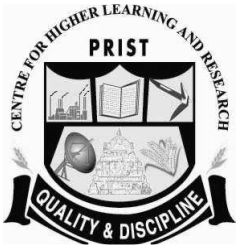


Ponnaiyah Ramajayam Institute of Science & Technology [PRIST]

(Institution Deemed to be University – U/s 3 of the UGC Act, 1956)

Vallam, Thanjavur – 613 403, TAMIL NADU

# B.Sc. (Agriculture) Syllabus

## 2017 Regulation

## Programme educational objectives

The educational objectives are intended to impart high quality education so as to produce not just agricultural graduates but agro technocrats with practical and conceptual skills. With precise and deliberate course modules, which provides education, research and training along with first hand field experiences, the students would sure be transformed as skilled human resources.

During the programme of four year duration, the students will undergo 69 courses in the domain of agriculture, horticulture, agricultural engineering, and information technology including linguistics. The students would gain in depth expertise in scientific farm management and post harvest technologies. The students are also taught with elective courses on mushroom cultivation, sericulture, tissue culture crops and bio fertilizer production, which could explore the graduates' entrepreneurial skills and also add students 'competitive values' in job market.

## Programme outcome

At the end of the programme, the graduate should be able to:

1. Recognize the importance of agriculture in providing food, fibre and income as well as nation building.
2. Understand scientific methods of cultivation of field crops and horticultural crops along with animal production.
3. Establish agro based start-ups for the upliftment of rural community
4. Initiate rural enterprises there by providing jobs for the jobless.
5. Carry out basic and applied research geared towards augmentation of crop and animal production
6. Transfer of agro technologies to the farming community via public and private sector stakeholders.
7. Pursue advanced courses and trainings in International and National institutions

# CREDIT DISTRIBUTION

| Semester | Core courses | | Experiential Learning courses | | Elective courses | | RSB Courses | | Total credits for OGPA |
|---|---|---|---|---|---|---|---|---|---|
| | No. | Credits | No. | Credits | No. | Credits | No. | Credits | |
| I | 10 | 21 | - | - | - | - | - | - | 21 |
| II | 10 | 23 | - | - | - | - | - | - | 23 |
| III | 10 | 23 | - | - | - | - | - | - | 23 |
| IV | 12 | 24 | - | - | - | - | 1 | 1 | 25 |
| V | 10 | 24 | - | - | - | - | 1 | 3 | 27 |
| VI | 9 | 22 | - | - | 1 | 2 | 1 | 2 | 26 |
| VII | 1 | 21 | - | - | - | - | 1 | 2 | 23 |
| VIII | - | - | 2 | 20 | - | - | - | - | 20 |
| **Total** | **62** | **158** | **2** | **20** | **1** | **2** | **4** | **8** | **188** |

# Semester – wise distribution of courses

**I Year I Semester**

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AGR 101 | Fundamantals of Agronomy and Agricultural Heritage | 1+1 |
| 2 | 17 BIC 101 | Fundamentals of Plant Biochemistry | 2+1 |
| 3. | 17 SAC 101 | Fundamentals of Soil Science | 2+1 |
| 4. | 17 FOR 111 | Introduction to Forestry | 1+1 |
| 5. | 17 ENG 101 | Comprehension & Communication skills in English | 1+1 |
| 6. | 17 HOR 111 | Fundamentals of Horticulture | 1+1 |
| 7. | 17 MAT 113 | Elementary Mathematics | 1+1 |
| 8. | 17 PBG 101 | Introduction to Agricultural Botany | 1+1 |
| 9. | 17 AEX 101 | Rural Sociology and Educational Psychology | 2+0 |
| 10. | 17TAM 101/ 17 ENG 102 | □□□□□ □□□□□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□ □□□□□□□ □□□□□□□□□□ / Development Education (for non Tamil students) | 0+1 |
| | | **Total** | **12+9=21** |

**I Year II Semester**

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 SWE 111 | Soil and Water Conservation Engineering | 2+1 |
| 2. | 17 CRP 101 | Fundamentals of Crop Physiology | 2+1 |
| 3. | 17 AEC 101 | Fundamentals of Agricultural Economics | 1+1 |
| 4. | 17 PAT 101 | Fundamentals of Plant Pathology | 2+1 |
| 5. | 17 AEX 102 | Fundamentals of Agricultural Extension Education | 2+1 |
| 6. | 17 FSN 111 | Principles of Food Science and Nutrition | 1+1 |
| 7. | 17 FMP 111 | Farm Machinery and Power | 1+1 |
| 8. | 17 AGR 102 | Introductory Agro-meteorology & Climate Change | 1+1 |
| 9. | 17 HOR 112 | Production Technology for Fruit and Plantation Crops | 1+1 |
| 10. | 17 RSG 101 | Geo-informatics for Precision Farming | 1+0 |
| | | **Total** | **14+9=23** |

**II year III Semester**

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AGM 201 | Fundamentals of Microbiology | 2+1 |
| 2. | 17 AEN 201 | Fundamentals of Entomology | 2+1 |
| 3. | 17 SST 201 | Principles of Seed Technology | 2+1 |
| 4. | 17 AGR 201 | Crop Production Technology – I (Kharif crops) | 1+1 |
| 5. | 17 HOR 211 | Production Technology for Vegetables and Spices | 1+1 |
| 6. | 17 ENS 201 | Environmental Studies and Disaster Management | 2+1 |
| 7. | 17 AMP 201 | Livestock and Poultry Management | 2+1 |
| 8. | 17 AEC 201 | Farm Management, Production and Resource Economics | 1+1 |
| 9. | 17 SAC 201 | Soil Resource Inventory | 1+1 |
| 10. | 17 AGR 202 | Study Tour (Non gradial; compulsory course) | 0+1[§] |
| | | **Total** | **14+9=23** |

[§] Non gradial; compulsory course

**II year IV Semester**

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 PBG 201 | Fundamantals of Genetics | 2+1 |
| 2. | 17 AEX 201 | Communication Skills and Personality Development | 1+1 |
| 3. | 17 MAT 211 | Statistical Methods | 1+1 |
| 4. | 17 PAT 201 | Principles of Plant Disease Management | 1+1 |
| 5. | 17 AEN 202 | Beneficial Insects and Principles of Insect Pest Management | 2+1 |
| 6. | 17 AGR 203 | Crop Production Technology – II (Rabi crops) | 1+1 |
| 7. | 17 ERG 211 | Renewable Energy | 1+0 |
| 8. | 17 AGR 204 | Farming System and Sustainable Agriculture | 1+1 |
| 9. | 17 SAC 202 | Problematic soils and their management | 2+0 |
| 10. | 17 HOR 212 | Production Technology for Ornamantal Crops, MAP and Landscaping | 1+1 |
| 11. | 17 ANM 201 | Introductory Nematology | 1+1 |
| 12. | 17 NST 201 | Fundamentals and Applications of nanotechnology | 1+0 |
| 13. | 17 RES 201 | Research Led Seminar | 0+1 |
| | | **Total** | **15+10=25** |

**III year V semester**

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 PBG 301 | Fundamentals of Plant Breeding | 2+1 |
| 2. | 17 AEC 301 | Agricultural Marketing, Trade and Prices | 2+1 |
| 3. | 17 AGM 301 | Soil and Applied Microbiology | 1+1 |
| 4. | 17 PAT 301 | Diseases of Horticultural Crops and their Management | 1+1 |
| 5. | 17 AEX 301 | Entrepreneurship Development and Business Communication | 1+1 |
| 6. | 17 AGR 301 | Practical Crop Production - 1 (Kharif Crops) | 0+2 |
| 7. | 17 HOR 311 | Post harvest management and value addition of fruits and vegetable crops | 1+1 |
| 8. | 17 SAC 301 | Manures, ferilizers and soil fertility management | 2+1 |
| 9. | 17 ABT 301 | Plant Biotechnology | 2+1 |
| 10. | 17 AGR 302 | Rainfed Agriculture and Watershed Management | 1+1 |
| 11. | 17 RES 301 | Research Methodology | 0+3 |
| | | **Total** | **13+14=27** |

**III year VI semester**

| S.No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AEC 302 | Agricultural Finance, Banking and Co-operation | 2+1 |
| 2. | 17 PAT 302 | Diseases of Field Crops and their Management | 2+1 |
| 3. | 17 COM 311 | Agriculture Informatics | 1+1 |
| 4. | 17 ENS 301 | Environmental Pollution and Management | 1+1 |
| 5. | 17 APE 311 | Post Harvest and Food Engineering | 1+1 |
| 6. | 17 AEN 302 | Pests of Crops, Stored Grain and their Management | 2+1 |
| 7. | 17 AGR 303 | Practical Crop Production – II (Rabi crops) | 0+2 |
| 8. | 17 AGR 304 | Principles of Organic Farming | 1+1 |
| 9. | 17 PBG 302 | Crop Improvement | 2+1 |
| 10. | 17 OPT 301 | Optional Course | 1+1** |
| 11. | 17 RES 302 | Participation in bounded research | 0+2 |
| | **Total** | | **13+13=26** |

** Elective courses (List of options given in page No. 8)

**IV year VII semester**

| S.No | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 16 AEX 401 | Rural Agricultural Work Experience - RAWE (VSP+ADA+NGO+INDUSTRY) | 0+20 |
| 2. | 16 PRJ 401 | Project Work** | 0+2 |
| 3. | 16 AEX 402 | All India Tour (21 days) | 0+1 |
| | | **Total** | **0+23=23** |

** Research course (Project Topic based on current issue)

**IV year VIII semester**

| S.No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 EXP 401 | Experiential Learning – Module I | 0+10*** |
| 2. | 17 EXP 402 | Experiential Learning – Module II | 0+10*** |
| | | **Total** | **0+20= 20** |

*** Experiential Learning Courses (List of options given in page No. 9)

## LIST OF ELECTIVE COURSES

Elective courses : A student can select one optional course out of the following offered during VI semester.

| S.No | Code No. | Courses | Credit Hours |
|---|---|---|---|
| 1. | 17 CRP 311 | Physiological Techniques in crop production | 2 (1+1) |
| 2. | 17 SAC311 | Designer fertilizer Production | 2 (1+1) |
| 3. | 17 SAC312 | Rejuvenation of Deteriorated lands | 2 (1+1) |
| 4. | 17 SAC313 | Soilless crop production | 2 (1+1) |
| 5. | 17 SAC314 | Instrumental methods of analysis | 2 (1+1) |
| 6. | 17 SST 311 | Seed entrepreneurship skill development and management | 2 (1+1) |
| 7. | 17 AGR 311 | Weed and water management | 2 (1+1) |
| 8. | 17 PGP 311 | Plant Genetic Resources Collection, Conservation and Utilization | 2 (1+1) |
| 9. | 17 NEM 311 | Commercial Production of Nematode Antagonistic bio-agents | 2 (1+1) |
| 10. | 17 AGM 311 | Downstream Processing for Industrially Important Microbial Products | 2 (1+1) |
| 11. | 17 AGM 312 | Microbial Enzymes | 2 (1+1) |
| 12. | 17 AGM 313 | Microbial Quality and Safety of Foods | 2 (1+1) |
| 13. | 17 AGM 314 | Plant –Microbe Interaction | 2 (1+1) |
| 14. | 17 AGM 315 | Quality Control of Bio-inoculants | 2 (1+1) |
| 15. | 17 SAC 315 | Crop and Pesticide Chemistry | 2 (1+1) |

## LIST OF EXPERIENTIAL COURSES

| S. No | Course code | Titles of the module | Credits |
|---|---|---|---|
| **1.** | 17 AGM 411 | Bio-inoculant production technology | 0+10 |
| **2.** | 17 HOR 411 | Hybrid Seed Production in Vegetable Crops | 0+10 |
| **3.** | 17 SAC 411 | On Farm Advisory for Soil Health, Water Quality & Plant Nutrition | 0+10 |
| **4.** | 17 AEN 411 | Commercial Beekeeping | 0+10 |
| **5.** | 17 SER 411 | Commercial Cocoon Production | 0+10 |
| **6.** | 17 ABT 411 | Commercial Plant Tissue Culture | 0+10 |
| **7.** | 17 HOR412 | Commercial Nursery Technology of Horticultural Crops | 0+10 |
| **8.** | 17 HOR 413 | Commercial Landscape Gardening | 0+10 |
| **9.** | 17 PAT 411 | Commercial production of Bio-control agents | 0+10 |
| **10.** | 17 PAT 412 | Commercial mushroom production | 0+10 |
| **11.** | 17 AMP 411 | Commercial broiler and layer production | 0+10 |
| **12.** | 17 SST 411 | Commercial seed production | 0+10 |
| **13.** | 17 PBG 411 | Hybrid pearl millet seed production | 0+10 |
| **14.** | 17 PBG 412 | Hybrid rice parental line seed production | 0+10 |
| **15.** | 17 ARM 411 | Managerial skills for Agribusiness | 0+10 |
| **16.** | 17 AGR 411 | Development of Integrated Farming system Model | 0+10 |
| **17.** | 17 HOR 414 | Protected cultivation of Vegetable crops | 0+10 |
| **18.** | 17 ENS 411 | Composting technology | 0+10 |
| **19.** | 17 AGR 412 | Organic Agriculture | 0+10 |

# I Semester

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AGR 101 | Fundamantals of Agronomy and Agricultural Heritage | 1+1 |
| 2 | 17 BIC 101 | Fundamentals of Plant Biochemistry | 2+1 |
| 3. | 17 SAC 101 | Fundamentals of Soil Science | 2+1 |
| 4. | 17 FOR 111 | Introduction to Forestry | 1+1 |
| 5. | 17 ENG 101 | Comprehension & Communication skills in English | 1+1 |
| 6. | 17 HOR 111 | Fundamentals of Horticulture | 1+1 |
| 7. | 17 MAT 113 | Elementary Mathematics | 1+1 |
| 8. | 17 PBG 101 | Introduction to Agricultural Botany | 1+1 |
| 9. | 17 AEX 101 | Rural Sociology and Educational Psychology | 2+0 |
| 10. | 17TAM 101/ 17 ENG 102 | □□□□□ □□□□□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□□ □□□□□□□□ □□□□□□□□□□□ / Development Education (for non Tamil students) | 0+1 |
| | | **Total** | **12+9=21** |

**17 AGR101 FUNDAMENTALS OF AGRONOMY AND AGRICULTURAL HERITAGE (1+1)**

**Theory:**

**Unit - I:**

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

**Unit - II:**

Agriculture heritage - Agriculture in ancient India - Stages of agriculture development - Era of civilization - Importance of Neolithic civilization - Chronological agricultural technology development in India - Kautilya‘s Arthasasthra - Sangam literature - Kambar Eaer Ezhupathu - ITK - Development of scientific Agriculture - National and International Agricultural Research Institutes in India - Indian agriculture.

