementary pollination**

It is done to promote higher cross pollination.

Rope pulling or stick shaking for 10 days from 20 per cent flowering

Best time is 10.00 to 1.00 a.m.

45. 14<sup>th</sup> week

### **Harvest and storage**

Male (B ) line should be harvested first and removed

Final rogueing should be done before the harvest of female (A) line

Harvested produce should be threshed, cleaned, dried and stored properly at 12% moisture. □□15<sup>th</sup>□week

Monitoring of farmers field for hybrid performance

58. 16<sup>th</sup> week

Calculation of Economics of seed production

### Deliverables

Students can learn the method of genetically pure parental line seed production techniques in rice hybrid CORH 3

The Hybrid rice seed production and parental line seed production techniques learned from this course will be much useful for the students to become entrepreneur in the future.

## **PBG 451 Hybrid pearl millet seed production (0+10)**

Activities :

### 28. 1<sup>st</sup> week

Studying the botany of Pearl millet, Flowering behavior and mode of pollination. Hybridization techniques, characteristics of A, B & R lines. Significance of hybrid Breeding in pearl millet. Maintenance breeding of A, B and R lines.

### 28. 2<sup>nd</sup> week

TNAU Cumbu hybrid CO 9 seed production; (ICMA 99111 x PT 0029-30 R)

Duration 75-80 days

Selection of field based on the isolation distance (500 m)

Seed treatment

Staggered sowing : Male parent (PT 6029-30) R line sowing has to be taken up seven days earlier than female parent).

I<sup>st</sup> sowing : PT 6029 – 30 R (male parent – R line)

Seed rate 1.5 kg/ha R line

Row Ratio : 4:2 (4 A : 2 R)

Spacing : 45 x 15 cm

Fertilizer application

Herbicide application

### 19. 3<sup>rd</sup> week

II<sup>nd</sup> sowing : ICMA 93111 (Female parent A line) After 7 days of male line sowing

Sowing of border Rows : R line - 4 Rows.

### 31. 4<sup>th</sup> week

Thinning of seedlings in both A and R lines

### 57. 5<sup>th</sup> week & 6<sup>th</sup> week

Weeding and irrigation

Top dressing of fertilizer

### 71. 7<sup>th</sup> week

II<sup>nd</sup> weeding and pest and disease control measures

Monitoring of flowering and rogueing

### 38. 8<sup>th</sup> and 9<sup>th</sup> week

### 28. 10<sup>th</sup> week



30. 11<sup>th</sup> week

Thorough roguing of the A line and harvesting

Threshing in the a separate threshing floor

Seed cleaning

16. 12<sup>th</sup> week

Germination test

Seed treatment of hybrid seed

17. 13<sup>th</sup> week

Seed packing

17. 14<sup>th</sup> week

26. 15<sup>th</sup> week

17. 16<sup>th</sup> week and 17<sup>th</sup> week

Report preparation and submission

Deliverables

Students can learn the method of genetically pure hybrid seed production techniques in pearl millet.

## SAC 451 On Farm Advisory for Soil Health, Water Quality and Plant Nutrition (0+10)

### Practical Schedule /week

46. Identification and Selection of farm holdings growing different crops
47. Studying the land features and collection of soil samples
48. Assessment of soil physical and chemical quality indices of collected soil samples
49. Assessment of soil biological quality indices and interpretation (Dept. of Agrl. Microbiology)
50. Interpretation of analytical results of collected soil samples for their quality
51. Identifying soil constraints - Interpretation of results (Soil physics)
52. Problem solving management techniques, Calculation of ameliorants.
53. Assessing the Land suitability for agricultural, horticultural and tree crops (Dept.of RS&GIS)
54. Water sample collection, quality assessment
55. Assessing the land suitability for irrigation
56. Fertilizer prescription calculations for important crops - Nutrient equivalent basis -Soil Test Crop Response based recommendation for targeted yields
57. Deriving the nutrient requirement using DSSIFER soft ware for different crops (STCR)
58. Issue of Soil Health Card and Fertilizer prescription using DSSIFER software
59. Diagnosis of nutrient deficiencies using VDK software and corrective measures
60. Formulating the plan for the selected farm holding for the existing crops
61. Formulating the most viable farm plan for the selected farm holding and Development of Soil Constraint Management Package (SCMP)
62. Recap and Practical examination

### References

60. Baruah J.C and D.K.Patgiri. 1996. Physics and Chemistry of Soils, New Age International Publications
61. Garison Sposito, 2008. The Chemistry of Soils. Oxford University Press, USA
62. Black, C.A. 1965. Agronomy Monograph. Methods of Soil Analysis. Part 1. Physical and Mineralogical properties including Statistics of Measurement and Sampling. Wiley, New York.
63. Hesse, P.R. 1971. A Text book of Soil Chemical Analysis. John Murray (Publishers) Ltd. London
64. Indian Society of Soil Science 1991. Soil related constraints in crop production Bulletin No.15.ISSS, New Delhi.
41. Indian Society of Soil Science 1996. Soil management relation to land degradation and environment. Bulletin No.17.ISSS, New Delhi.
42. Jackson, M.L. 1973. Soil Chemical Analysis. Prentice Hall Pvt.Ltd
43. Mani.A.K., R.Santhi, K.M.Sellamuthu. 2007. A handbook of Laboratory Analysis.A.E.Publications, Coimbatore
44. Motsara.M.R and R.N.Roy.2008.Guide to laboratory establishment for plant nutrient analysis. Food and Agriculture organization of the United Nations.Rome.pp.220 (also available online <ftp: /ftp.fao.org/agl/ agll/docs /fpm 19. pdf>)
45. Piper, C.S 1942. Soil and plant analysis: Inter science *Publishers*, New York.
46. Sehgal,J.2005. A text book of Pedology- Concepts and applications. Kalyani Publishers, Ludhiana, New Delhi.
47. Subramanian,S.S, G.V.Kothandaraman, S.Natarajan and P.P.Ramaswami. ed. 1987. Soil survey and land use planning for watershed management. Directorate of Soil and Crop Management Studies, TNAU, Coimbatore
48. Tandon, H.L.S.1994. Fertilizers, organic manures, recyclable wastes and
49. biofertilizers. Fertilizer Development and Consultant Organization, New Delhi
50. USDA 1954. Diagnosis and Improvements of Saline and Alkali Soils. (Ed) L.A.Richards. Handbook No.60. USDA Washington DC.
51. Werner Bergmann.Ed.1992.Nutritional Disorders of Plants - Development, Visual and analytical Diagnosis. Gustav Fischer Verlag Jena.Stuttgart. New York

**E-References**

29. <ftp://ftp.fao.org/agl/agll/docs/fpnb19.pdf>
30. <http://www.agric.gov.mt/soil-and-irrigation-water-lab>
31. [www.soiltesting.okstate.edu/](http://www.soiltesting.okstate.edu/)
32. [www.texasplantandsoillab.com/](http://www.texasplantandsoillab.com/)
33. [www.ulm.edu/spal/](http://www.ulm.edu/spal/)
34. [soilhealth.cals.cornell.edu/extension/.../managing\\_constraints.pdf](http://soilhealth.cals.cornell.edu/extension/.../managing_constraints.pdf)
35. [cna1.cals.cornell.edu/](http://cna1.cals.cornell.edu/)
36. [http://agritech.tnau.ac.in/agriculture/agri\\_reosurcemgt\\_soil\\_soilconstraints.html](http://agritech.tnau.ac.in/agriculture/agri_reosurcemgt_soil_soilconstraints.html)
37. <http://edis.ifas.ufl.edu/topicjertilization>

## **HOR 451 Hybrid seed production in vegetable crops (0+10)**

### **CONTENT**

#### **Unit I - Introduction to quality seed production, principles and practices**

Scope and importance of vegetable seed industry and vegetable seed production - principles and practices of seed production - generation system of seed multiplication - pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental line and hybrids - designing of planting ratio and border rows - physical and genetic contaminants - isolation distance.

#### **Unit II - Seed production planning and pre sowing seed treatments**

Planning of seed production - season and land selection - assessment of seed source and seed selection - pre sowing seed invigouration treatments - dormancy breaking treatments - seed priming - pelleting - polymer coating. Practicing nursery and main field preparation - practicing the sowing of seeds in the nursery - types of nursery - media preparation for protray nursery - sowing -nursery management.

#### **Unit III - Seed crop management and hybrid seed production techniques**

Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management - weed management - irrigation management - special cultural practices - pest and disease management - identification and removal of off-types and volunteer plants - practicing hybridization techniques (emasculation and pollination) - identification of physiological disorders and management - exposure visit to seed certification department - seed certification procedures - registration and sowing report - field inspection - field counting - visit to seed production plots.

#### **Unit IV - Pre and post harvest operations**

Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - harvesting methods - post harvest verification – fruit grading - extraction of seeds - processing sequence

28. seed drying - seed cleaning - grading - pre-storage seed treatment - seed packing - seed storage - visit to seed processing unit and seed storage godown and learning sanitation measures. Economics of hybrid seed production (cost benefit ratio) - visit to private seed industry.

#### **Unit V - Seed testing and marketing**

Seed sampling procedure and submission of samples - seed testing procedure – estimation of seed moisture - physical purity analysis - germination test - visit to grow out test field and DNA finger printing laboratory for genetic purity assessment - visit to seed retail shop - seed marketing - project preparation.

**Crops:** Tomato, brinjal, chillies, bhendi, and gourds.

#### **Deliverables:**

Students who complete this course will gain enough confidence to establish seed industry as a successful business venture.

#### **References**

- Arya, P.S., 1995. Vegetable seed production principles. Kalyani Publishers. New Delhi.
- Geetharani, P., V.Swaminathan and V.Ponnuswami. 2012. Seed Technology of Horticultural Crops. Narendra Publishing House, Delhi - 6.
- Kulkarni, G.N. 2011. Principles of seed technology, Kalyani publishers, Ludhiana, New Delhi
- Singh, N, and Vishal Nath, 2011. Varieties and hybrids of vegetables, Satish serial publishing house, Delhi.
- Sumesh Chandra Gaur, 2013. A hand book of seed processing and marketing Agrobios (India), Jodhpur Udai
- R. Bishnoi and R.P.S. Kharb, 2012. Fundamentals of seed production and testing, Oxford book company, Jaipur.

Vanangamudi, K. *et al.*, 2010. Vegetable hybrid seed production and management, Agro bios (India), Jodhpur.

#### **E-References**

7. [Seednet.gov.in](http://Seednet.gov.in)
8. [www.dare.gov.in](http://www.dare.gov.in)
9. [http:sfci.nic.in](http://sfci.nic.in)
10. [www.iar.org.in/Directorate1.htm](http://www.iar.org.in/Directorate1.htm)
11. [www.apsa.org](http://www.apsa.org)
12. [www.seedassociationofindia.com](http://www.seedassociationofindia.com)
13. [www.apaseed.com](http://www.apaseed.com)
14. [www.apaseed.org](http://www.apaseed.org)

## Hybrid seed production in vegetable crops (0+10)

### Practical schedule

**Crops:** Tomato, brinjal, chillies, bhendi, and gourds.

Week	Classes
1.	Scope and importance of vegetable seed industry and vegetable seed production - principles and practices of seed production - generation system of seed multiplication.
2.	Pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental line and hybrids.
3.	Designing of planting ratio and border rows - physical and genetic contaminants - isolation distance.
4.	Planning of seed production - season and land selection - assessment of seed source and seed selection.
5.	Pre sowing seed invigouration treatments - dormancy breaking treatments - seed priming - pelleting - polymer coating.
6.	Practicing nursery and main field preparation - practicing the sowing of seeds in the nursery - types of nursery - media preparation for protray nursery - sowing -nursery management.
7.	Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management.
8.	Weed management - irrigation management - special cultural practices - pest and disease management.
9.	Identification and removal of off-types and volunteer plants - practicing hybridization techniques (emasculation and pollination) - Identification of physiological disorders and management.
10.	Exposure visit to seed certification department - seed certification procedures - registration and sowing report - field inspection - field counting - visit to seed production plots – project preparation.
11.	Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - harvesting methods - project preparation - project preparation.
12.	Post harvest verification – fruit grading - extraction of seeds - processing sequence - seed drying - seed cleaning - grading - pre-storage seed treatment - seed packing - seed storage.
13.	Visit to seed processing unit and seed storage godown and learning sanitation measures - project preparation.
14.	Economics of hybrid seed production (cost benefit ratio) - visit to private seed industry.
15.	Seed sampling procedure and submission of samples - project preparation.
16.	Seed testing procedure - estimation of seed moisture - physical purity analysis - germination test - visit to grow out test field and DNA finger printing laboratory for genetic purity

	assessment.
18.	Visit to seed retail shop - seed marketing - project preparation and submission.

## **SST 451 Commercial seed production (0+10)**

### **CONTENT**

#### **Unit I - Introduction to quality seed production, principles and practices**

Scope and importance of seed industry and seed production - principles and practices of seed production - generation system of seed multiplication - pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental line and hybrids - designing of planting ratio and border rows - physical and genetic contaminants - isolation distance.

#### **Unit II - Seed production planning and pre sowing seed treatments**

Planning of seed production - season and land selection - assessment of seed source and seed selection - pre sowing seed invigouration treatments - dormancy breaking treatments - seed priming - pelleting - polymer coating. Practicing nursery and main field preparation - practicing the sowing of seeds in the nursery - protray nursery - sowing - nursery management.

#### **Unit III - Seed crop management and hybrid seed production techniques**

Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management - weed management - irrigation management - special cultural practices - pest and disease management - identification and removal of off-types and volunteer plants - practicing hybridization techniques (emasculation and pollination and detasseling) - identification of physiological disorders and management - exposure visit to seed certification department - seed certification procedures - registration and sowing report - field inspection - field counting - visit to seed production plots.

#### **Unit IV - Pre and post harvest operations**

Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - harvesting methods - post harvest verification - kapas sorting, cob sorting and pod verification - threshing / extraction of seeds - processing sequence - seed drying - seed cleaning - grading - pre-storage seed treatment - seed packing - seed storage - visit to seed processing unit and seed storage godown and learning sanitation measures. Economics of variety and hybrid seed production (cost benefit ratio) - visit to private seed industry.

#### **Unit V - Seed testing and marketing**

Seed sampling procedure and submission of samples - seed testing procedure - estimation of seed moisture - physical purity analysis - germination test - visit to grow out test field and DNA finger printing laboratory for genetic purity assessment - visit to seed retail shop - seed marketing - project preparation.

#### **Crops**

Cereals, pulses, oilseeds, cotton and commercially important vegetable crops.

#### **Deliverables:**

Students who complete this course will gain enough confidence to establish seed industry as a successful business venture

### **Reference**



27. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
28. Bhaskaran, M. A.Bharathi, K.Vanangamudi, N.Natarajan, P.Natesan, R.Jerlin and K.Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.
29. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4<sup>th</sup> Ed. Chapman & Hall.
30. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
31. Vanangamudi, K. 2014. Seed Science and Technology. An Illustrated Text Book. New India Publishing Agency, New Delhi.