**Unit - III:**

Agronomy - Definition - Importance - Meaning 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 - 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:**

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. Stages of agriculture development - Era of civilization - Importance of Neolithic civilization.
5. Chronological agricultural technology development in India. Kautilya‘s Arthasasthra - 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. **Mid-semester Examination.**
9. Crops and major soils - classification - Economic and agricultural importance in Tamil Nadu and India.
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. **Practical Examination.**

**References**


1. Yellamananda Reddy, T. and G.H. Sankara Reddi. 1997. Principles of Agronomy. Kalyani Publishers, New Delhi.
2. Sankaran, S. and V.T. Subbiah Mudaliar. 1997. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
3. ICAR. 2011. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.


**E-References**


http://icar.res.in
ww.webcast.gov.in
ww.icar.org.in/nasm.html

**17 BIC 101 FUNDAMENTALS OF BIOCHEMISTRY (2+1)**

**OBJECTIVE**

- To gain basic knowledge of the biomolecules *viz*., Carbohydrates, Proteins and Lipids - properties, structure and metabolism.
- To learn basics of enzymes

**Theory**

**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 pathyway 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. **MIDSEMESTER 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**

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, 7th 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.


**Teaching Resources**

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:// freemedebooks. 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, 3rd Edn, New Age International.
5. Wilson, K. and Walker, J.M. (2000), Principles and techniques of Practical Biochemistry, 5th Edn. – Cambridge University Press.
6. www.ncbi.nlm.nih.gov

**17 SAC 101 FUNDAMENTALS OF SOIL SCIENCE (2 + 1)**

**Aim:**

To impart knowledge about soils, their formation, pedological and edaphological approaches and physical, chemical and biological properties of soils.

**Syllabus - Theory**

**Unit l-Earth, Rocks and Minerals**

Soil - Pedological and edaphological concepts - Origin of the Earth - Composition of Earth's crust -Rocks and minerals - primary and secondary minerals.

**Unit II - Soil Formation**

Weathering of rocks & minerals - Physical, chemical and biological weathering - Soil formation - factors-active & passive. - Soil forming processes - Simenson's and specific - Soil profile.

**Unit III- Physical Properties**

Soil physical properties and their significance - Soil texture and textural classes - Soil structure and classification - Soil consistence. Bulk density, particle density and porosity - Soil colour - significance -causes and measurement. Soil temperature - Soil air - Soil water- Measurement - Soil water potentials -Soil moisture constants - Movement of soil water - saturated and unsaturated flow - infiltration, hydraulic conductivity, percolation, permeability and drainage**.**

**Unit IV-Chemical Properties**

Soil colloids - Properties, types and significance - Layer silicate clays - their genesis and sources of charges - Ion exchange - CEC, AEC and Base saturation - Factors influencing Ion exchange -significance. Soil reaction, Buffering capacity and EC.

**Unit V-Organic matter and Humus**

Soil organic matter - Composition - decomposition and mineralization, C : N ratio, Carbon cycle -Fractions of soil organic matter - Humus formation. Soil organisms - Beneficial and harmful effects.-Soil enzymes**.**

**Syllabus-Practical**

Identification of rocks and minerals - Study of soil profile - collection and processing of soil samples -Determination of bulk density, particle density and porosity - Particle size analysis - Feel method -International pipette method - Soil colour - Munsell colour chart. Soil moisture determination -Gravimetric method, gypsum block, tensiometer, TDR and neutron probe moisture meter. Determination of infiltration rate and hydraulic conductivity - Soil temperature. Soil pH and EC - Organic carbon -Chemical constituents of soil - Field study of different soil types.

**Lecture Schedule**

1. Soil definition – soil as a three dimensional narural body – Pedalogical and edaphological concepts.
2. Origin of Earth – theories – planetesimal and nebular hypothesis – Composition of Earth‘s crust
3. Rocks – definition, formation, classification – 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 of rocks and minerals – Physical, chemical and biological
8. Soil profile description – Master horizons – pedon and poly pedon
9. Factors of soil formation – Passive soil forming factors
10. Factors of soil formation – Active soil forming factors
11. Fundamental soil forming process – Simenson‘s four fold soil forming process – eluviation, illuviation, translocation and humification.
12. Specific Soil forming processes – podzolization, laterization, salinization, alkalization, calcification, decalcification and pedoturbation.
13. Soil texture – particle size distribution – textural classes – textural triangular diagram significance of soil texture
14. Soil structure – classification – genesis – factors influencing structural stability – significance of soil structure
15. Soil consistence – cohesion, adhesion, plasticity, Atterberg‘s constants – upper and lower plastic limits, plasticity number – significance of soil consistence
16. Soil bulk density,particle density and porosity – factors influencing – significance
17. Mid semester Examination
18. Soil colour – causes and measurement – Munsell colour chart – factors influencing soil colour – significance
19. Soil temperature – measurement , soil air – composition – aeration, measurement – significance of soil temperature and soil air
20. Soil water – forms of water, units of expression and pF scale
21. Measurement of soil moisture – Gravimetric, Tensiometer, Gypsum Block, TDR, Neutron probe and Theta probe
22. Soil water potentials – gravitational, matric, osmotic –soil moisture constants
23. Movement of soil water – Saturated and unsaturated flow – infiltration, hydraulic conductivity, percolation, permeability and drainage.
24. Soils colloids – types, properties – inorganic colloids and organic colloids
25. Layer silicate clays – genesis and classification – 1:1, 2:1 expanding and non expanding – 2:2 clay minerals, amorphous minerals.
26. Sources of charges in expanding and non expanding crystalline lattice clays, amorphous minerals and organic colloids
27. Ion exchange reactions – cation exchange, anion exchange and base saturation – significance
28. Soil reaction (pH) – definition, pH scale, factors affecting soil pH, buffering capacity
    – Significance
29. Soil Electrical Conductivity – factors affecting EC – Significance
30. Soil organic matter – composition, decomposition, mineralization and immobilization Carbon cycle, C:N ratio, biomass carbon and nitrogen.
31. Fractions of soil organic matter – humus formation and stabilization

32. Soil organisms – soil flora and fauna formation and stailization
33. Soil organisms – soil flora and fauna – beneficial and harmful roles – earth worms – micro – organisms and their influence on soil properties – Soil enzymes – Dehydrogenase, catalase and phosphatise
34. Importance of soil properties on crop growth.

**Practical Schedule**

1. Identification of common rocks and minerals
2. Methods of soil sample collection
3. Visit to soils of different terrains and study of soil profiles
4. Determination of bulk density, particle density and porosity - cylinder, wax coating and core methods.
5. Soil textural analysis - feel method, International pipette method (part 1)
6. International pipette method (part 2)
7. International pipette method (part 3)
8. Determination of soil colour and temperature.
9. Determination of soil moisture- Gravimetry and moisture probes
10. Determination of available soil moisture - Pressure Plate Apparatus
11. Determination of Infiltration rate - Double Ring Infiltrometer
12. Determination of hydraulic conductivity - Constant head Hydraulic Conductivity unit
13. Determination of soil pH and EC
14. Estimation of soil organic carbon
15. Colloquium 1. - Chemical constituents of soil - Total elemental composition - relevance in soil properties and behaviour
16. Colloquium 2. - Preparation of interpretative reports of soil analysis and assignments
17. Final Practical Examination

**Text Books**


1. Brady, N.C. and Raymond, C.Weil. 2013. The Nature and Properties of Soils (14th Edition). Pearson Education, Inc. Publishing as Prentice Hall.
2. Sehgal, J. 2005. Pedology concepts and applications, Kalyani Publishers, New Delhi.


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1. Arun Kumar Saha and Anuradha Saha. 2012. Text book of Soil Physics. Kalyani Publishers. New Delhi.
2. Bear, Firman.E. 2012. Soil Science. Vol. 8. Scientific Publishers, Jodhpur, India.
3. Bear,Firman.E.2014. Chemistry of the soil. 2nd Edition. ScientificPublishers,Jodhpur,India.
4. Biswas T.D. and Mukherjee S.K., 1987. Text Book of Soil Science-Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Black, C.A. 1965. Agronomy Monograph. Methods of Soil Analysis. Part1. Physical & Mineralogical properties including Statistics of Measurement and Sampling. Wiley, NewYork.
6. Brady, N.C. and Raymond, C.Weil. 2013. The Nature and Properties of Soils (14th Edition). Pearson Education, Inc. Publishing as Prentice Hall.

7. Daji A.J. 1970. A Text Book of Soil Science - Asia Publishing House, Madras.
8. Dilip Kumar Das. 2004. Introductory Soil Science, Kalyani Publishers, New Delhi
9. Fanning, D.S. and C.B.Fanning. 1989. Soil: Morphology, Genesis and Classification. John Wiley and Sons, New York.
10. Fundamentals of Soil Science. 2009. ISSS Publication, New Delhi.
11. Garrison Sposito. 2008. The Chemistry of Soils. Amazon Publishers, India.
12. Ghildyal, B.P. and Tripathi, R.P. 2001. Soil Physics. New Age International Publications.
13. Hillel, D. 1998. Environmental Soil Physics. Academic Press: Orlando, Fl.
14. Helmut Kohnke and D.P.Franzmeier. 2013. Soil Science Simplified. Amazon Publishers, India
15. Henry D.Foth. 1990. Fundamentals of Soil Science. Amazon Publishers, India.
16. Jenny, H. 1941. Factors of Soil Formation - A System of Quantitative Pedology. McGraw-Hill Book Company INC. NewYork.
17. Joffe, J.S. 1936. The ABC of Soils. Pedology Publication, New Jersy.
18. Kim H.Tan. 2003. Principles of Soil Chemistry. Third Edition. Scientific Publishers, Jodhpur, India.
19. Kohnke, H. and D.R.Franzmeier. 2013. Soil Science Simplified. Amazon Publishers.
20. Michael J.Singer and Donald N. Munns. 2005. Soils : an introduction ($6^{th}$ Edition). Amazon Publishers.
21. Sahai, V.N. 2008. Fundamentals of Soils. Kalyani Publishers, New Delhi.
22. Schaetzl, R. and S.Anderson. 2005. Soils - Genesis and geomorphology. Cambridge University Press, Cambridge.
23. Soil Science Society of America. 2001. Glossary of Soil Science Terms 1996. Soil Science Society of America, Madison, Wis.
24. Michael J.Singer and Donald N.Munns. 2005. Soils : An Introduction ($6^{th}$ Edition) Amazon Publishers.
25. Sree Ramulu, U.S. 2003. Principles in the quantitative analysis of waters, fertilizers, plants and soil. Scientific Publishers.
26. William A.Jury and Robert Horton. 2004. Soil Physics. Amazon Publishers.

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3. http://www.pedosphere.com/volume01/pdf/Section. 01.pdf
4. http://waterquality.montana.edu/docs/homeowners/Septic Drainfield Soil Suitability, Presentations /6 Soil Texture and Structure.pdf
5. http://wfrec.ifas.ufl.edu/landscape horticulture/PDFdocuments/SoilProp.pdf
6. http://www.rootsofpeace.org/assets/Soil%Testinq%Manual%20V6%20(Feb%208).pdf
7. http://www.soils.wisc.edu/courses/SS325/morphology.htm
8. http://www.google.co.in/#hlBase+saturation+%E2%80%93+Factors+influencing +ion+exchange+significance.+Soil+reaction%2C+Buffering+capacity+and+EC+ +&btnG

9. ftp: / / ftp- fc. sc. egov. usda. qov/ NSSC/ Lab Methods Manual/ SSIR42 2004 print, pdf
10. www.scribd.com/.../15751720-Soil-Survev-lab-Methods-Manual-2004-USDA
11. www.asssi.asn.au/.../Understanding_Soils_and_Their_lnteractions_with_La nd Management_2005.pdf
12. http://www.soils.wis.edu/courses/SS325/morphology.htm
13. http://landresources.montana.edu/
14. http://ftp.wcc.nrcs.usda.goV/H....soilOther/soil-USDA-textural-class.pd

**Outcome:**

This course will give a comprehensive knowledge on rocks and minerals, their composition and the types of soils formed from different parent materials. It will enrich the students on the role of soil forming factors and processes in soil formation. The students will understand the various soil physical, chemical and biological properties and their impact on plant growth. The knowledge gained in this course will be useful in understanding the behaviour of soils in crop production and management

**17 FOR 111 INTRODUCTION TO FORESTRY (1+1)**

**Aim**

To impart knowledge about the basic facts of Forestry as well as agroforestry and familiarize the students with important trees suitable for agroforestry and various agroforestry systems.