## **E References**

1. Seednet.gov.in
2. [www.iar.org.in/Directorate1.htm](http://www.iar.org.in/Directorate1.htm)
3. www.apsa.org
4. www.seedassociationofindia.com
5. www.apaseed.com
6. www.apaseed.org

## Commercial seed production (0+10)

### Schedule of Activities

Week	Classes
1.	Scope and importance of seed industry and seed production - principles and practices of seed production - generation system of seed multiplication.
2.	Pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental line and hybrids.
3.	Designing of planting ratio and border rows - physical and genetic contaminants - isolation distance.
4.	Planning of seed production - season and land selection - assessment of seed source and seed selection.
5.	Pre sowing seed invigouration treatments - dormancy breaking treatments - seed priming - pelleting - polymer coating.
6.	Practicing nursery and main field preparation - practicing the sowing of seeds in the nursery - protray nursery - sowing - nursery management.
7.	Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management.
8.	Weed management - irrigation management - special cultural practices - pest and disease management.
9.	Identification and removal of off-types and volunteer plants - practicing hybridization techniques (emasculation and pollination and detasseling) - identification of physiological disorders and management.
10.	Exposure visit to seed certification department - seed certification procedures - registration and sowing report - field inspection - field counting - visit to seed production plots - project preparation.
11.	Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - harvesting methods - project preparation.
12.	Post harvest verification - kapas sorting, cob sorting and pod verification - threshing / extraction of seeds - processing sequence - seed drying - seed cleaning - grading - pre-storage seed treatment - seed packing - seed storage.
13.	Visit to seed processing unit and seed storage godown and learning sanitation measures - project preparation.
14.	Economics of variety and hybrid seed production (cost benefit ratio) - visit to private seed industry.
15.	Seed sampling procedure and submission of samples - project preparation.
16.	Seed testing procedure - estimation of seed moisture - physical purity analysis - germination test - visit to grow out test field and DNA finger printing laboratory for genetic purity assessment.
17.	Visit to seed retail shop - seed marketing - project preparation and submission.

## **ENS 451 COMPOSTING TECHNOLOGY**

### **Activities**

Collection and characterization of solid-wastes – analyzing physical and chemical properties – site selection for composting – infrastructure required for compost making – processing of solid waste for composting – carbon : nitrogen ratio maintenance – selection of microbial inoculum for composting - compost bed formation – windrow method – heap method – application of microbial inoculum – recording compost heap temperature- thermophilic phase and mesophilic phase – turning of compost pile for uniform composting – moisture maintenance in compost pile – assessing reduction in carbon and nitrogen ratio – compost maturity assessment – curing of compost material – value addition through beneficial microbes - Assessing nutritive value of compost – national and international standards for compost quality parameters – project preparation for compost making facility – Marketing of compost products – working out cost benefit ratio for compost production – Record maintenance in compost making.

### **Deliverables/Out come**

The students who are undergoing this experiential learning will have independent skill to manage large quantity of solid waste through composting technology. They know how to prepare a project on solid waste management and it will create a self enterprising activity for them.

### **References:**

- 1.Kelly Smith. 2012. How to build, maintain and use a compost system. Atlantic publishers, Florida.
30. John Berry. 2014. How to make compost? A quick and easy guide. Hewel Trading, USA
31. Roland Ulrich. 2014. Creating humus on farm – The controller heat method of composting. Outskirts press
32. Augustine Afulio, 2014. Integrated solid waste management. Hand book for Beginners, Planners, Environmentalists, Students and policy makers. Warmra Twechoprise, Nairobi, Kenya.

### **E -References:**

1. <http://www.eartheasy.com>
2. <http://www.composting council.org>
3. <http://www.Epa.gov/compost>
4. <http://www.Compost.css.cornell.edu>

## **HOR 452 Commercial Nursery Technology of Horticultural Crops (0+10)**

### **Deliverables**

Students who undergo this course will gain practical knowledge and hands on experience in different aspects of a commercial fruit nursery.

Students' attitude in leadership quality, managerial skill and professionalism will be enriched.

### **References**

1. Sadhu, M.K. 1989. Plant Propagation. Wiley Eastern Ltd., New Delhi
2. Bose, T.K., S.K. Mitra, M. K. Sadhu and B. Mitra. 1991. Propagation of Tropical and Subtropical Horticultural crops. Naya Prakash Publishers, Calcutta, India.
3. Hartmann, H.T., D. E. Kester, F.T. davies and R. L. Grene. 2010. Plant Propagation – Principles and Practices. Prentice Hall of India Private Ltd., New Delhi.
4. Nanda, K. K and V. K. Kochhar. 1995. Vegetative Propagation of Plants. Kalyani Publishers, Ludhiana.

### **References**

1. <http://www.oer.nios.ac.in>
2. <http://www.sas.upenn.edu>
3. <http://www.tmnehs.gov.in>
4. <http://www.instructables.com>

## **HOR 453 COMMERCIAL LANDSCAPE GARDENING (0 + 10)**

### **Activities**

Understanding the concept of experiential learning and identifying the broad area for experiential learning project activity in commercial Landscape Gardening - Fixing the area of interest for individual or group experiential learning project activity in commercial Landscape Gardening ( Green consultancy, Green wall fixtures, Green showcases, Green wall hangings, Green furniture, Cacti buckets and flower bouquets, Green glasses, Trees indoor, Smart garden *etc.*) - Rationale for selecting the activity in commercial Landscape Gardening and formulating the anticipated methodology for execution - Preparation of the project with budget for execution and marketing - Nurturing the students potential and innovativeness in their area of interest and facilitating the project activity (planning, development and execution) - Concept of advertising the product and developing market strategies for efficient selling - Working out the cost economics / balance sheet involved in the project - Generating a reflective report about the project and the student's potential in academic and personal development.

### **Deliverables**

24. Entrepreneurship skill and buoyancy in handling commercial ventures in the domain of landscape gardening is assured
25. Student's attitude in leadership quality, managerial skill and professionalism will be enriched

## HOR 454 PROTECTED CULTIVATION OF VEGETABLE CROPS (0 + 10)

### Practical content

Understanding the concept of experiential learning and identifying the broad area for experiential learning project activity in protected cultivation in vegetable crops - Fixing the area of interest for individual or group in project activity in protected cultivation (Establishment and operation of protected structures - types of growing structures - construction of poly house and shade net house - manipulation of environmental factors - practical learning in nursery raising - growing systems - growing media - sterilization - preparation of beds- planting- and cultivation practices - harvesting practices - post harvest handling – storage - project preparation and analysis of cost economics *etc.*) - Rationale for selecting the activity in protected cultivation and formulating the anticipated methodology for execution - Preparation of the project with budget for execution and marketing - Nurturing the students potential and innovativeness in their area of interest and facilitating the project activity (planning, development and execution) - Concept of advertising the product and developing market strategies for efficient selling - Working out the cost economics / balance sheet involved in the project - Generating a reflective report about the project and the student's potential in academic and personal development.

### Crops: Tomato / Capsicum / Cucumber

#### 68. References

- <sup>1</sup> Prasad, S. and U. Kumar. 2005. Green house management for horticultural crops. 2<sup>nd</sup> ed. Agrobios.
- <sup>2</sup> Tiwari, G.N. 2003. Green house technology for controlled environment . Narosa Publ. House.

### References

1. Harry Tomilson,2010. The complete book on bonsai. Abbevellie press, Glasgow. Phaidon,2014. The garden book, Phaidon book, London
2. Judith blacklock,2012. The complete guide for beginners. Flower fresh publisher, U.K.
3. Nancy Norris, 2011. Miniature garden guide book. Kalmbach Publishing company, Netherlands
4. Bose.T.K, R.G. Maiti, R.S. Dhua and P.Das. 1999. Floriculture and Landscaping. Naya prakash, Calcutta. Booth. N.K. 1983. Basic elements of landscape architectural design.
5. Randhawa, G.S. and A. Mukhopadhyay, 2001. Floriculture in India. Allied Publishers Limited, New Delhi. Foja Singh, 1997. Advances in Floriculture. Media Today Pvt Ltd., New Delhi-17
6. Chattopadhyay, S.K. 2007. Commercial Floriculture. Gene-Tech Books, New Delhi

### References

<http://floracultureinternational.com>  
<http://www.wvu.edu/~agexten/hortcult/greenhou/>  
[http://www.umass.edu/umext/floriculture/fact\\_sheets/greenhouse\\_management.html](http://www.umass.edu/umext/floriculture/fact_sheets/greenhouse_management.html)  
<https://sharepoint.agriculture.purdue.edu/agriculture/flowers/GHguides.aspx>  
<http://www.ag.auburn.edu/hort/landscape/structures.html>  
[www.bonsaiempire.com](http://www.bonsaiempire.com)  
[www.gardenweb.com](http://www.gardenweb.com)  
[www.my-garden-school.com](http://www.my-garden-school.com)  
[www.florista.in](http://www.florista.in)  
[www.realsimple.com](http://www.realsimple.com)