**Theory**

**Unit I –Introduction to Forestry**

Forests and Forestry - Definition, scope, classification of Indian Forests - Role of forests – Tangible and intangible benefits - Forest types of Tamil Nadu – Forest cover of India - Silvics and Silviculture – definition and objectives – relation with other branches of forestry.

**Unit II – Agroforestry concept and systems**

Agroforestry – definition, scope and history - Agroforestry components – benefits and limitations – Agroforestry systems in different agro climatic zones of Tamil Nadu - Classification of agroforestry systems – structural, functional, ecological and socio-economic basis.

**Unit III – Agroforestry tree species**

Important farm grown trees - Silvicultural characters – Regeneration techniques – Tending – Rotation – Yield and Uses of *Tectona grandis, Santalum album, Casuarina equisetifolia, Eucalyptus hybrid, Azadirachta indica, Melia dubia, Ailanthus excelsa, Dalbergia sissoo, and Pterocarpus santalinus*

**Unit IV – Agroforestry practices**

Agroforestry practices for arid and semi arid regions, salt affected soils, waterlogged areas, fuelwood and fodder production, soil and water conservation, wasteland development – Carbon sequestration through agroforestry approaches – Forest Mensuration – definition, objectives – Diameter, girth and height measurement methods–standard rules governing breast height measurement – Volume estimation in standing and felled trees - measurement of weight and biomass - Timber transit rules for farm grown trees - National Agroforestry policy, 2014

**Unit V Forests and people**

Social forestry – Definition, history, objectives – Components – Farm forestry, Extension forestry, Community forestry, Recreation forestry, Urban forestry – Benefits of social forestry - Important social forestry schemes implemented in India - Definition, origin and evolution of JFM in India – Salient features of JFM – Organisational structure in JFM-Benefit sharing mechanism

**Practical**

Identification of major farm grown tree species – Design and Layout of permanent forest nursery - Nursery technology of *Tectona grandis, Casuarina equisetifolia, Eucalyptus hybrid, Azadirachta indica, Ailanthus excelsa, Melia dubia, Dalbergia sissoo, Gmelina arborea, Santalum album* and *Pterocarpus santalinus* – Visit to agroforestry models – Agrisilviculture – Silvipasture – Integrated Farming System - Windbreaks and shelterbelts – Industrial wood plantations and contract tree farming - Estimation of volume – Estimation of

biomass – Economics of agroforestry – Preparation of two agroforestry models for the region**.**

**Lecture Schedule**

1. Forests and Forestry - Definition, scope and classification of Indian forests
2. Role of Forests – Tangible and Intangible benefits - Forest types of Tamil Nadu – Forest cover of India
3. Silvics and Silviculture – definition and objectives – relation with other branches of forestry
4. Agroforestry – definition, scope and history
5. Agroforestry components – benefits and limitations – Agroforestry systems in different agro climatic zones of Tamil Nadu
6. Classification of agroforestry systems – structural, functional, ecological and socio-economic basis
7. Silvicultural characters, regeneration techniques, tending, rotation, yield and uses of *Tectona grandis, Santalum album* and *Pterocarpus santalinus*
8. Silvicultural characters, regeneration techniques, tending, rotation, yield and uses of *Casuarina equisetifolia, Eucalyptus hybrid* and *Ailanthus excelsa*
9. Mid semester examination
10. Silvicultural characters, regeneration techniques, tending, rotation, yield and uses of *Azadirachta indica, Melia dubia* and *Dalbergia sissoo*
11. Agroforestry practices for arid, semi-arid, salt affected and waterlogged soils
12. Carbon sequestration through agroforestry approaches
13. Definition, objectives, scope of Forest Mensuration - Diameter, girth and height measurement methods
14. Standard rules governing breast height measurement – volume estimation of standing and felled trees – measurement of weight and biomass
15. Timber transit rules for farm grown trees – National Agroforestry policy, 2014
16. Definition, history and objectives of social forestry – Components and benefits of social forestry – Important social forestry schemes implemented in India
17. Joint Forest Management – definition, origin, evolution, salient features and organizational structure- benefit sharing mechanism

**Practical schedule**

1. Identification of major farm grown tree species
2. Design and Layout of permanent Forest Nursery
3. Nursery technology of *Tectona grandis* and *Santalum album*
4. Nursery technology of *Casuarina equisetifolia* and *Eucalyptus hybrid*
5. Nursery technology of *Azadirachta indica* and *Melia dubia*
6. Nursery technology of *Ailanthus excelsa* and Red *Pterocarpus santalinus*
7. Nursery technology of *Dalbergia sissoo* and *Acacia spe.*
8. Visit to agrisilviculture and silvipasture models
9. Visit to Integrated Farming System
10. Design and establishment of windbreaks and shelterbelts
11. Visit to pulpwood / plywood plantations

12. Studies on contract tree farming practices in Tamil Nadu
13. Estimation of volume of standing and felled trees
14. Estimation of tree biomass through various methods
15. Economics of agroforestry
16. Preparation of two agroforestry models for the region
17. Final practical examination

**Text Books**


1. Divya, M.P., K.T.Parthiban, K.Srinivasan, K.Vanangamudi and M.Govinda Rao. 2008. A text book on Social Forestry and Agroforestry. Satish Publishers, Delhi
2. Dwivedi, A.P. 1992. Agroforestry Principles and Practices. oxford & IBH publishing Co., New Delhi


**For further reading**


1. Sunil Puri and Pankaj Panwar. 2007. Agroforestry Systems and Practices. New India Publishing Agency, New Delhi
2. Antony Joseph Raj and S.B.Lal, 2014. Agroforestry – Theory and Practices. Scientific Publishers (India), Jodhpur
3. Pathak, P.S. and Ram Newaj. 2003. Agroforestry – Potentials and Opportunities. Agrobios (India)
4. Nair, P.K.R. 1993. An introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht


**Websites**

www.worldagroforestry.orgn
www.global-saf.com
www.agroforestry.net.au
www.nac.unl.edu/documents/insideagroforestry/vol16issue2.pdf

**Outcome**

The students will gain knowledge on concepts of forestry, agroforestry and the important agroforestry systems. The students will learn about the silviculture and nursery technology of important agroforestry tree species.

## 17 ENG 101 COMPREHENSION & COMMUNICATION SKILLS IN ENGLISH (1+1)

### AIM

To make the students competent in

Listening – receptive skill

Speaking – productive skill

Reading - receptive skill

Writing - productive skill

**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.

### THEORY 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) textural 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) textural 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) textural grammar – subject – verb – agreement
8. **A Dilemma** (A lesson from the Text Book, Layman looks at Science by Raymond Fosdick) textural 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) textural 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. **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.


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

**AIM**

- To inculcate the basic concepts, technical knowhow of horticultural operations.

**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 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. **Practical examination**

**References**

**Text books**


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, IndiaHartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greneve. 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.


**Journals**

1. Indian Horticulture
2. Chronica Horticulture
3. Hort technology

**e references**

- http://aggie – horticulture, tamu.edu/propagation/propagation.html
- http://www/britannica.com/
- http://www.horticulture.com.au/export/hmac.asp
- http://www.horticultureworld.net/hort-india.htm
- http://www.fao.org/

**Outcome**

The students will know about the history, principles, basic concepts and technical knowhow of the horticultural operations

## 17 MAT 113 ELEMENTARY MATHEMATICS ( 1+1)

**Objective:**

To understand and apply fundamental concepts of mathematics applicable in biology and to acquire about theoretical concepts of Algebra, Geometry, Calculus and Mathematical Modeling.

**Theory**

**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 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 $3^{rd}$ order evaluation and inverse up to $3^{rd}$ 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$^{rd}$ 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.

## 17 PBG 101 INTRODUCTION TO AGRICULTURAL BOTANY (1+1)

**Aim**: To expose the students to the basic features of botanical description, economic parts and economic importance of different field and horticultural crops

### SYLLABUS FOR THEORY

**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

**SYLLABUS FOR 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; Arecaceae: 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 schedule**

1. Bentham and Hooker‘s classification of plant kingdom — International code of nomenclature and its major guidelines – author citation – Agricultural classification of
2. crops
3. General morphology: Life span, habit, root, stem, leaf - petiole, leaf margin, leaf apex, leaf shape, venation and phyllotaxy; Modification of roots and leaf
4. Floral morphology: Kinds of bracts, inflorescence; Structure of flower, androecium, gynoecium, placentation , types of fruits.
5. List of cultivated crops, economic parts, chromosome number and family description of Poaceae; Key botanical features of Rice and Wheat.
6. Key botanical features of sorghum, maize, pearl millet and finger millet. List of small millets
7. Key botanical features of Guinea grass, Napier grass, *Cenchrus* and sugarcane.
8. List of cultivated crops, economic parts, chromosome number and family description of (Papilionaceae) Key botanical features of Red gram, Bengal gram and Soybean
9. Key botanical features of Black gram, Green gram, Cowpea, Lab lab, Horse gram and Groundnut.
10. **Mid Semester Examination**
11. Key botanical features of Lucerne, *Stylosanthes*, Clitoria, Agathi, and Sunnhemp.
12. 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
13. 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
14. List of cultivated crops, economic parts, chromosome number and family description of Arecaceae and Malvaceae; Key botanical features of Coconut, Arecanut, Oilpalm, Sugarpalm, Cotton, Mesta and Bhendi.
15. List of cultivated crops, economic parts, chromosome number and family description of Tiliaceae, Piperaceae and Chenopodiaceae; Key botanical features of Jute, Betelvine,

Sugar beet.

16. 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

17. 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

18. 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

19. **Final Theory Examination**

**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**

**Assignment**

- Collection and preparation of 25 herbarium specimens representing minimum of ten families of the crop species studied.
- Collection of crop seeds of 10 traditional varieties.

**Outcome**

Botanical features and economic importance of different crop plants belonging to 20 families will be exposed.

**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


**Further reading**


1. Purse glow, 1988. Tropical Crops - Monocotyledons. The English Language book Society and Longman Co., Singapore
2. Purse glow. 1988. Tropical Crops - Dicotyledons. The English language book Society and Longman Co., Singapore.
3. Albert F. Hill and O.P. Sharma, 1996. Economic Botany. Tata McGraw - Hill Publishing Co. Ltd., New Delhi.
4. 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.


**Web resources**

- www.nmsu.edu
- www.biology200.gsu.edu

**17 AEX 101** **RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY** **2+0**

**Objective**

This course will enable students to acquire knowledge on basics concepts related to rural sociology and educational psychology. Students will also learn the practical applications of important sociological and psychological concepts.

**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.

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


- Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi Press, Bapatla, Andhra Pradesh.

- Chatterjee, S. 2000. Advanced Educational Psychology, Books & Allied (P) Ltd., Calcutta.
- 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.
- Dahama, O.P. and O.P. Bhatnagar. 2007. Education and Communication for Development, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Kundu, C.L and Tutoo, D.N. 2001. Educational Psychology, Sterling Publishers Pvt. Ltd., New Delhi.
- Lester Crow, D and Alice Crow. 1973. Educational Psychology, Eurasia Publishing House Pvt. Ltd., New Delhi.
- Madumita Gupta. 2011. Fundamentals of Sociology, Pacific Publications, New Delhi.
- Mangal, S.K. 2000. Educational Psychology, Prakash Brothers, Ludhiana.
- Shankar Rao, C.N. 2012. Sociology – Principles of Sociology with an Introduction to Social Thought, S.Chand & Co. Ltd., New Delhi.
- Sharma, R.N. 1968. Principles of Sociology, Asia Publishing House, New Delhi.
- Supe. S.V. 2012. Text book of Extension Education, Agrotech Publishing Academy, Udaipur.
- Usha Rao. 2008. Advanced Educational Psychology, Himalaya Publishing House, New Delhi.
- Vidya Bhushan and Sachdeva, D.R. 2003. An Introduction to Sociology, Kitab Mahal, Allahabad.


**Journals**


- Indian Journal of Social Research
- Journal of Rural Development
- Journal of Social Sciences
- Journal of Advances in Social Work
- Journal of Asian Social Sciences
- Journal of Social Sciences and Research
- Journal of Current Research in Social Psychology
- Journal of Rural Sociology
- Journal of Extension Education - Coimbatore


**Web resources**


- www.sociologyguide.com
- eu.wikipedia.org
- www.princeton.edu

## 17 ENG 102 - DEVELOPMENT EDUCATION (0+1)

**(Alternate course for non-Tamil students)**

**Aim:** To impart the students

- Basic principles of learning
- Taxonomy of education
- Career development and entrepreneurship
- Communication skills

**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**

**Outcome:**

- Understand the concepts of learning,
- The necessity for Lifelong education,
- Communication skills in terms of career development

**Text book:**

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-books:**

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

**References**

Bloom,B.S.Hastings J.T. and Maduas J.F, *Handbook on Formative and Summative Evaluation of Student Learning*, Mc Graw Hill Pub, New York, 1971.