**PAT 451 Commercial production of Bio-control agents 0+10**  
(Team teaching by Entomologists, Pathologists and Economists)

**Reference**

1. Kennedy, J.S and Zadda Kavitha. 2006. Manual on commercial Production of biocontrol agents. Department of Agricultural Entomology, TNAU, Coimbatore. 156p
2. Gautam, R.D. 1994. Biological Pest Suppression. Westville Publishing House, New Delhi. 221 p
3. Course plan: TB: Text Book

Units / Practicals	Topics to be covered	Chapter <sup>#</sup>
1 <sup>st</sup> week	Establishment of a biocontrol unit, Mass production of <i>Corcyra cephalonica</i> and <i>Maconellicoccus hirsutus</i>	Chap#1,2,3,6 (TB1 )
2 <sup>nd</sup> week	Mass production of parasitoids viz., <i>Trichogramma</i> sp., <i>Chelonus blackburnii</i> , <i>Bracon</i> sp	Chap#7,8,10 (TB1 )
3 <sup>rd</sup> week	Mass production of parasitoids viz., <i>Goniozus nephantidis</i> and <i>Nesolynx thymus</i>	Chap#11 (TB1 )
4 <sup>th</sup> week	Mass production of predators viz., <i>Cryptolaemus montrouzieri</i> and <i>Chrysoperla carnea</i> .	Chap#13,14 (TB1 )
5 <sup>th</sup> week	Rearing of host insects viz., <i>Helicoverpa armigera</i> and <i>Spodoptera litura</i>	Chap#4,5 (TB1 )
6 <sup>th</sup> week	Mass production of nuclear polyhedrosis virus of <i>Helicoverpa armigera</i> and <i>Spodoptera litura</i>	Chap#15,16 (TB1 )
7 <sup>th</sup> week	Mass production of entomopathogenic fungi viz. <i>Metarhizium anisopliae</i> , <i>Beauveria bassiana</i> and <i>Verticillium lecanii</i>	Chap#18,19,20 (TB1 )
8 <sup>th</sup> week	Processing and standardization of microbial pathogens	Chap#21 (TB1 )

**12. References**

<http://www.mycologia.Org>  
<http://www.nysaes.cornell.edu>  
[http://www.Eduwebs.org/bugs/mealybug\\_destroyers.htm](http://www.Eduwebs.org/bugs/mealybug_destroyers.htm)  
[http:// plant disease.ippc.orst.adv/articles](http://plant.disease.ippc.orst.adv/articles)  
[http:// www.nbaii.res.in](http://www.nbaii.res.in)

**PRACTICAL SYLLABUS**

**Unit 3:**

Importance of biological control in plant disease management – Handling of equipments – sterilization techniques –Preparation of media

Collection of soil sample and Isolation of antagonists - *Trichoderma*, *Chaetomium*, *Beauveria*, *Pseudomonas fluorescens*, and *Bacillus subtilis* - Maintenance of pure cultures - Morphological and molecular characterization of antagonists

**Unit 4**

Keys for the identification of lab contaminants - Assessing the efficacy *in vitro* - mode of action of antagonists - Fermentation systems and different kinds of formulations - Mass multiplication

Methods of delivery of biocontrol agents - Bio efficacy against plant diseases – Container content compatibility - packaging methods and shelf life studies of bio control agents -Guidelines and requirements to establish a commercial bio control lab - energy requirements to establish a commercial

bio control lab

## Unit 5

Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale) - Cost Analysis and project preparation - Principles of enterprise management. Exposure visit to commercial bio control units

### PRACTICAL SCHEDULE

#### 9 week

14. Bio-control agents and their significance in plant disease management
15. Safety procedures for handling of equipments (Autoclave, Laminar Air Flow Chamber, Hot air oven, pH meter)
16. Safety procedures for handling of equipments (Electronic balance, Fermentor, Distillation unit, Spectrophotometer, Microscopes and Spiral Kneader)
17. Good laboratory practices of a bio control lab
18. Sterilization techniques

#### 10 week

16. Preparation of PDA and Rose Bengal agar medium
17. Preparation of *Trichoderma* selective medium,
18. Preparation of Kings B medium and Nutrient Agar medium
19. Preparation of Actinomycetes and *Chaetomium* selective medium.

#### 20. week

- Collection of soil samples and isolation of *Trichoderma*, *Beauveria* and *Chaetomium* 11
12. Collection of soil samples and isolation of *Pseudomonas fluorescens* and *Bacillus subtilis* and maintenance of pure cultures of biocontrol agents
  13. Morphological and molecular characterization of *Trichoderma*
  14. Morphological and molecular characterization of *Pseudomonas fluorescens*
  15. Morphological and molecular characterization of *Bacillus subtilis*

#### 12 week

11. Keys for the identification of lab contaminants (*Salmonella*, *Shigella*, *Vibrio*, *Aspergillus*, *Penicillium*, *Rhizopus* etc.,)
12. Assessing the efficacy of *Trichoderma* under *in vitro* condition.
13. Assessing the efficacy of *Pseudomonas* and *Bacillus* under *in vitro* condition.
14. Studies on the mode of action of *Trichoderma* against soil-borne, foliar and Post harvest pathogens
15. Studies on mode of action of *Pseudomonas* and *Bacillus* against soil-borne, foliar and Post harvest pathogens

#### 13 week

26. Fermentation systems
27. Different kinds of formulations- solid , liquid oil invert formulation etc.
28. Mass multiplication of *Trichoderma*
29. Mass multiplication of *Trichoderma*
30. Quality analysis of *Trichoderma*

#### 14 week

- 19 Mass multiplication of *Pseudomonas*
- 20 Mass multiplication of *Bacillus*
- 21 Quality analysis of *Pseudomonas* and *Bacillus*
- 22 Methods of delivery of bio control agents - *Trichoderma*
- 23 Methods of delivery of bio control agents - *Pseudomonas* and *Bacillus*

#### 15 week

35. Bioefficacy of *Trichoderma* against plant diseases
36. Bioefficacy of *Pseudomonas* and *Bacillus* against plant diseases



37. Biocontrol agents in pipeline –*Chaetomium*
38. Biocontrol agents- *Beauveria*
39. Container content compatibility, packaging methods and shelf life studies of bio control agents.
40. Guidelines and requirements to establish a commercial bio control lab

#### 16 week

- F. Studies on energy requirements to establish a commercial bio control lab
- G. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).
- H. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).
- I. Exposure visit to commercial bio control units
- J. Exposure visit to commercial bio control units

#### 17 week

1. Cost Analysis and project preparation: Principles of enterprise management.
2. Financial management – Agricultural Finance – Source of finance– Acquisition – Ratio analysis.

#### Economics of Mass Production of Biocontrol agents

##### Mass Production of *Trichoderma viride* talc formulation (500kg for 30 students)

S. No.	Particulars	Quantity	Amount (Rs.)
<b>I.Non-Recurring or Capital Investment *</b>			
1.	Fermentor – 100 lit	1	6,00,000
2.	Autoclave	1	40,000
3.	Hot air Oven	1	25,000
4.	Laminar Air flow Chamber-2’/3’/4’	1	60,000
5.	Electronic Balance	1	10,000
6.	Racks and Cabinet	1	15,000
7.	Plastic tray and glasswares	1	20,000
8.	Sealing machine	1	3000
9.	Refrigerator	1	20,000
10.	Gas connection, Cooker and burner	1	5,000
		<b>Total</b>	<b>7,98,000</b>

S. No.	Particulars	Quantity	Amount (Rs.)
<b>II. Recurring or Working Expenditure</b>			
1.	Talc Powder	500kgs	7500
2.	Chemicals		2500
3.	Polybags		750
4.	Electricity and gas refilling		1000
5.	Labour charges		5000
6.	Miscellaneous expenditures		2000
		<b>Total</b>	<b>18,750.00</b>

<b>III. Income</b>			
1.	500 kgs of product @Rs. 75/-		37,500.00
2.	Total Expenditure		18,750.00
		<b>Net Profit Rs.</b>	<b>18,750.00</b>

5. **Non-Recurring:** One time investment

**Mass Production of *Pseudomonas fluorescens* talc formulation (1000kg for 30 students)**

S. No.	Particulars	Quantity	Amount (Rs.)
<b>I.Non-Recurring or Capital Investment</b>			
1.	Fermentor	1	3,00,000
2.	Autoclave	1	40,000
3.	Hot air Oven	1	25,000
4.	Laminar Air flow Chamber	1	60,000
5.	Electronic Balance	1	10,000
6.	Racks and Cabinet	1	15,000
7.	Plastic tray and glasswares	1	20,000
8.	Sealing machine	1	3000
9.	Refrigerator	1	20,000
10.	Gas connection, Cooker and burner	1	5,000
		<b>Total</b>	<b>4,98,000</b>
S. No.	Particulars	Quantity	Amount (Rs.)
<b>II. Recurring or Working Expenditure</b>			
1.	Talc Powder	1000kgs	15000
2.	Chemicals		5000
3.	Polybags		1500
4.	Electricity and gas refilling		2000
5.	Labour charges		10000
6.	Miscellaneous expenditures		5000
		<b>Total</b>	<b>38,500.00</b>
<b>III. Income</b>			
1.	1000 kgs of product @Rs. 75/-		75,000.00
2.	Total Expenditure		38,500.00
		<b>Net Profit Rs.</b>	<b>36,500.00</b>

**J Non-Recurring:** One time investment

**REFERENCE**

- JJ Baker, K.F. and Cook, R.J. 1974. Biological control of plant pathogens. W.H. Freeman and Co. San Francisco, U.S.A.
- KK Chet, I. 1987. Innovative approaches to plant disease control, John wiley and Sons, New York.
- LL Dinakaran, D, G.Arjunan & G.Karthikeyan 2003. Biological control of crop diseases.
- MM Papavizas, G.C. 1985. *Trichoderma* and *Gliocladium* : biology, ecology and potential for biocontrol. Annu. Rev. Phytopathol. 23 : 23-54.
- NN Maheswari ,D.K and R.C Dubey 2008 .Potential micro organisms for sustainable agriculture. I.K International Publishing House Pvt. Lts , New Delhi
- OO Prakasam, V., Raguchander, T. and Prabakar, K. 1998. Plant Disease Management. AE Publications, Coimbatore, India.
- PP Ahamed S and Narain U 2007 . Eco friendly management of plant diseases. Daya Publishing house , New Delhi
- QQ Utkhede, R.S. and Gupta, V.K. 1996. Management of soil borne diseases. Kalyani Publishers, New Delhi.

## **PAT 452 COMMERCIAL MUSHROOM PRODUCTION (0+10)**

**(Team Teaching)**

Unit 1 : Different types of mushroom , Morphology - **Edible and poisonous type - edible mushrooms- *Pleurotus, Agaricus, Volvariella* and *Calocybe*** – nutritional values - and pharmacological values-**preparation of culture media- pure culture techniques- sterilizing techniques-media - glassware - maintenance of culture**

Unit 2: Mother spawn **production-type of spawn-Multiplication of bed spawn** – Substrates for mushroom cultivation **and their preparation -mushroom cultivation techniques for *Agaricus, Pleurotus, Calocybe* and *Volvariella*- maintenance of spawn running and cropping room-harvest-packing and storage of *Pleurotus, Agaricus* and *Calocybe*.**

Unit 3 : Problems in cultivation of *Agaricus, Pleurotus, Calocybe* and *Volvariella* – pests, diseases and weed moulds, abiotic disorders – management strategies -- Biodegradation of coir pith - cost estimation

Unit 4 : Post harvest technology of *Agaricus, Pleurotus, Calocybe* and *Volvariella* – methods of preservation –**Drying: solar, cabinet, fluidized bed and freeze drying – Packing methods and storage - Controlled atmospheric storage- modified atmospheric storage and canning – Cost analysis.**

Unit 5 : Mushroom recipes of *Agaricus, Pleurotus, Calocybe* and *Volvariella* - **Cooking methods- value added products – instant food mixes –Cost analysis. Project preparation- principles of mushroom farm enterprise management – cost estimation**

### **Practical schedule**

#### **1 week**

Studying the general characters of mushrooms  
Different types of mushrooms and their morphology  
Identification of edible and poisonous mushrooms  
Morphological characters of *Pleurotus, Agaricus, Volvariella* and *Calocybe*  
Equipments required for culture media preparation and tissue culture - their operation

#### **2 week**

Equipments required for spawn preparation - their operation Equipments required for substrate sterilization - their operation  
Preparation of different types of culture media- Potato Dextrose Agar ( PDA) , Oats meal agar ( OMA), Malt extract Agar medium ( MEA)  
Pure culture technique –Tissue isolation methodology  
Pure culture technique –**Tissue isolation in PDA, OMA and MEA medium 3**

#### **week**

Sub culturing of fungal cultures and maintenance.  
Spawn preparation- laboratory requirements, essentials required for mother spawn and bed spawn preparation and their usage.  
Oyster mushroom: mother spawn preparation – Cooking of cholam grains , packing in polybags and autoclaving  
Oyster mushroom: mother spawn preparation - inoculation  
Oyster mushroom: first generation bed spawn preparation - Cooking of cholam, packing in polybags and autoclaving

#### **4 week**

Oyster mushroom: first generation bed spawn preparation - inoculation  
Observe the spawn contaminants.  
Oyster mushroom: second generation bed spawn preparation – Cooking of cholam, packing in polybags and autoclaving  
Oyster mushroom: second generation bed spawn preparation - inoculation  
Management of contaminants in mother spawn and bed spawn

#### **5 week**

Oyster mushroom cultivation – essentials required, cropping room requirement  
Oyster mushroom: preparation of substrates for bed preparation  
Oyster mushroom – Bed preparation

Oyster mushroom – Maintenance of beds, harvest and storing

Oyster mushroom – pest and their management

**6 week**

Oyster mushroom – moulds and disease management

Visit to oyster mushroom farm (spawn lab and mushroom farm)

Visit to ulavar sandai markets (Farmers' Market) and observing the marketing pattern of oyster mushroom

Milky mushroom: mother spawn preparation – Cooking of cholam grains, packing in polybags and autoclaving

Milky mushroom: mother spawn preparation - **inoculation 7**

**week**

Milky mushroom: first generation bed spawn preparation – Cooking of cholam, packing in polybags and autoclaving

Observing the spawn contaminants, their management

Milky mushroom: first generation bed spawn preparation - inoculation

Milky mushroom: second generation bed spawn preparation – Cooking of cholam, packing in polybags and autoclaving

Milky mushroom: second generation bed spawn preparation - inoculation **8**

**week**

Milky mushroom cultivation – essentials required, cropping room requirement

Milky mushroom:– substrates for bed preparation

Milky mushroom – Bed preparation

Milky mushroom- casing

Milky mushroom – Maintenance of beds, harvest and storing **9**

**week**

Milky mushroom – pest and their management  
Milky mushroom – moulds and disease management

Visit to Milky mushroom farm (spawn lab and mushroom farm)

Visit to ulavar sandai, markets and observing the marketing pattern of milky mushroom  
Button mushroom: visiting units and learning – tissue isolation, spawn preparation

**10 week**

Button mushroom: visiting units and learning compost preparation

Button mushroom: visiting units and learning: cropping, harvest and storage

Visit to ulavar sandai, markets and observing the marketing pattern of button mushroom

Paddy straw mushroom: tissue isolation

Paddy straw mushroom: **spawn preparation**

**11 week**

Paddy straw mushroom: Substrate preparation for beds

Paddy straw mushroom: bed preparation

Paddy straw mushroom cultivation – cropping room requirement, Maintenance of beds, harvest and storing