Day, A Robert, *How to Write and Publish a Scientific Paper*, CUP, 1993.

Hariharan.S. *Brainstorming and Interactive Learning*, Research Quarterly, ADU, Coimbatore, 1995.

Mathew.M. Monipally. *The craft of Business Letter Writing*, Tata McGraw Hill Pup., Ch. 10 & Appendix – I, 1997.

Seely John, *Communicating in Everyday Life*, The Oxford Guide to Writing and Speaking, OUP. P.1-79, 1988.

Sudarsanam.R. *Development Education*, Chapter 1,2, 1985.

Taneja.R.P, *Dictionary of Education*, Anmol Pub., New Delhi, India, 1991.

Wallace, L.Michael, *Study Skills in English*, CUP Unit.4, 1998.

17 TAM 101 இலக்கிய"களில் வெளாண்மையஜம் அறிவியல் தமிர்ப் பயனாக்கமும் (Q1)

நொக்கம்

இளநிலை வெளாண்மை பயிலும் மாணவர்களுக்கு தமிர் இலக்கிய"கள் வரி வெளாண்மை மற்றும் வெளாண்மை சார்ந்த டிதாரில்நுட்ப"களையஜம் டிசய்திகளையஜம் அறியச் டிசய்தல்- தற்கால வெளாண் டிதாரில்நுட்ப"களொடு டிபாருத்திப் பார்த்தல் - வெளாண்மை தவிர தொட்டக்கலை – வனவியல்- வெளாண்டிபாறியியல் - மனையியல் சார்ந்த கருத்துக்களை டிவளிக்டிகாணர்தல் - வெளாண்துறைக்கு இன்றியமையாத கலைச்டிசாற்கள் - டிமாரிப்டிபயர்ப்பஜ - பாரம்பரிய டிதாரில்நுட்ப"களை அறியச்டிசய்தல் - மாணவர்களின் எதிர்காலத் தெவைக்கு அழப்படையான பெச்சுப்டபயிர்ச்சி – நெர்காணலை எதிர்டிகாள்ளும் வகையில் டிமன்திறன்களான தலைமைப்பண்பஜ - ஆளுமைப்பண்பஜ - காலமெலாண்மை ஆகியவற்றில் திறம்டிபறச்டிசய்தல் - மாணவர்களின் ஆய்வஜக்கட்டுரை திறனை வளர்த்தல் - வெளாண்மை இதர்கள்.'. நூல்கள் குறித்து விரிப்பஜணர்வை வர்"குதல் - கணினி வரி தமிரில் வெளாண் டிசய்திகளை பதிவெற்றம்.'. பதிவிறக்கம் டிசய்யஜம் முறைகளை அறியச்டிசய்தல் ஆகியவற்றை நொக்கமாக டிகாண்டு பாடத்திட்டத்தை வரையறை டிசய்தல்.

பாடத்திட்டம்

டிதால்காப்பியம் காட்டும் முதற்டிபாருள்.'. கருப்டிபாருள் - ச"க இலக்கியத்தில் வொளாண் டிதாரில் நுட்ப"கள் - பதிடினண் கீர்க்கணக்கு நூல்களில் வெளாண்மைஅறிவியல் - பள்ளு இலக்கிய"கள்.'. ஏடிரபுபது.'. இலக்கியத்தில் வெளாண் டிபாறியியல் - தொட்டவியல் - வனவியல் மனையியல் - ரேலியல் வெளாண்மைப் பர்டிமாரிகள் - இலக்கியம் காட்டும் வார்வியல் டிநறிமுறைகள் - இக்கால இலக்கிய"களில் வெளாண்மைச் சிந்தனைகள் - பிரிர்யின்றிஎபுதும் முறைகள் - பாரம்பரியத் டிதாரில்நுட்"கள் - இலக்கியத்தில் டிமன்திறன்கள் - அறிவியல் தமிர் வளர்ச்சிநிலைகள் - கலைச்டிசால்லாக்கம் - டிமாரிடிபயர்ப்பஜ - கட்டுரைச் சுருக்கம் எபுதுதல் - கணினிஉலகில் தமிர்

டிசய்முறைப் பயிற்சிகள்

1. டிதால்காப்பியம் காட்டும் முதற்டிபாருள்.'. கருப்டிபாருள்.'. தாவரவியல் அறிவஜ.'. வெளாண் மாந்தர் குறித்த டிசய்திகளை அறிதல்

2. ச"க இலக்கியத்தில் வெளாண் டிதாரில் நுட்ப"கள் - (எட்டுத்டிதாகை.'. பத்துப்பாட்டு)

3. பதிடினண் கீர்க்கணக்கு நூல்களில் வெளாண்மைஅறிவியல்

4. பள்ளு இலக்கிய“கள்.˙. ஏடிரபுபது–உர்வர் வார்வியல் டிநறிமுறைகளும் வெளாண்மைத் டிதாரில் நுட்ப“களும்

5. இலக்கியத்தில் வெளாண் டிபாறியியல் - தொட்டவியல் - வனவியல் - மனையியல் - ரேலியல்

6. வெளாண்மைப் பர்டிமாரிகள் - உர்வஜ விதைஅறிவியல் - பருவம் - மரை - நாற்றுநடுதல் - எரு இடுதல் - நீர்ப்பாசனம் - களைமெலாண்மை–பயிர்பாதுகாப்பஜ - அறுவடை–உர்வர் சமுதாயம்

7. இலக்கியம் காட்டும் வார்வியல் டிநறிமுறைகள்

8. இக்கால இலக்கிய“களில் வெளாண்மைச் சிந்தனைகள் - பாரதி.˙. பாரதிதாசன் படைப்பஜகள் - பஜதுக்கவிதை

9. இடைநிலைப் பருவத்தெர்வஜ

10. பிரர்யின்றிளபுதும் முறைகள் - எபுத்துப் பிரர்கள் - டிசாற்பிரர்கள் - டிசாற் பிரிப்பஜப்பிரர்–வாக்கியப்பிரர்–டிமய்ப்பஜத் திருத்தம்

11. பாரம்பரிய வெளாண்மைத் டிதாரில்நுட்ப“கள்

12. இலக்கியத்தில் டிமன்திறன்கள் - தலைமைப்பண்பஜ - காலமெலாண்மை

13. ஆளுமைப்பண்பஜ மெம்பாடு–மனித உறவஜத்திறன்கள் வளர்த்தல்

14. அறிவியல் தமிர் வளர்ச்சிநிலைகள்.˙. வெளாண் நூல்கள்.˙. வெளாண் இதர்கள் - அலுவலகக் கழதம்

15. கலைச்டிசால்லாக்கம் - வெளாண் கலைச் டிசாற்களைஉருவாக்கும் முறை–தரப்படுத்துதல் - இலக்கியவெளாண் கலைச்டிசாற்கள்.˙. வட்டாரவெளாண்மைவர்க்குச் டிசாற்கள் - அகராதியியல்

16. டிமாரிடிபயர்ப்பஜ - முக்கியவிதிகள் - பழநிலைகள் - டிமாரிடிபயர்பாளரின் இன்றியமையாப் பண்பஜகள் - வெளாண் டிசய்திகளைடிமாரிடிபயர்த்தல் - கட்டுரைச் சுருக்கம் எபுதுதல்

17. கணினிஉலகில் தமிர் - விக்கிபீழயா–வெளாண் டிசய்திகளைப் பதிவெற்றம் டிசய்தல் - வெளாண் டிசய்திகளை இணையதளவரிஅறிதல்

மெற்பார்வை நூல்கள்


- கந்தசாமி.இல.டிச.வெளாண்மையஜம் பண்பாடும்.'. தமிர்நாடுவெளாண்மைப் பல்கலைக்கர்கம்.'. கொயம்பஜத்தூர்.'. 1974

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- மீனாட்சிசுந்தரம். மா. மற்றும் ஏ.இல.விசயலட்சுமி..'. தகவல் டிதாடர்பில் தமிர் டிமாரிப்பயன்பாடு.'. கெ.ஆர்.எ.ஆப்டிசட் பிரிண்டர்.'. கொவை– 2002

- மணிமெகலை.ம.தமிர் டிமாரித் தடத்தில் வெளாண் அறிவியலின் சுவடுகள்.'. தெவிபதிப்பகம்.'. திருச்சிராப்பள்ளி.'. 2002

- இலக்கியமும் வெளாண்மையஜம்.'. அனைத்திந்தியஅறிவியல் தமிர்க் கர்கம்.'. த"சாவர்.'. 2006

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- சந்திரசெகரன்.'. இரா.'. டிமாரிப்பாடம் - படைப்பாக்கத்திறன் வளர்த்தல்

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## II Semester

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 SWE 111 | Soil and Water Conservation Engineering | 2+1 |
| 2. | 17 CRP 101 | Fundamentals of Crop Physiology | 2+1 |
| 3. | 17 AEC 101 | Fundamentals of Agricultural Economics | 1+1 |
| 4. | 17 PAT 101 | Fundamentals of Plant Pathology | 2+1 |
| 5. | 17 AEX 102 | Fundamentals of Agricultural Extension Education | 2+1 |
| 6. | 17 FSN 111 | Principles of Food Science and Nutrition | 1+1 |
| 7. | 17 FMP 111 | Farm Machinery and Power | 1+1 |
| 8. | 17 AGR 102 | Introductory Agro-meteorology & Climate Change | 1+1 |
| 9. | 17 HOR 112 | Production Technology for Fruit and Plantation Crops | 1+1 |
| 10. | 17 RSG 101 | Geo-informatics for Precision Farming | 1+0 |
| | | **Total** | **14+9=23** |

## 17 SWE 111 FUNDAMENTALS OF SOIL AND WATER CONSERVATION ENGINEERING (2+1)

**Scope**

To gain knowledge and skills on measurement of land, surveying and leveling, different irrigation methods, pumping of water, soil and water engineering concepts

**Objective**

To impart the basics of soil and water conservation engineering to the undergraduate students

**Theory**

**Unit I Surveying**

Surveying and levelling – chain, compass and plane table survey – levelling – land measurement and computation of area – Simpson‘s rule and Trapezoidal rule.

**Unit II Soil erosion**

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion - water erosion - causes - erosivity and erodibility - mechanics 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 – insitu soil moisture conservation – Runoff Computation - runoff water harvesting — Farm ponds and percolation ponds - storage and its use for domestic and ground water recharge. Gully control structures -Check dams – Temporary and permanent. 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 - canal lining - underground pipe line system - surface irrigation methods - borders, furrows and check basins - drip and sprinkler irrigation– agricultural drainage - surface drainage systems – sub-surface drainage systems - drainage coefficient-design of open ditches.

**Unit V Wells and Pumps**

Groundwater occurrence – aquifers – types of wells and sizes – pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps – selection of pumps – operation and their maintenance.

**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.– Computation of area and volume - Contouring. Design of contour bund and graded bund. Visit to CSWCRTI, Ooty. 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.

**Lecture schedule**

1. Introduction - land surveying - uses in agriculture.
2. Chain cross staff and compass surveying - computation of angles.
3. Radiation, intersection and traversing.
4. Dumpy level - setting, observation and tabulation of readings - computation of land slope - difference in elevation.
5. Computation of area and volume – Simpson‘s rule and Trapezoidal rule.
6. Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion
7. Water erosion - causes - erosivity and erodibility - mechanics of water erosion
8. Splash, sheet, rill and gully erosion - ravines - land slides
9. Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep
10. Effects of water and wind erosion
11. Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping - Cropping systems – vegetative barriers - Windbreaks and shelterbelts - shifting cultivation
12. Mechanical measures – contour bund – graded bund - Broad beds and furrows – basin listing – random tie ridging
13. Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall
14. Rain water harvesting – insitu soil moisture conservation – Runoff Computation - runoff water harvesting
15. Farm ponds and percolation ponds - storage and its use for domestic and ground water recharge
16. Gully control structures -Check dams – Temporary and permanent
17. Watershed concept – Integrated approach and management
18. Mid semester examination.
19. Irrigation - measurement of flow in open channels - velocity area method
20. Rectangular weir - Cippoletti weir - V notch
21. Orifices - Parshall flume
22. Duty of water - irrigation efficiencies
23. Conveyance of irrigation water - canal lining
24. Underground pipe line system
25. Surface irrigation methods - borders, furrows and check basins
26. Components of drip and sprinkler irrigation system
27. Agricultural drainage – need - surface drainage systems
28. Surface drainage systems - drainage coefficient
29. Groundwater occurrence – aquifers types
30. Types of wells and sizes

31. Pump types – reciprocating pumps – centrifugal pumps
32. Turbine pumps – submersible pumps
33. Jet pumps – Airlift pumps
34. Selection of pumps – operation and their maintenance.

**Practical schedule**

1. Study of survey instruments - chains - compass - plane table - 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 – determination of difference in elevation.
6. Computation of area
7. Computation of volume - Contouring
8. Design of contour bund and graded bund.
9. Visit to CSWRTI, Ooty.
10. Drip Irrigation systems.
11. Sprinkler irrigation system
12. Problems on water measurement.
13. Problems on duty of water, irrigation efficiencies.
14. Problems on water requirement - agricultural drainage.
15. Study of different types of wells and its selection.
16. Study of pumps and Selection of pumps.
17. 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

## 17 CRP 101 FUNDAMENTALS OF CROP PHYSIOLOGY (2+1)

**Aim**

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

**Syllabus**

### Unit I: Plant Water Relations

Importance of Crop Physiology in Agriculture – cell organelle- plasma membrane, chloroplast, mitochondria, peroxisome and vacuole - Structure and role of water –water potential and its components – diffusion – osmosis – imbibition - plasmolysis – Field Capacity and Permanent Wilting Point- Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast - Translocation of water – ascent of sap – mechanisms - Transpiration – significance – structure of stomatal pore- mechanisms of stomatal opening and closing – guttation – antitranspirants

### Unit II: Plant Mineral Nutrition

Criteria of essentiality - classification of nutrients – macro, micro, mobile, beneficial elements and immobile – mechanism of nutrient uptake- Physiological functions, deficiencies and disorders of macro and micro nutrients – Hidden hunger- Foliar nutrition-root feeding and fertigation – sand culture, hydroponics and aeroponics

### Unit III: Photosynthesis and Respiration

Light reaction – Photosystems- red drop and Emerson enhancement effect- Photolysis of water and photophosphorylation - Z scheme - Photosynthetic pathways – $C_3$ and $C_4$, CAM

– 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 - Glycolysis – TCA cycle - Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient

### Unit IV: Growth and Development

Growth – phases of growth - Factors affecting growth – Hormones- classifications - Biosynthetic pathway and role of auxins - Biosynthetic pathway and role of gibberellins and cytokinins- Biosynthetic pathway and role of ethylene and ABA- Novel and new generation PGR‘s – Brassinosteroids and salicylic acid - Growth retardants – Commercial uses of PGR‘s- 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 and Chailakhyan‘s 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

**Unit V: Stress Physiology**

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**

Preparation of different types solutions -Measurement of plant water potential by different methods - Estimation of photosynthetic pigments- Chlorophylls and Carotenoids - Determination of stomatal index and stomatal frequency - Measurement of leaf area by different methods Physiological and Nutritional disorders in crops plants -Estimation of chlorophyll Stability Index - Estimation of Relative Water Content -Determination of photosynthetic efficiency in crop plants – soluble protein - Estimation of Nitrate Reductase activity -Growth Analysis - Bioassay of Cytokinin and GA - Estimation of proline - Demonstration of Practical applications of PGRs. Field visit for foliar diagnosis

**Theory lecture schedule**

1. Importance of Crop Physiology in Agriculture – Structure of plasma membrane, chloroplast, mitochondria, peroxisome and vacuole
2. Structure and role of water –water potential and its components – Diffusion – Osmosis – imbibition – Plasmolysis - Field Capacity and Permanent Wilting Point
3. Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast
4. Translocation of water – ascent of sap – mechanisms of xylem transport
5. Transpiration – significance – structure of stomata - mechanisms of stomatal opening and closing – guttation - antitranspirants
6. Mineral nutrition – criteria of essentiality - classification of nutrients – macro, micro, mobile and immobile – mechanism of nutrient uptake
7. Physiological functions and disorders of macro nutrients – Hidden hunger
8. Physiological functions and disorders of micro nutrients
9. Foliar nutrition- root feeding and fertigation – sand culture, hydroponics and aeroponics
10. Light reaction – photolysis of water and photophosphorylation - Z scheme
11. Photosynthetic pathways – $C_3$ and $C_4$ cycles
12. CAM pathway – difference between three pathways - Factors affecting photosynthesis.
13. Photorespiration – pathway and its significance
14. Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations
15. Glycolysis – TCA cycle
16. Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient
17. Mid Semester Examination
18. Growth – phases of growth – factors affecting growth – Hormones- classifications
19. Biosynthetic pathway and role of auxins
20. Biosynthetic pathway and role of gibberellins and cytokinin

21. Biosynthetic pathway and role of ethylene and ABA
22. Novel growth regulators – Brassinosteroids and salicylic acid – New Generation PGR‘s
23. Growth retardants and inhibitors -commercial uses of PGR‘s
24. Photoperiodism - short, long and day neutral plants – Chailakhyan‘s theory of flowering
25. Forms of phytochrome - Pr and Pfr - regulation of flowering
26. Vernalisation - theories of vernalisation – Lysenko and Chailakhyan‘s theories
27. Seed germination - physiological and biochemical changes - seed dormancy and breaking methods
28. Senescence and abscission – physiological and biochemical changes
29. Physiology of fruit ripening- climacteric and non climacteric fruits - factors affecting ripening and manipulations
30. Drought - physiological changes - adaptation – compatible osmolytes - alleviation
31. High and low temperature stress – physiological changes - membrane properties - adaptation
32. Salt stress - physiological changes - adaptation – compartmentalization - alleviation
33. Flooding and UV radiation stresses – physiological changes - adaptation
34. Global warming – green house gases –-physiological effects on crop productivity- Carbon Sequestration

**Practicals schedule**

1. Preparation of different types solutions
2. Measurement of plant water potential by different methods
3. Estimation of photosynthetic pigments- chlorophylls and Carotenoids
4. Determination of stomatal index and stomatal frequency
5. Measurement of leaf area by different methods
6. Physiological and Nutritional disorders in crops plants
7. Estimation of chlorophyll Stability Index
8. Estimation of Relative Water Content
9. Determination of photosynthetic efficiency in crop plants – soluble protein
10. Estimation of Nitrate Reductase activity
11. Growth Analysis - LAI, LAD, SLA, SLW, LAR, NAR, RGR, CGR and HI
12. Bioassay of Cytokinin
13. Bioassay of GA
14. Estimation of proline
15. Demonstration of Practical applications of PGRs.
16. Field visit for foliar diagnosis
17. Final Practical Examination

**Outcome**

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

enzyme assays and demonstration of plant growth regulator applications

**Text books**


1. P. Boominathan, R. Sivakumar, A. Senthil, and D. Vijayalakshmi. 2014. Introduction to Plant Physiology, A.E. Publications. Coimbatore
2. Jain, V.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
3. Taiz. L. and Zeiger. E., 2010 (Fifth edition). Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.


**e- books and e-references**

- **http://www.plantphys.org**
- **http://www. Biologie. Uni-hamburg. de/b-online**
- **http://4e.plantphys.net**

## 17 AEC 101 FUNDAMENTALS OF AGRICULTURAL ECONOMICS (1+1)

### Objective

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

### Theory

### Unit 1: Nature and Scope of Economics

Nature and Scope of economics: Importance, Subject matter: Science Vs. art, Positive science Vs. normative science, Deductive method Vs. inductive method - Definitions of Economics: Wealth, Welfare, Scarcity and Growth - Different economic systems: merits and demerits - Divisions of Economics - Microeconomics and Macroeconomics - Agricultural Economics: Definition and scope - Basic concepts: Goods, Service, Value, Cost, Price, Wealth and Welfare - Wants: Characteristics and classification.

### Unit 2: Theory of Consumption

Utility: Definition, Measurement: Cardinal and ordinal utility, Marginal utility - Law of Diminishing Marginal Utility and Law of Equi-marginal Utility: Definition, Assumptions, Limitations and Applications - Indifference curve analysis: Definition and properties of indifference curves and budget line - Demand: Definition, Kinds of demand, Demand schedule, Demand curve, Law of Demand, Determinants of demand, Extension and Contraction of demand Vs. Increase and decrease in demand - Elasticity of Demand: Types, Degrees of price elasticity of demand, Factors influencing elasticity of demand, Importance of elasticity of demand – Standard of Living: Definition, Engel‘s Law of Family Expenditure - Consumer surplus: Definition and Importance.

### Unit 3: Theory of Production

Concept of production – Factors of production – Land: Characteristics of land - Labour: Characteristics of labour, Division of labour, Malthusian and Modern theories of population – Capital: Characteristics of capital, Capital formation – Entrepreneur: Characteristics and functions of entrepreneur. Supply: definition, Law of Supply, Factors influencing supply - Elasticity of Supply – Producer surplus.

### Unit 4: Exchange and Theory of Distribution

Exchange and Distribution: Definition – Pricing of factors of production - Marginal productivity theory of distribution - 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

Macroeconomics: Definition and Subject matter – National Income: Concepts – GNP, GDP, NNP, Disposable income and Per capita income – Money: Definition, Types and functions of money - Inflation: Meaning, types of inflation - Public Finance: Meaning,

Principles - Public Revenue: Meaning, Classification of taxes - Canons of Taxation - Public expenditure: Principles – Welfare Economics: Meaning, Pareto‘s optimality.

**Practical**

Ten principles of economics - Law of Diminishing Marginal Utility - Law of Equi-Marginal Utility - Indifference Curve analysis and consumer equilibrium - Individual andmarket 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 – Theories of Distribution – Computation of National Income – Study of structural changes in the economy - Estimation of Growth Rate - Money: Quantity theory of money - Inflation: Causes and control measures – Estimation of price index - Measures of standard of living – Indices of human development.

**Theory Schedule**

1. Nature and Scope of economics: Importance, Subject matter: Science Vs. art, Positive science Vs. normative science, Deductive method Vs. inductive method -
2. Different economic systems: merits and demerits.
3. Definitions of Economics - Wealth, Welfare, Scarcity and Growth- Divisions of Economics: Micro economics and Macroeconomics - Agricultural Economics: Definition and scope.
4. Basic concepts – Goods, Services, Use value and Exchange value, Cost, Price, Wealth and Welfare - Wants: Characteristics and Classification of wants.
5. Utility: Definition, Measurement: Cardinal and ordinal utility - Marginal utility - Law of Diminishing Marginal Utility.
6. Law of Equi-marginal Utility: Definition, Assumptions, Limitations and Applications - Indifference curve analysis: Definition and properties of indifference curves and budget line.
7. Demand: Definition, Kinds of demand, Demand schedule, Demand curve, Law of Demand, Determinants of demand - Extension and contraction of demand Vs. Increase and decrease in demand.
8. Elasticity of Demand: Own price, cross price and income elasticities of demand, Degrees of price elasticity of demand, Factors influencing elasticity of demand and Importance of Elasticity of demand.
9. Standard of Living – Definition, Engel‘s Law of Family Expenditure – Consumer surplus: Definition and Importance.
10. **Mid Semester Examination.**
11. Concept of production – Factors of production – Land and its characteristics.
12. Labour: Characteristics of labour - Division of labour - Malthusian and Modern theories of population.
13. Capital: Characteristics of capital - Capital formation: Phases of capital formation - Entrepreneur: Characteristics and functions of entrepreneur.
14. Supply: Definition, Law of Supply, Factors influencing supply - Elasticity of supply -

Producer surplus.

15. Exchange and Distribution: Definition – Pricing of factors of production - Theory of distribution – Marginal productivity theory of distribution - Rent and Quasi rent.
16. Wages: Real wage and money wage – Interest: Pure interest and gross interest – Profit: Meaning of economic profit.
17. Macroeconomics: Definition and Subject matter - National Income: Concepts – GNP, GDP, NNP, Disposable income and Per capita income – Money: Definition, Types and functions of money - Inflation: Meaning and Types of inflation.
18. Public Finance: Meaning, Principles - Public Revenue: Meaning, Classification of taxes - Canons of taxation - Public expenditure: Principles – Welfare Economics: Meaning, Pareto‘s optimality.

**Practical Schedule**

1. Elucidation of 10 principles of economics.
2. Exercise on Law of Diminishing Marginal Utility - Exercise on Law of Equi-Marginal Utility.
3. Indifference Curve Analysis: Properties, budget line and consumer equilibrium.
4. Demand schedule - Graphical derivation of individual and market demand - Measurement of Arc and Point elasticities of demand.
5. Estimation of own price, income and cross price elasticities of demand - Estimation of consumer surplus.
6. Law of Diminishing Marginal Returns: Relationship among TPP, APP and MPP.
7. Cost concepts: Total cost, total fixed costs, total variable cost, average costs, marginal costs and Graphical derivation of cost curves - Estimation of total revenue and profit.
8. Supply: Estimation of supply elasticity - Estimation of producer surplus.
9. Market Structure – Characteristic features of different types of Sellers‘ markets –
10. Perfect competition, monopoly, oligopoly and monopolistic competition – Buyers‘ Market – Price determination under Perfect completion and Monopoly.
11. Rent: Theories of Rent: Ricardian and Modern theories of rent - Wages: Determination of wages: Marginal productivity theory and Demand and supply theory of wages.
12. Interest: Theories of interest: Keynesian and Modern theories of interest – Profit: Risk - bearing theory of profit.
13. Approaches to computation of National Income - Analysis of Trends in National Income - Study of structural changes in the economy.
14. Estimation of Growth Rate of Population and Food grain production.
15. Money: Quantity theory of money – Inflation: Causes and control measures
16. Consumer price index and Wholesale price index - Estimation of price indices.
17. Measures of standard of living and human development – Human Development Index – Physical Quality of Life Index – Gender Development Index.
18. **Practical Examination.**

**References**


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

**17 PAT 101 FUNDAMENTALS OF PLANT PATHOLOGY (2+1)**

**Theory**

**Unit I: Plant pathogenic organisms**

Introduction – Definition – Plant Pathology – History of Plant Pathology- causes of plant diseases- biotic and abiotic- Losses due to plant diseases – Plant Pathogenic organisms

– Protozoa ,chromista, Fungi, Bacteria, *Candidatus Phytoplasma*, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites

**Unit II: Pathogenesis**

Pathogenesis - Mode of infection – pre-penetration, penetration and post penetration – - Effect of pathogen on physiological functions of the plants - Role of enzymes and toxins on disease development – Plant defense mechanisms

**Unit III: General characters and molecular phylogeny of fungi**

General characters of fungi – somatic structures, types of fungal mycelia - Modification of mycelia – reproduction in fungi (Vegetative, asexual and sexual) –nutrition in fungi- Disease cycle –Symptoms of fungal diseases - Classification based on molecular phylogeny. **I Kingdom: Protozoa,** Phylum: Plasmodiophoromycota, Class: Plasmodiophoromycetes (Plasmodiophorales) **II. Kingdom**: **Chromista,** Phylum: Oomycota, Class: Oomycetes (Pythiales and Peronosporales). **III. Kingdom: Fungi. Phylum: Chytridiomycota**, Class: Chytridiomycetes (Chytridiales, Spizellomycetales); **Phylum: Blastocladiomycota,** Class: Blastocladiomycetes (Physodermaceae); **Phylum: Zygomycota,** Subphylum: Mucoromycotina (Mucorales).