Paddy straw mushroom – pest and disease management

Abiotic disorders and their management

**12 week**

Integrated pest and disease management in Mushrooms  
Biodegradation of agrowastes using mushroom spawn  
Biodegradation of agrowastes using mushroom spawn- continuation  
Mushroom as a component in Integrated Farming System  
Interaction with successful spawn producers – TNAU community radio

**13 week**

Interaction with successful mushroom producers- TNAU community radio

Short term post harvest processing of oyster mushroom

Long term post harvest processing of oyster mushroom  
Packing methods of oyster mushrooms

Short term post harvest processing of milky mushroom **14 week**

Long term post harvest processing of milky mushroom  
Packing methods of milky mushrooms  
Short term post harvest processing of button mushroom  
Long term post harvest processing of button mushroom  
Packing methods of button mushrooms

**15 week**

Canning of button mushroom  
Recipe and value added products from oyster mushroom  
Recipe and value added products from oyster mushroom continued  
Recipe and value added products from milky mushroom  
Recipe and value added products from milky mushroom continued

**16 week**

Recipe and value added products from button mushroom  
Recipe and value added products from button mushroom continued  
Recipe and value added products from paddy straw mushroom  
Project preparation on oyster -spawn production and economics  
Project preparation on oyster mushroom production and cost estimation

**17 week**

Project preparation on milky spawn production and cost estimation  
Project preparation on milky mushroom production and cost estimation  
Project preparation on button -spawn production and cost estimation  
Project preparation on button - mushroom production and cost estimation  
Practical examination

## BUDGET

Economics of Spawn Production (100 spawn bags per day) for oyster and milky mushroom mother spawn and bed spawn

Total working days for spawn: 25

Sl.No.	Item	Quantity	Rate (Rs.)	Total (Rs.)
	Recurring cost (100 spawn x 25 days)			
1.	Polypropylene bags	18 kg	120/kg	14,400
2.	<b>Cholam grain</b>	<b>700 Kg</b>	<b>30/kg</b>	<b>21,000</b>
3.	<b>Calcium carbonate (commercial grade)</b>	<b>50</b>	<b>25/kg</b>	<b>1,250</b>
4.	<b>Non-absorbent cotton (400 g rolls)</b>	<b>100</b>	<b>80/roll</b>	<b>8,000</b>
5.	<b>Fungicides &amp; Fumigants</b>	--	--	<b>3,000</b>
6.	<b>Electricity &amp; Fuel</b>	--	--	<b>20,000</b>
7.	<b>Labour @ 2 women per day for 25 days</b>	<b>2 nos</b>	<b>190/person</b>	<b>9,500</b>
8.	<b>Glass wares and chemicals for preparing mother spawn</b>	--	<b>5,000</b>	<b>5,000</b>
9.	<b>Miscellaneous</b>	--	--	<b>2,000</b>
	<b>Total</b>			84,150
	<b>Overall total</b>			84,150

Economics of Oyster mushroom production and milky mushroom (each 5 Kg/day)

Total working days: 10

Sl.No.	Item	Quantity	Rate (Rs.)	Total (Rs.)
	<b>Recurring Cost</b>			
1.	<b>Paddy straw</b>	<b>100 kg</b>	<b>5/kg</b>	<b>5,000</b>
2.	<b>Spawn</b>	-	-	-
3.	<b>Polythene bags for bed &amp; packing</b>	<b>2 kg</b>	<b>120/kg</b>	<b>240</b>
4.	<b>Fungicides, Fumigants &amp; Chemicals</b>	--	--	<b>5000</b>
5.	<b>Labour @ 2 Per day</b>	<b>2</b>	<b>190 /day</b>	<b>3,800</b>
6.	<b>Miscellaneous (gunny bags, rope,racks)</b>	--		<b>6000</b>
<b>II.</b>	<b>Non recurring-Oyster Mushroom Shed</b>	<b>800 sq.ft.</b>	<b>75,000</b>	<b>75,000</b>
Total (Rs.)				95,040

**REFERENCES**

Agarwal, R.K. and C.L.Jandaik.1986. Mushroom cultivation in India. Indian Mushroom Growers Association, Solan, Himachal Pradesh.p-83.

Bahl, N.1988. Hand book of Mushroom II Edn. Oxford & IBM Publishing Co. New Delhi.

**Reference books- further reading**

Marimuthu, T., A.S Krishnamoorthy, K.Sivaprakasam and R.Jeyarajan, 1989. Oyster Mushroom Production. The Vijay Books. Sivakasi, India.P.57.

A.S Krishnamoorthy, Marimuthu, T., and S. Nakkeran . 2005 . Mushroom Biotechnology ,The Vijay Books. Sivakasi, India., Pub.ODL, TNAU, Cbe-3

Pathak,V.N. Nagendra Yadav and Maneeskas Gaur.2000.Mushroom production and processing Technology. Agribios (India) Ltd., New Delhi

**E-REFERENCES**

1. [www.mushroomcouncil.com/grow/grow.html](http://www.mushroomcouncil.com/grow/grow.html)
2. [www.krishiworld.com/html/mushroom.html](http://www.krishiworld.com/html/mushroom.html)
3. [www.gmushrooms.com/pots.html](http://www.gmushrooms.com/pots.html).
4. [www.mushworld.com/home/](http://www.mushworld.com/home/)
5. [www.mushroomcouncil.org](http://www.mushroomcouncil.org)

### AMP 451 Commercial broiler and layer production (0+10)

	<b>Unit – I - Introduction</b>
	Poultry Industry in India - Current status of broiler and layer industry – Scope of broiler and layer production in India - Introduction to Broilers and Layers – Commercial strains of broilers and layers.
	<b>Unit – II – Housing Management</b>
	Housing management – Location and layout of commercial broiler and layer farm – Preparation of poultry house - Equipments used in broiler and layer farm - Different system of Management - Deep litter system, Cage system of management, Raised housing - Litter management - Preparation of brooder house – Brooder Management –Chick management – Grower management – Layer management -Summer management of broiler -Winter management of broiler – Lighting management – Common procedures followed in broiler and layer farm.
	<b>Unit – III – Feeding Management</b>
	Water – Requirement, quality analysis and its maintenance - Feeding Management of broilers and layers – Types of feed – Feed ingredients – Quality assessment of feed ingredients and feed – Additive and supplementation of additives - Storage of feed-Feeding Methods – Nutrient requirement of different stages of broilers and layers – Various standards for broilers and layers - Feed formulation – Least cost formulation –Preparation of compound feed –Components in feed mill –Feed mill operations - Hatchery Management – Hatchery layout and design – Hatcher and Setter – Collection and handling of egg – Setting and hatching of eggs and chicks quality assessment.
	<b>Unit – IV – Flock Health Management</b>
	Common disease of broilers and layers – Control and Prevention - Medication and Vaccination in broilers and layers – Different vaccination methods – Cold chain for vaccine – Vaccination schedule for broilers and layers -Postmortem inspection –Waste management -Disposal of dead birds and Manure management - Biosecurity measures.
	<b>Unit – V – Processing and Marketing</b>
	Processing of broilers - Slaughtering of broilers and cut up parts of broilers – Evaluation of egg for its quality - Record maintenance- Marketing Channels in broilers and layers - Export of egg and poultry meat - Integration method of broilers marketing–Team teaching along with Department of Economics on Economics of broiler and layers farming and Project preparation for broiler and layer farm unit for bank loan–Role of NECC and BCC in marketing of poultry and its products - Visit to commercial broiler farm, layer farm, feed plant, hatchery unit and processing plant.
	<b>Practical schedule</b>
<b>Week</b>	<b>Topic to be covered</b>
B	Current status of broiler and layer industry Scope of broiler and layer production in India Commercial strains of broilers and layers Location and layout of commercial broiler and layer farm Preparation of poultry house

2	Equipments used in broiler and layer farm Different system of Management Deep litter system Cage system of management, Raised housing Litter management
3	Preparation of brooder house Brooder Management, Grower management and Layer management