**Unit IV: Phylum Ascomycota and Basidiomycota**

**Phylum**: **Ascomycota**, Classes: Taphrinomycetes (Taphrinales), Dothideomycetes (Dothidiales, Capnodiales, Pleosporales,) Eurotiomycetes (Euriotiales), Leotiomycetes (Erysiphales and Helotiales),Sordariomycetes (Hypocreales, Phyllochorales, Glomerales, Diaporthales,) and mitosporic ascomycetes; **Phylum: Basidiomycota**, Classes: Agaricomycetes (Agaricales, Corticiales, Cantharellales and Polyporales), Pucciniomycetes (Pucciniales) and Ustilaginomycetes (Ustilaginales, Urocystidales) Exobasidiomycetes (Exobasidales and Tilletiales)

**Unit V: Bacteria, Phytoplasma, virus viroid, Algae, Phanerogams and abiotic disorders**

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

**Practical**

Study of important taxonomic characters and symptoms produced by *Plasmodiophora, Pythium Phytophthora, Albugo, Sclerospora, Peronospora, Peronosclerospora, Pseudoperonospora*, and *Plasmopara, Mucor, Rhizopus, Taphrina, Capnodium, Cercospora*, (*Mycospaerella*), *Botryodiplodia* (*Botryosphaeria*), *Curvularia, Drechslera* (*Helminthosporium), Alternaria, Venturia, Erysiphe*, *Phyllactinia*, *Uncinula, Leveillula* and *Claviceps, Fusarium* (*Gibberella ,Nectria*), *Verticillium ,Colletotrichum (Glomerella) Pestalotia (Pestalosphaeria), Pyricularia*(*Magnoporthe*) *Sarocladium,*

*Macrophomina, , Puccinia, Uromyces , Hemileia, Ustilago Sphacelotheca (Sporisorium), Tolyposporium (Moesziomyces), Exobasidium, Sclerotium, Rhizoctonia* (*Thanatephorus*) *Ganoderma Agaricus, Pleurotus, Volvariella* and *Calocybe.* Symptoms of bacterial diseases, *Candidatus Phytoplasma*, Fastidious vascular bacteria, algal parasite, phanerogamic parasites and non-parasitic diseases.

**Note: Students should submit 50 well-preserved Herbariums**

**Theory schedule**

1. Definition of Plant Pathology – History of Plant Pathology
2. Losses caused by plant diseases
3. Causes of Plant diseases – Protozoa , Chromista, , fungi, Bacteria, Fastidious vascular bacteria, Spiroplasma, *Candidatus Phytoplasma,*
4. Causes of Plant diseases -Virus, viroid, algal, phanerogamic parasites and abiotic disorders
5. Pathogenesis – stages in pathogenesis – pre-penetration, penetration and post penetration
6. Role of enzymes in disease development
7. Role of toxins in disease development
8. Effect of pathogen on physiological functions of the plants- Effect on Photosynthesis- Transpiration- Respiration- translocation of water and nutrients
9. General characters of fungi- Mycelia – vegetative resting structures
10. Asexual reproduction in fungi
11. Sexual reproduction in fungi
12. 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
13. Classification of Kingdom Protozoa - important taxonomic characters , symptoms and life cycle of *Plasmodiophora brassicae* and symptoms of Protozoan diseases
14. Classification of Kingdom Chromista- General characters of Oomycetes- Symptoms and life cycle of *Pythium,Phytophthora* and *Albugo*
15. Symptoms and life cycle of *Peronosclerospora, Sclerospora. Perenospora, Pseudoperenospora and Plasmopara*
16. Classification of Kingdom– Chytridiomycota and Zygomycota - important characters, symptoms and life cycles of *Synchtrium* and *Rhizopus* and *Mucor*
17. **Mid Semester Examination**
18. Classification of Kingdom– Ascomycota- important characters
19. Symptoms and life cycles of *Taphrina, Capnodium, Cercospora,* (*Mycospaerella*), *Botryodiplodia* (*Botryosphaeria*), *Drechslera* (*Helminthosporium), Alternaria* and *Venturia and Macrophomina*
20. Symptoms and life cycles of *Eurotium, Talaromyces, Erysiphe, Leveillula, Phyllactinia, Uncinula , Podosphaera and Sphaerotheca*
21. Symptoms and important characters of *Claviceps, Fusarium* (*Gibberella, Nectria*) and *Verticillim*
22. Symptoms and important characters of *Colletotrichum (Glomerella) Pestalotia*

*(Pestalosphaeria), Pyricularia*(*Magnoporthe*) and *Sarocladium*

23. Classification of Kingdom - Basidiomycota- important characters
24. Symptoms and life cycles of *Puccinia ,Uromyces, Hemileia*
25. Symptoms and life cycles of *Ustilago, Sphacelotheca (Sporisorium), Tolyposporium (Moesziomyces), Tilletia and Exobasidium*
26. Symptoms and life cycles of *Athelium, Thanetephorus* and *Ganoderma*
27. Important taxonomic characters of *Agaricus, Pleurotus* , *Volvariella* and *Calocybe*
28. Classification and general characters of phytopathogenic bacteria
29. Symptoms and characters of *Xanthomonas, Ralstonia, Erwinia, Pantoea, Pectobactrium Agrobacterium (Rhizobium), Corynebacterium* (*Clavibacter*,) and *Streptomyces*
30. Important characters and symptoms of *Candidatus Phytoplasma* diseases – Phyllody, little leaf, yellow dwarf and sandal spike, Fastidious vascular bacteria and Spiroplasma
31. Virus - definition, nature and properties of plant virus, Single stranded, Double stranded RNA and DNA viruses and Transmission of plant viruses
32. Common symptoms of virus diseases – mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis , ring spot, vein clearing, leaf crinkle, rosette and bunchy top
33. Important characters and symptoms of Viroid, Algal and Phanerogamic parasites
34. Symptoms and characters of non-parasitic diseases

**Practical schedule**

1. General characters of fungi – Types of mycelia -Types of vegetative, asexual and sexual spores- asexual and sexual fruiting bodies.
2. Study of important taxonomic characters and symptoms produced by *Plasmodiophora*, *Pythium* and *Phytophthora*.
3. Study of important taxonomic characters and symptoms produced by *Sclerospora, Peronospora, Peronosclerospora Pseudoperonospora* and *Plasmopara*
4. Study of important taxonomic characters and symptoms produced by *Albugo and Rhizopus.*
5. Study of important taxonomic characters and symptoms produced by *Taphrina, Capnodium, Cercospora,* (*Mycospaerella*), *Botryodiplodia* (*Botryosphaeria*), *Drechslera* (*Helminthosporium)* and *Alternaria*
6. Study of important taxonomic characters and symptoms produced by *Eurotium, Talaromyces, Erysiphe, Leveillula, Phyllactinia, Uncinula , Podosphaera and Sphaerotheca*
7. Study of important taxonomic characters and symptoms produced by *Claviceps, Fusarium* (*Gibberella, Nectria*) and *Verticillim*
8. Study of important taxonomic characters and symptoms produced by *Colletotrichum (Glomerella), Pestalotia (Pestalosphaeria), Pyricularia* (*Magnoporthe*), *Sarocladium* and *Macrophomina.*
9. Study of important taxonomic characters and symptoms produced by *Puccinia, Uromyces and Hemileia*
10. Study of important taxonomic characters and symptoms produced by *Ustilago, Sphacelotheca (Sporisorium), Tolyposporium (Moesziomyces),and Exobasidium*
11. Study of important taxonomic characters of *Agaricus, Pleurotus, Calocybe, Volvariella*

and symptoms produced by *Athelium, Thanetephorus* and *Ganoderma*

12. Symptoms of bacterial diseases – leaf blight, leaf streak, canker, scab, crown gall, wilt and soft rot.
13. Symptoms of *Candidatus Phytoplasma* and Algae
14. 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
15. Phanerogamic parasites and non-parasitic diseases
16. Field visit
17. **Final Practical Examination.**

Note: Students should submit 50 well-preserved disease specimens.

**References**


1. Agrios, G.N. 2005. Plant Pathology – ($5^{th}$ Edition). Academic Press, New York.
2. Alexopoulos,C.J., Mims,C.W. and Blackwell, M.2010 Introductory Mycology. John Wiley and Sons Ltd., N.York.
3. Alice D, and Jeyalakshmi C 2014. Plant Pathology. A.E Publications ,Coimbatore
4. Dube, H.C.2009. A textbook of Fungi, Bacteria and Viruses, Vikas Publishing House P. Ltd, New Delhi.
5. Mehrotra, R.S. and Aneja, K.R. 1990. An Introduction to Mycology, Wiley E.Ltd. New Delhi.
6. Singh, R.S.1982. Plant Pathogens – The Fungi. Oxford and IBH Publishing Co., New Delhi.
7. Vidyasekaran, P. 1993. Principles of Plant Pathology –. CBS Publishers & Distributors, New Delhi.


**E-books**


1. Agrios, G.N. 2005. Plant Pathology – ($5^{th}$ Edition). Academic Press, New York.
2. Janse,J.D. 2006. Phytobacteriology- Principles and practice, CABI Publishing, UK
3. Phyllis G. Weintraub and Phil Jones ,2010. Phytoplasma- Genomes,plant host and vectors


**Web resources**

1. www.mycobank.org
2. www.mycology.net
3. www.bspp.org.uk
4. www.ictv.org
5. www.bibo.library.cornel.edu

**17 AEX 102 FUNDAMENTALS OF AGRICULTURAL EXTENSION EDUCATION (2+1)**

**Objective**

The course intends to expose students to the fundamentals of extension education, extension systems in India, programme planning and rural development efforts. The course will also provide an opportunity to students to visit different organizations involved in extension activities and rural development work.

**Theory**

**UNIT I**

**Introduction to Extension Education**

Extension Education – meaning, definition, scope, objectives, philosophy, principles; Extension Education Process; Differences among formal, informal and non-formal education; Extension education as a science – relationship with other social sciences.

**UNIT II**

**Early Rural Development attempts, Extension in USA, Extension approaches in India**

Historical development of extension in India – Famine Commission, Royal Commission, Scheme of Rural Reconstruction, Economic Conference of Mysore, Gurgaon Experiment, Sriniketan, Sevagram, Marthandam project, India Village Service, Firka development scheme, Etawah pilot project, Nilokheri Experiment; Extension in USA – origin, Cooperative Extension Service, organization of extension work, 4-H club; Extension programmes of Ministry of Agriculture – Training and Visit (T&V) System, Broad Based Extension System (BBES), Farming System Research Extension(FSRE) , Agricultural Technology Management Agency (ATMA); Firstline Extension System – KVK, IVLP, ATIC, Frontline demonstrations.

**UNIT III**

**Major Rural Development Programmes**

Rural Development – meaning, definition, concept, 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 – Community Development Programme (CDP), National Extension Service (NES), IADP, IAAP, HYVP, IVLP, WDP, NATP, ITDP, IRDP, SFDA, MFAL, NREP, RLEGP, DPAP, CADP, FFW, JRY, EAS, IAY, SGSY, PMEY, SJSRY, PMGSY, SGRY, MGNREGA, PURA, NAIP, NADP (RKVY) - the strengths and weaknesses of the above programmes.

**UNIT IV**

**Women and Youth Development Programmes**

Women Development Programmes – DWCRA, RMK, ICDS, MSY, TANWA; Youth Development Programmes – TRYSEM, Nehru Yuva Kendra (NYK), ARYA - the strengths and weaknesses of the above programmes.

**UNIT V**

**Extension Programme Planning**

Extension Programme Planning – definition, principles; meaning of project, plan, calendar of work, plan of work; steps in programme planning.

**Practical**

Visit to District Rural Development Agency (DRDA) to study the organizational set up and rural development programmes; Visit to Panchayat Union office to learn their functions; Exposure to Grama Panchayat activities; Study of the functions of JDA / ADA and to learn about ATMA and other schemes; Interaction with a Self-Help Group to study its activities; Exposure to a Non-Governmental Organization (NGO) to study its role in rural development; Study of the activities of State Department of Horticulture to learn their extension activities; Visit to Krishi Vigyan Kendra (KVK) to learn their roles and activities; Visit to Social Welfare Department to study the women development programmes; Exercise to assess the awareness and participation of village people in rural development programmes in a rural setting.