	<p>Summer management of broiler and layer</p> <p>Winter management of broiler and layer</p> <p>Lighting management</p>
4	<p>Common procedures followed in broiler and layer farm.</p> <p>Water – Requirement</p> <p>Quality analysis and its maintenance</p> <p>Feeding Management of broilers and layers</p> <p>Types of feed</p>
5	<p>Feed ingredients</p> <p>Quality assessment of feed ingredients and feed</p> <p>Additive and supplementation of additives</p> <p>Storage of feed-Feeding Methods</p> <p>Nutrient requirement of different stages of broilers and layers</p>
6	<p>Various standards for broilers and layers</p> <p>Feed formulation</p> <p>Least cost formulation</p> <p>Preparation of compound feed</p> <p>Components in feed mill</p>
7	<p>Feed mill operations</p> <p>Hatchery Management</p> <p>Hatchery layout and design</p> <p>Hatcher and Setter</p> <p>Collection and handling of egg</p>
8	<p>Setting and hatching of eggs and chicks quality assessment</p> <p>Common disease of broilers and layers</p> <p>Control and Prevention</p> <p>Medication and Vaccination in broilers and layers</p> <p>Different vaccination methods</p>
9	<p>Cold chain for vaccine</p> <p>Vaccination schedule for broilers and layers</p> <p>Postmortem inspection</p> <p>Disposal of waste -dead birds and manure</p>
10	<p>Biosecurity measures.</p>
11	<p>Processing of broilers</p> <p>Slaughtering of broilers and cut up parts of broilers</p>



B	Evaluation of egg for its quality Record maintenance Marketing Channels in broilers and layers
C	Export of egg and poultry meat Integration method of broilers marketing
D	Team teaching along with Department of Economics on Economics of broiler and layers farming and Project preparation for broiler and layer farm unit for bank loan
E	Role of NECC and BCC in marketing of poultry and its products
F	Visit to commercial broiler farm, layer farm, feed plant, hatchery unit and processing plant
G	Examination

## AEN 451 Commercial Beekeeping (0+10)

### Activities

Honey bee species, castes, social biology and communication in honey bees - Bee pasturage and preparation of bee floral calendar - Honey bees for crop pollination and seed production. - Stingless bees, little bees, rock bees conservation and honey harvest - Beehives, beekeeping equipments specification and uses, visit to manufacturing unit - Hiving feral Indian bee colony, site selection for apiary, visit to migratory bee keeping sites, visit to commercial cerana bee farm, - Honey extraction, processing, purity testing and value addition, visit to honey processing unit - Hive inspection, maintenance of hive records, management in nectar flow season, dearth period, management of swarming, absconding and laying workers - Dividing, uniting bee colonies, artificial feeding, protecting bees from pesticides - Insect, mite and bird enemies of honeybees, brood and adult diseases - Mass queen rearing and production of mating nucleus, visit to beekeeping society - Methods of collection of bees wax, bee pollen, propolis, bee venom, royal jelly - Visit to commercial mellifera bee farm - Marketing and economics of honey and bee products, preparation of bee keeping projects for bank funding

### Reference

- (e) Atwal, A.S. 2013. Mellifera Bee Keeping and Pollination. *Kalyani Publishers, Ludhiana*. 394 p.
- (f) Ted Hooper, 1991. Guide to Bees and Honey (Third Edition), *BAS printers ltd. Over Wallop, Hampshire* 271 p.
- (g) Roger A. Morse, 1994. The new complete guide to beekeeping. *The Countryman Press, Woodstock, Vermont*. 207p.
- (h) Thomas D. Seeley. 1995. The Wisdom of the Hive, Harvard University Press, Cambridge, 295p.

<b>Sl. No.</b>	<b>Practical classes</b>	<b>Activity</b>	<b>Ref Book</b>
<b>1.</b>	1-10	Honey bee species, castes, social biology and communication in honey bees	Chapters 3,5,6 and 10 of TB Chapters 2 to 5 of RB 1 Chapter 2,10 of RB 4
<b>2.</b>	11-20	Bee pasturage and preparation of bee floral calendar	Chapter 11 of TB Chapter 12 of RB 1 Chapter 10 of RB 2
<b>3.</b>	21-30	Honey bees for crop pollination and seed production.	Chapter 17 and 18 of TB Chapter 15 of RB 1
<b>4.</b>	31-40	Stingless bees, little bees, rock bees conservation and honey harvest	Chapter 5 of TB Chapter 2 of RB 1
<b>5.</b>	41-50	Beehives, beekeeping equipments specification and uses, visit to manufacturing unit	Chapter 9 of TB Chapter 1 of RB 1 Chapter 4 of RB 2 Chapter 1 of RB 3 Chapter 4 of RB 4
<b>6.</b>	51-70	Hiving feral Indian bee colony, site selection for apiary, visit to migratory bee keeping sites, visit to commercial cerana bee farm	Chapter 8 of TB Chapter 1 and 8 of RB 1 Chapter 2 of RB 3
<b>7.</b>	71-80	Honey extraction, processing, purity testing and value addition, visit to honey processing unit	Chapter 12, 20, 29 of TB Chapter 10 of RB 1 Chapter 11 of RB 2 Chapter 5 of RB 3
<b>8.</b>	81-100	Hive inspection, maintenance of hive records, management in nectar flow season, dearth period, management of swarming, absconding and laying workers	Chapter 12 of TB Chapter 6, 9 of RB 1 Chapter 7 of RB 2 Chapter 3 to 7 of RB 3
<b>9.</b>	101-120	Dividing, uniting bee colonies, artificial feeding, protecting bees from pesticides	Chapter 12, 14, 25 of TB Chapter 9 of RB 1
<b>10.</b>	121-130	Insect, mite and bird enemies of honeybees, brood and adult diseases	Chapter 21 of TB Chapter 13 of RB 1 Chapter 8 of RB 3 Chapter 9 of RB 2
<b>11.</b>	131-140	Mass queen rearing and production of mating nucleus, visit to beekeeping society	Chapter 16, 22 of TB Chapter 10 of RB 1 Chapter 8 of RB 2
<b>12.</b>	141-150	Methods of collection of bees wax, bee pollen, propolis, bee venom, royal jelly - Visit to commercial mellifera bee farm	Chapter 19 of TB Chapter 14 of RB 1
<b>13.</b>	151-170	Marketing and economics of honey and bee products, preparation of bee keeping projects for bank funding	Chapter 28, 29 of TB Chapter 14 of RB 1

## **E- Reference**

- i. [http://agritech.tnau.ac.in/farm\\_enterprises/fe\\_apiculture\\_home.html](http://agritech.tnau.ac.in/farm_enterprises/fe_apiculture_home.html)  
<http://agdev.anr.udel.edu/maarec/>  
<http://www.aragriculture.org/insects/beekeeping.htm>  
<http://tiwanabeefarm.com/>
- ii. <http://beekeeping.com/>
- iii. <http://www.apimondia.com/en>

## SER 451 Commercial Cocoon Production (0+10)

### UNIT I : MULBERRY PRODUCTION AND MANAGEMENT

- Area and distribution of mulberry –Popular Varieties – climatic requirements and soils
- Propagation of nursery - Selection of planting material - Nursery bed Preparation - planting - management – Economics.
- Main field preparation - manuring – planting - Irrigation –Weeding- fertilizers – Intercropping – Training and pruning. Shoot harvest - Transporting - preservation – Economics - project preparation.
- Pruning methods –farm machinery implements.
- Insect pests and diseases of mulberry –management.

### UNIT II: SILKWORM REARING AND MANAGEMENT

1. Authorized Silkworm Races – crossbreed and bivoltine. Rearing houses – plan and maintenance. Rearing appliances - disinfection.
2. Agencies involved in egg production - procurement - transportation - preservation– incubation - black boxing – hatching. Brushing of eggs – rearing of chawki worms – leaf selection – feeding – moulting - bed cleaning - bed disinfectants.
3. Chawki Garden – maintenance and management
4. Estimation of population of chawki - establishing Chawki Rearing Centres - Record maintenance – Transport - Fixation of rate. Visit to Chawki Rearing Centre.
5. Late age rearing – tray and shoot rearing methods - leaf selection – feeding - spacing - bed cleaning
6. Moulting care - bed disinfectants. Mounting and mountages. Spinning care and Harvesting.
7. Calculation of Effective rate of rearing - Transporting and marketing of cocoons- Economics of rearing silkworms.
8. Project preparation for establishing Late age rearing centres. Large scale sericulture farming and contract farming.