**Theory Schedule**

1. Extension Education – meaning, definition, scope, objectives, philosophy, principles.
2. Extension Education Process, Differences among formal, informal and non-formal education.
3. Extension education as a science – relationship with other social sciences.
4. Historical development of extension in India – Famine Commission, Royal Commission, Scheme of Rural Reconstruction, Economic Conference of Mysore, Gurgaon experiment, Sriniketan.
5. Sevagram attempt, Marthandam Project, Indian Village Service, Firka Development Scheme, Etawah Pilot project, Nilokheri Experiment.
6. Extension in USA – origin, Cooperative Extension Service, organization of extension work, 4-H clubs.
7. Extension programmes of Ministry of Agriculture – Training and Visit (T&V) System, Broad Based Extension System (BBES), Farming System Research Extension (FSRE), Agricultural Technology Management Agency (ATMA).
8. Firstline Extension System – Krishi Vigyan Kendra (KVK), Institution Village Linkage Programme (IVLP), Agricultural Technology Information Centre (ATIC), Frontline demonstrations.
9. **Mid Semester Examination**
10. 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.
11. Community Development Programme (CDP), National Extension Service (NES), Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) - their strengths and weaknesses.
12. High Yielding Variety Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), Integrated Rural Development Programme (IRDP) - their strengths and weaknesses.
13. 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.
14. 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), 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) - their strengths and weaknesses.

15. 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.
16. Women Development Programmes – Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS), Mahila Samridhi Yojana (MSY), Tamil Nadu Women in Agriculture (TANWA), Youth Development Programmes – TRYSEM, Nehru Yuva Kendra (NYK), Attracting Rural Youth towards Agriculture (ARYA) - their strengths and weaknesses.
17. Extension Programme Planning – definition, principles; meaning of project, plan, calendar of work, plan of work; steps in programme planning.

**Practical Schedule**

1. Visit to District Rural Development Agency (DRDA) to study the organizational set up and rural development programmes.
2. Visit to a Panchayat Union Office to learn about its functions.
3. Exposure to the activities of a Grama Panchayat.
4. Study of the functions of JDA / ADA and to understand the reorganized extension system, organizational setup, functions, ATMA scheme and other schemes.
5. Interaction with a SHG to study its activities.
6. Exposure to an NGO to study their role in rural development activities.
7. Study of the extension activities of the State Department of Horticulture.
8. Visit to a nearby KVK to study its role and activities.
9. Visit to the Social Welfare Department to study the social welfare and women development programmes.
10. Construction of interview schedule to study the awareness and participation of people in rural development programmes implemented in a village (Group exercise)
11. Visit to a village to collect data (Group exercise).
12. Preparation of report.
13. Presentation of report.
14. **Final Practical Examination**

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


- ✓ Dipak de, Basavaprabhu Jirli.2010. A Handbook of Extension Education, Agrobios, India.
- ✓ Pandey, B.K. 2005. Rural Development, ISHA Books, New Delhi.
- ✓ Puran, Chandra. 2005. NGOs in India. A. Kansha Publishing, New Delhi.
- ✓ Ray, G.L. 1999. Extension Communication and Management, Noya Prakash, Kolkatta, West Bengal.
- ✓ Reddy Adivi, A. 1993. Extension Education, Shree Lakshmi Press, Bapatla, Andhra Pradesh.
- ✓ Sagar Mondal and Ray, G.L. 2007. Text book of Rural Development, Kalyani Publishers, New Delhi.
- ✓ Sanjay Prakash Sharma. 2006. Panchayat Raj, Vista International Publishing House, New Delhi.

- ✓ Singh, A.K. 2012. Agricultural Extension, Agrobios, New Delhi.
- ✓ Van den Ban, A.W and H.S. Hawkins. 2002. Agricultural Extension, CBS Publishers & Distributors, New Delhi.
- ✓ Viswanathan Maithili. 1994. Women in Agriculture and Rural Development, Printwell, Jaipur.


**Journals**

- International Journal of Extension Education
- Indian Journal of Extension Education
- Journal of Extension Education – Coimbatore
- Journal of Extension Education – Bhubaneshwar
- Rajasthan Journal of Extension Education
- The Journal of Agricultural Education and Extension
- Journal of Agricultural Extension Management
- Journal of Agricultural Education and Extension
- Indian Journal of Gender Studies
- Indian Research Journal of Extension Education
- Journal of Community Mobilization and Sustainable Development

**Web resources**

- rural.nic.in
- www.panchayat .gov.in
- wcd.nic.in
- moud.nic.in
- mhupa.gov.in

**17 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 Schedule**

1. Food Science – definition, scope and classification, food pyramid.
2. Methods, merits and demerits of moist heat, dry heat and microwave cooking of foods.
3. Importance and scope of nutrition and the relation of nutrition to health.
4. Carbohydrate – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements.
5. Protein – classification, functions, digestion and absorption, deficiency symptoms, sources and requirements. Protein quality – supplementary value of protein.
6. Fat - classification, functions, digestion and absorption, deficiency symptoms, sources and requirements. Rancidity – types. Determination of energy value of foods.
7. Fat soluble vitamins – A, D, E and K – functions, deficiency symptoms, sources and requirements.
8. Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid, ascorbic acid – functions, deficiency symptoms, sources and requirements.
9. **Mid Semester Examination**
10. Minerals – calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, requirements and deficiency diseases.
11. Importance of water and maintenance of electrolyte balance. Health benefits of fibre.
12. Preservation of food by low and high temperature and food irradiation.
13. Processing of puffed, flaked and extruded products
14. Preservation by using sugar (jam, jelly, squash and marmalade), preservation by using salt (brining and pickling) and use of preservatives in food preservation.
15. Food packaging – importance, types of packaging materials and nutrition labeling.
16. Common food adulterants and their detection.
17. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius Commission.

**Practical Schedule**

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

**TEXT BOOKS**


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


**JOURNALS**

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

**WEB RESOURCES**

1. www.cellinteractive.com
2. www.nutrition.org.uk
3. www.fnic.nal.usda.gov
4. www.myfooddiary.com

**17 FMP 111 FARM POWER AND MACHINERY 1+1**

**Aim :** To equip the students with sufficient theoretical knowledge and practical skills about farm power and tractor power, implement resources used in agriculture, their cost of operation and selection

**Theory:**

**UNIT I – Farm Power & Tractors**

Farm power in India- sources, IC engines- working principles, two stroke and four stroke engines, IC engine terminology, different systems of IC engine. Tractors- types and utilities.

**UNIT II – Tillage and Tillage Machinery**

Tillage – ploughing methods - primary tillage implements – mould board, disc ploughs and chisel plough – secondary tillage implements – cultivators, harrows and rotovators – wetland equipment - puddlers, tramplers and cage wheels.

**UNIT III – Sowing, Planting and Intercultural Equipment**

Sowing methods - seed drills, seed cum fertilizer drills - Paddy transplanters - nursery requirements - implements for intercultural operations - wet land, dry land and garden land intercultural tools.

**UNIT IV – Plant Protection Gadgets, Harvesting Machinery and Horticulture Tools**

Plant protection equipment - harvesting tools and equipment - reapers and combine - harvesting machinery for groundnut, tuber crops and sugarcane - tools for horticultural crops

**UNIT V – Equipment for Land Development and Farm Machinery Selection**

Equipment for land development and soil conservation – Cost of operation of farm machinery - Tractor and implement selection.

**Practical:**

Study of different components of IC engine, four stroke petrol engine, two stroke petrol engine. Study of MB plough, disc plough, seed-cum-fertiliser drills, their mechanisms. Operation of tractor and implements - operation and maintenance of power tiller – Study of different inter-cultivation equipments - Sprayers and dusters – their operation, repairs and adjustment - Paddy transplanting and allied machines. Harvester for paddy, sugarcane, groundnut – horticultural tools – land development and soil conservation machines – Field capacity and cost economic analysis

**Lecture Schedule:**

| | | |
|---|---|---|
| 1. | Farm power in India - human, animal, mechanical and electrical energy sources and their use in agriculture | **TB1: 1-11**<br>**TB2: 1-16** |
| 2. | Two stroke and Four stroke engines, working principles, applications - types, power and efficiency | **TB1: 27-39**<br>**TB2: 32-39**<br>**52-55** |
| 3 | Different systems of IC engine – cooling, lubricating, fuel injection systems | **TB1: 18-26**<br>**TB2: 39-46** |
| 4 | Tractors- types and utilities | **TB1:12-18**<br>**TB2:135-137** |
| 5. | Tillage, objectives, types - ploughing methods. Field capacity and field efficiency | **TB1:40-52**<br>**TB2:224-226**<br>**234-235** |

| | | |
|---|---|---|
| | | **244-247** |
| 6 | Primary tillage, objectives, mould board ,disc plough, chisel plough and subsoiler, components and functions, types, advantages and disadvantages. | **TB1:53-71** **TB2:226-244** |
| 7 | Secondary tillage equipment – harrows, land forming equipment – rotaravators – wet land equipment – puddlers, manure tramplers and cage wheels | **TB1:72-91** **TB2:254-274** |
| 8 | Sowing methods - seed drills, seed cum fertilizer drills - components and functions | **TB1:92-106** **TB2:277-294** |

9. Mid semeter examination

10. Paddy transplanters, types, working principle, field and nursery requirements **TB1:106-119**

11. Implements for intercultural operations – cultivators, sweep, junior hoe, manual weeders and power operated weeders for wet land and garden land **TB1:121-129**

12. Sprayers and their functions, classification, manually operated sprayers, power sprayers - dusters, types and uses **TB1:130-143** **TB2:326-337**

13. Harvesting tools and equipment- sickles, paddy reapers and combine **TB1:144-167**

- Harvesting machinery for groundnut, tuber crops and sugarcane **TB2:340-347**

14.Tools for horticultural crops – propagation tools, planters and harvesting tools and machinery **TB1:168-190**

15. Equipment for land development and soil conservation - dozers, levelers, chisel plough, sub soil plough, blade harrow and bund former **TB1:191-198**

16 Cost of operation of farm machinery – problem solving **TB1:212-217**

17 Tractor and implement selection for different agricultural operations **TB1:199-211**

**Practical Schedule:**

| | |
|---|---|
| 1 | Study of working of two and four stroke IC engines |
| 2 | Study of MB plough and disc plough, measurement of plough size, different parts, horizontal and vertical suction, |
| 3 | Study of disc harrows, bund former, leveller and rotavator |
| 4 | Study of seed-cum-fertiliser drills- furrow opener, metering mechanismand calibration |
| 5 | Study of tractors – their operation and maintenance |
| 6 | Learning to drive and operate the tractor |
| 7 | Learning to operate tractor with mounted implement |
| 8 | Study of power tiller - their operation and maintenance |
| 9 | Study of different inter-cultivation equipments in terms of efficiency, field capacity |
| 10 | Study of plant protection equipment – power sprayers, knapsack sprayers, dusters – minor repairs and adjustment of sprayers |
| 11 | Study of paddy transplanters – allied machinery for raising mat nursery |
| 12 | Study of paddy reaper and paddy combine – Registration and alignment of cutter bars |
| 13 | Study of sugarcane, turmeric and groundnut harvesters. |
| 14 | Tools for horticultural crops – propagation tools, planters and harvesting tools and machinery |
| 15 | Study of land development and soil conservation machinery - dozers, levelers, chisel plough, blade harrow, bund former and trenchers |
| 16 | Problems on field capacity and cost of operation of farm machinery |

17 Final practical examination

**Text Books:**


1. Senthilkumar, T., R. Kavitha and V.M.Duraisamy 2015. **A Text Book of Farm Machinery**, Thannambikkai Publications, Coimbatore . ISBN: 978-9381102305
2. Jagadishwar Sahay, 2010. **Elements of Agricultural Engineering**. Standard Publishers Distributors, Delhi. ISBN: 978-8180140440


**Reference Books:**


1. Ojha, T.P and A.M.Michael 2005. **Principles of Agricultural Engineering Vol-I**. Jain Brothers, New Delhi. ISBN: 978-8186321638
2. Nakra C.P 1970. **Farm Machinery and Equipment**,: Dhanpat Rai Publishing Company Ltd, New Delhi ISBN: 978-8187433231
3. Srivastava, A.C., 1991. **Elements of Farm Machinery**. Oxford & IBH Publishing Co Pvt Ltd, New Delhi. ISBN: 978-8120405134


**WEB RESOURCES:**

www.agricoop.nic.in/dacdivision/Machinery1/directory.htm

www.farmmachineryshow.org

**Outcome:**

Students will be equipped with sufficient theoretical knowledge with practical skills on farm power sources, the availability of tractors and handling of tractors, power tillers and various implements used in land preparation, sowing, inter cultivation, plant protection and harvesting operations.

## 17 AGR 102 INTRODUCTORY AGRO-METEOROLOGY AND CLIMATE CHANGE 1+1

**Theory**

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

**Practical**

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

**Theory:**

**Unit - I:**

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 - 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 - Pressure systems - cyclones, anticyclones, tornado, hurricane and storms - Wind systems of the world - Inter Tropical Convergence Zone. 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:**

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

**Unit - V:**

Climate change- climate variability - definition and causes of climate change - Impact of climate change on Agriculture, Forestry, Hydrology, marine and coastal ecosystem

**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 - Fortein‘s barometer - Barograph - Altimeter; Wind vane, Anemometer - Raingauge - Ordinary and self-recording - Dew guage; Automatic weather station - Evaporimeters - Lysimeters, Automatic weather station - Preparation of synoptic charts and crop weather calendars. Rainfall probability analysis. Mapping of Agroclimatic Zones.