### Unit III: Silk Reeling

9. Physical and commercial properties of cocoons and silk. Cocoon sorting - defective cocoons - cocoon drying - stifling – cooking - brushing - reeling machines - parts and their functions.
10. Study of silk reeling - re-reeling - Skein preparation – packing.
11. Eri silk spinning – spinning - methods.
12. Sampling and testing procedure for winding, size, strength test, condition cohesion and seriplane test. Standards for grading raw silk. Economics of establishing reeling units. Visit to silk reeling units automatic silk reeling units.

### PRACTICAL SCHEDULE (WEEKLY)

Week	Syllabus to be covered and Expected Learning experience
1	Area and distribution of mulberry – Popular Varieties – climatic requirements and soil requirement. Preparation of nursery - planting material - manure application.

2	Nursery management – irrigation, weeding, fertilizer application and plant protection. Economics of nursery management.
3	Main field preparation, manuring - Planting methods - Irrigation – Weeding – Intercropping
4	Training and pruning the mulberry crop. Chawki rearing garden - Pruning methods – schedule of operations. Visit to Chawki rearing garden.
5	Late age silkworm rearing - Harvest of leaf and shoot- methods of harvest. Transporting – preservation of leaves and shoots – methods. Visit to Late age silkworm rearing garden - Calculation of brushing capacity.
6.	Farm machinery implements – mulberry pruner, stem cutter and power weeder. Insect pests and diseases of mulberry –natural enemies- IPM. Economics of Mulberry leaf production. Preparation of project proposals.
7.	Authorized Silkworm Races –crossbreed and bivoltine silkworm rearing. Requisites, inspection and selection of site for rearing house.
8.	Rearing houses – plan and maintenance. Rearing appliances – Disinfection. Agencies involved in egg production - procurement of eggs. Transportation – preservation of eggs – incubation.
9.	Black boxing of eggs. - hatching - estimation of hatching percentage. Brushing of eggs – practicing brushing. Rearing of chawki worms – methods. Leaf selection and feeding for young age silkworms.
10.	Moulting, Bed cleaning and bed disinfectants for chawki worms. Estimation of population of chawki worms. Establishing Chawki Rearing Centres. Record maintenance and logistics at Chawki Rearing Centres. Transport of Chawki worms. Visit to Chawki Rearing Centre.
11.	Late age rearing – tray and shoot rearing methods. Leaf selection and feeding for late age silkworms. Spacing of late age worms and bed cleaning.
12.	Moulting care, application of bed disinfectants and its importance. Mounting of worms and mountages. Spinning care and Harvesting.
13.	Calculation of Effective rate of rearing. Maintenance of rearing records, rearing environment for successful rearing. Transporting and marketing of cocoons. Economics of rearing silkworms and maintenance of rearing records.
14	Project preparation for establishing Late age rearing centres. Large scale sericulture farming and contract farming. Visit to Chawki Rearing Centre and late age rearing centres.

1. Physical and commercial properties of cocoons and silk. Study of cocoon sorting – defective cocoons - drying - stifling - cooking – brushing. Study of reeling machines parts and their functions.  
Study of silk reeling - re-reeling - Skein preparation - packing.

2. Study of tasar and muga cocoons – characteristics - cooking and reeling.  
Study of eri silk spinning - methods of spinning.  
Sampling and testing procedure for winding, size, strength test. Sampling and testing procedures for condition cohesion and seriplane test.
  3. Standards for grading raw silk. Economics of establishing reeling units. Visit to cocoon market and silk reeling units.
- 

## References

- Dandin S.B. Jayant Jayswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
- Krishnaswami,S., M.N. Narasimhanna, S.K Suryanarayan and S.Kumararaj. 1978. Sericulture Manual 2 – Silkworm Rearing . FAO Agricultural Services Bulletin 15/2. Food and Agriculture Organisation of the United Nations, Rome, 131 p.
- Somashekar, T.H. and K. Kawakami. 2003. Manual on Bivoltine Silk Reeling Technology. Central Silk Board, Bangalore. 122 p.

## E- References

1. [www.silkbase.org](http://www.silkbase.org)
2. [www.papilo.ab.a.u.tokyo.ac.jp](http://www.papilo.ab.a.u.tokyo.ac.jp)

## ARM 451 MANAGERIAL SKILLS FOR AGRIBUSINESS (0+10)

### Week 1

1. Sectors of Agribusiness – Seed, Fertilizer, PP Chemicals, Poultry, Bio inputs, Food Processing, Nursery, Logistics, Warehousing, Retail, Consultancy etc
  2. Discussion on Agribusiness – Input sector
  3. Discussion on Agribusiness – Processing sector
  4. Discussion on Agribusiness – Service sector
  5. Presentation on identified agribusiness sector – growth and future directions
- 
11. Institutions promoting agribusiness in India
  12. Government schemes promoting Agribusiness – Start up India, Make in India
  13. Visit to District Industries Centre
  14. Visit to MSME
  15. Presentation on promotional schemes for identified agribusiness sector

### Week 3

1. Business incubation – Types, Process
  2. Business incubation models
  3. Visit to Directorate of Agribusiness Development
  4. Discussion with the TNAU incubatees
  5. Visit to an Agribusiness firm
- 
4. Functions of management
  5. Functional areas of management - Operations
  6. Functional areas of management – Human resources
  7. Functional areas of management - Marketing
  8. Functional areas of management - Finance
- 
1. Location decision for a business
  2. Layout – Goods and Services
  3. Demand forecasting
  4. Planning the operations
  5. Scheduling the operations

### Week 6

1. Inventory management decisions
2. Warehousing management
3. Transportation management
4. Packaging management
5. Presentation of plan of operations

### Week 7

1. Market segmentation
2. Targeting and positioning
3. Marketing mix – 4Ps
4. Product - Features, brand name, uses
5. Place – Distribution strategies

### Week 8

1. Price – Pricing strategies
2. Promotion – Advertising and Sales promotion
3. Planning display, preparation of floor layout plan
4. Preparation of a newspaper advertisement, selection of advertising media
5. Visit to retail outlets to understand the retail formats



**Week 9**

11. Visit to local shandy
12. Visit to Farmers market
13. Visit to Regulated market
14. Market survey –
15. Presentation on the survey conducted

**Week 10**

1. Forms of business organization
2. Farmer Producer Organizations
3. Visit to FPO
4. Financial Assistance for promoting FPOs
5. Presentation on the activities carried out by FPO

**Week 11**

1. Human Relations skills required for business
2. Leadership – Good and Bad cases
3. Communication– Verbal and written communication strategies
4. Emotions – Emotional Intelligence
5. Business Etiquettes

1. Human Resource Management Policy of Firms
2. Human Resource Planning
3. Recruitment and Selection
4. Training
5. Negotiation

1. Company Vision and Mission statement
2. SWOT / TOWS Analysis
3. BCG / Portfolio Matrix
4. Levels of Management
5. Company – Strategy formulation

**Week 14**

3. Source of funds
4. Capital Budgeting Techniques
5. Analyzing Financial Statements
6. Analyzing Financial Statements
7. Discussion on a Case Study

**Week 15**

1. Business Plan – components, types
2. Preparation of model business plan
3. Preparation of model business plan
4. Presentation of business plan
5. Presentation of business plan

**Week 16**

3. Entrepreneur – Qualities, Types of Entrepreneurship
4. Institutes promoting Entrepreneurship
5. Writing Biography of an agribusiness entrepreneur

6. Writing Biography of an agribusiness entrepreneur
7. Finding Entrepreneurial competency level

**Week 17**

Term paper presentation and Evaluation  
Conducting Final Practical Examination