**Theory - Lecture Schedule:**

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

variation - Isobar - Low, depression, anticyclone, Tornado, hurricane.

10. Wind systems of the world - Inter Tropical Convergence Zones (ITCZ), wind speed in different seasons -. Clouds and their classification - Concepts of cloud seeding - present status.
11. Precipitation - Forms of precipitation - Isohyte - Monsoon - Different monsoons of India - Rainfall variability - Drought and flood - Impact on crop production.
12. Evaporation - Transpiration, evapotranspiration - Potential evapotranspiration - Definition and their importance in agricultural production. Agroclimatic zones of Tamil Nadu - Agroclimatic normals for field crops.
13. Weather forecasting - Types, importance, Agro Advisory Services - Synoptic chart - Crop weather calendar.
14. Remote sensing and its application in agriculture - Crop weather modeling and its application in agriculture - list of models available.
15. Effect of weather and climate on crop production, soil fertility and incidence of pest and diseases.
16. Climate change, climate variability - definition and causes of climate change including ENSO.
17. Impact of climate change on Agriculture, Forestry, Hydrology, marine and coastal ecosystem.

**Practical schedule:**

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

**References:**


1. Prasad, Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University, Press, Thrissur.
2. Mavi, H.S., 1996. Introduction to Agrometeorology, oxford and IBH Publishing Co., New Delhi.

3. Gopalaswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur.

**E:References:**

www.tawn.tnau.ac.in
www.usbr.gov/pn/agri.met
www.imd.gov.in

## 17 HOR 112 PRODUCTION TECHNOLOGY OF FRUITS AND PLANTATION CROPS (1+1)

**Aim**

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

**Theory**

**Unit I**: **Fundamentals and propagation techniques of fruit crops**

Horticulture – Origin, definitions – role of fruit crops in national economy - pollination mechanism – fruitfulness and causes of unfruitfulness. Propagation – definition – methods - merits and demerits – propagation through seeds - dormancy and methods of overcoming dormancy – vegetative propagation – merits and demerits – cutting, layering, grafting and budding – rootstock influence – stock / scion relationship– micro propagation.

**Unit II: Production status and crop production techniques in tropical fruit crops**

Scope and importance of fruit crops- classification of fruit crops – area, production, productivity and export potential.

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

**Crops**: Mango, Banana, Grapes, Citrus (sweet orange, mandarin, acid lime), Papaya, Indian goose berry (Aonla)

**Unit III: Crop production techniques in subtropical and temperate fruit crops**

Climate and soil requirements – varieties – propagation - planting density and systems of planting -cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management.

**Crops**: Sapota, pomegranate,Guava, Pineapple, Jack, Apple, Pear, Plum.

**Unit IV: Status of production, principles of crop production and production technologies in plantation crops**

Scope and Importance of plantation crops - area and production- export potential-classification of plantation crops- planting and cropping systems - principles of canopy management and growth regulation.

Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-intercropping -mulching-cover cropping -harvest- post harvest management and processing

**Crops:** Tea, coffee, rubber

**Unit V: Crop production technologies in plantation crops**

Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-intercropping – multi-tier cropping system-mulching-top working and other special horticultural practices- maturity indices and harvest- post harvest management and processing

**Crops:** cocoa, cashew, coconut, arecanut, oil palm and palmyrah

**Practical**

Features of an orchard – Tools, implements and machineries used for horticultural operations - preparation and application of PGR's for propagation and crop regulation - micropropagation, protocol for mass multiplication and hardening. Propagation techniques, selection of planting material, varieties, important intercultural practices for the fruit crops: mango, banana, grapes, papaya, sapota, guava, Indian goose berry and plantation crops :Tea-Coffee -Rubber -Cocoa and Coconut – Areca nut. Visit to commercial fruit and plantations industries.

**Theory schedule**

1. Horticulture - Origin, definitions – role of fruit crops in national economy.

   Flowering, pollination, fruit set in fruit crops - Fruitfulness and causes of unfruitfulness.

2. Propagation – sexual and asexual propagation - Seed propagation – dormancy and measures to overcome seed dormancy.

   Vegetative propagation – merits and demerits – cutting, layering.

3. Vegetative propagation - Grafting and budding.

   Rootstock influence – stock / scion relationship in fruit crops.

4. Micro propagation in fruit crops.

   Scope and importance of fruit crops cultivation - Area, production, productivity and export potential of fruit crops.

5. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning- top working - water, nutrient and weed management of **Mango**

   Special horticultural techniques - plant growth regulation-GAP - important disorders – maturity indices and harvest - post harvest management of **Mango**

6. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- water and nutrient management – fertigation technique – weed control of **Banana**

   Special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of **Banana**

7. Climate and soil – varieties - propagation methods - planting and cropping systems-after care – systems of training and pruning and bud forecasting - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Grapes**

   Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation – nutrient deficiencies and important disorders – maturity indices and harvest- post harvest management of **Citrus (Sweet orange)**

8. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation – nutrient deficiencies and important disorders – techniques to rectify – maturity indices and harvest - post harvest management of **Mandarin and Acid Lime**

   Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - special horticultural techniques - plant growth regulation- important disorders – maturity indices and harvest - post harvest management of **Papaya**

9. **Mid Term**

10. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity

indices and harvest - post harvest management of **Sapota and pomegranate**

Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Guava**

11. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - special horticultural techniques - plant growth regulation- important disorders – maturity indices and harvest – techniques of round the year production of pineapple - post harvest management of **Pineapple and Jack** .

    Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of **Apple.**

    Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Pear and Plum**
12. Value addition technologies for fruit crops.
13. Scope and Importance of plantation crops - area and production- export potential-classification of plantation crops- planting and cropping systems - principles of canopy management and growth regulation.
14. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning of tea

    Water, nutrient and weed management- shade management and harvest- processing of tea

    Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning of coffee.
    Water, nutrient and weed management- shade management-maturity indices and harvest- processing of coffee.
15. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- water, nutrient and weed management - intercropping – tapping system and processing of rubber

    Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems including multitier system - after care- training and pruning- water, nutrient and weed management- shade management–mulching- maturity indices, harvest and processing of cocoa

    Climate and soil requirements- varieties- propagation- nursery management- planting-high density and systems of planting- cropping systems- after care- water, nutrient and weed management –intercropping- mulching -top working- maturity indices and harvest and processing of cashew
16. Climate and soil requirements- varieties- propagation- nursery management- planting systems- after care- water, nutrient and weed management- intercropping at various ages of plantation – multi-tier cropping system- harvest and post-harvest handling of coconut

    Climate and soil requirements- varieties- propagation- nursery management- planting-after care-

water, nutrient and weed management- intercropping- harvest and post-harvest handling of arecanut

Climate and soil requirements- varieties- propagation- nursery management- planting-after care- water, nutrient and weed management- tapping and harvesting of palmyrah.

Climate and soil requirements- propagation - planting- water, nutrient and weed management and harvest of oil palm.

17. Value addition in plantation crops.

**Practical schedule**

1. Features of an orchard – Tools, implements and machineries used for horticultural operations
2. Preparation and application of PGR's for propagation.
3. Micro propagation, protocol for mass multiplication and hardening of fruit crops.
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 **Grapes**
7. Propagation techniques, selection of planting material, varieties, important cultural practices for **Papaya**
8. Propagation techniques, selection of planting material, varieties, important cultural practices for **Sapota** and **Guava**
9. Crop regulation in fruit crops – Training and Pruning practices, top working and rejuvenation of old trees.
10. Tea- identification of species, nursery practices, training and pruning – processing
11. Coffee - identification of species, nursery practices, training and pruning – processing
12. Rubber - identification of clones, bud wood nursery practices - processing
13. Cocoa - identification of types, clonal nursery practices, training and pruning – processing; Cashew- identification of varieties, propagation techniques, top working-processing
14. Coconut - identification of varieties, mother palm and seed nut selection, nursery practices- management of nutrient deficiencies - processing
15. Arecanut- identification of varieties, mother palm and seed nut selection, nursery practices- management of nutrient deficiencies - processing
16. Visit to commercial fruit and plantation industries.
17. Practical examination

**Outcome**

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

**Reference text books**

1. Kumar, N. 2014. Introduction to Horticulture. Oxford & IBH Publishing co. Pvt. Ltd.

2. Chadha, K.L and Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vols. 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.

**E-References**

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

## 17 RSG 101 GEO-INFORMATICS FOR PRECISION FARMING 1+0

**Theory**

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

**Practical**

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. Fertilizers recommendations based of VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

## III Semester

| S. No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AGM 201 | Fundamentals of Microbiology | 2+1 |
| 2. | 17 AEN 201 | Fundamentals of Entomology | 2+1 |
| 3. | 17 SST 201 | Principles of Seed Technology | 2+1 |
| 4. | 17 AGR 201 | Crop Production Technology – I (Kharif crops) | 1+1 |
| 5. | 17 HOR 211 | Production Technology for Vegetables and Spices | 1+1 |
| 6. | 17 ENS 201 | Environmental Studies and Disaster Management | 2+1 |
| 7. | 17 AMP 201 | Livestock and Poultry Management | 2+1 |
| 8. | 17 AEC 201 | Farm Management, Production and Resource Economics | 1+1 |
| 9. | 17 SAC 201 | Soil Resource Inventory | 1+1 |
| 10. | 17 AGR 202 | Study Tour (Non gradial; compulsory course) | 0+1[§] |
| | | **Total** | **14+9=23** |

[§] Non gradial; compulsory course

**17 AGM 201 FUNDAMENTALS OF MICROBIOLOGY (2+1)**

**Aim**

1. To enable better understanding of students about the microscopic world around them
2. To acquaint students with the basic laboratory techniques and tools of microbiology
3. To introduce the fundamental characteristics of various microorganisms
4. To develop experimental skills, including the collection and analysis of data, the ability to draw valid conclusions and apply these conclusions within a larger framework

**Theory**

**Unit I. History of Microbiology**

Definition and scope of microbiology – microbes for human welfare and environment. Historical roots of microbiology; biogenesis and abiogenesis theory; germ theory of diseases and fermentation. Contributions of Antonie Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming and Waksman.

**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, moulds and actinobacteria. Preservation of microbial cultures.

**Unit III. Position of Microbes in the living World and their Structure**

Evolutionary relationship among the living organisms. Whittaker‘s Five Kingdom concept of living organism and Carl Woese systems. Three domains of life – similarities and differences; Modern approach to the bacterial systematics; Differentiation of bacteria, archaea and eukaryotes; Systematic bacteriology; prokaryotic diversity - Bergey‘s Manual of Systematic Bacteriology. Cell biology - bacterial size, shape and arrangement; cell structure and components of bacteria. Morphology of fungi and algae.

**Unit IV. Growth, Nutrition and Metabolism**

Bacterial growth- population growth- growth cycles of population - measurement of growth ; environment on growth – temperature, oxygen, pH and salts; energetics in bacteria; oxidation –reduction , electron carrier – overview of aerobic and anaerobic respiration and fermentation in bacteria.

**Unit V. Viruses, Bacterial Genetics and Immunology**

General properties of viruses: different types; overview of bacteriophages; morphology of bacteriophages: Lytic and lysogenic cycles; lytic and temperate phages. Genetic elements of bacteria; bacterial chromosomal DNA and plasmid; gene arrangements. Mutation - types and mutagens. Genetic recombinations: Transformation, transduction and conjugation. Genetic engineering – an introduction. Basic concepts of immunology – antigen – antibody reactions and vaccines.

**Practical**

Safety in Microbiology laboratory. Microscopes – Micrometry – Sterilization techniques and equipment – Growth media preparation – bacteria, fungi and actinobacteria. Isolation, purification and preservation of bacteria yeast and moulds. Staining techniques: Simple and differential staining - spore staining - Measurement of bacterial growth. Identification of microorganisms: cultural, physiological and biochemical tests for bacteria and actinobacteria. Morphological identification of yeasts, moulds and algae. Molecular identification of bacteria (16s rDNA). Isolation of bacteriophages. Isolation of mutants employing physical or chemical mutagens.

**Theory schedule**

1. Definition and scope of microbiology – Development of microbiology as science
2. Biogenesis and a biogenesis theory.Contributions by Antonie Van Leeuwenhoek, Louis Pasteur
3. Contributions of John Tyndall, Joseph Lister, Edward Jenner, Robert Koch, Alexander Fleming and Waksman. Germ theory of fermentation and disease
4. Microscopy; principles – resolving power and magnification. Light microscopy
5. Different types of microscopes - UV, Dark Field, Phase Contrast, Fluorescence and Electron Microscopes; Atomic and Confocal Scanning Laser Microscopy
6. Staining techniques - principle and types of stains - staining techniques- simple, negative, differential and structural staining methods
7. Sterilization – principle – physical agents and chemical methods
8. Isolation and enrichment culture techniques; preservation techniques
9. Evolutionary relationship - Position of microbes in living world – concepts and developments in classification of microorganisms
10. Groups of microorganisms - prokaryotes and eukaryotes
11. Archaea – ecology; differences among archaea, eubacteria and eukaryotes
12. Systematic bacteriology - Bergey‘s manual of systematic bacteriology – outline only
13. Cell biology; size, shape, structure and arrangement of cells
14. External structures in bacteria and their functionality
15. Functional anatomy and reproduction in bacteria
16. Morphology of fungi – economic importance
17. Morphology of algae – economic importance
18. **Mid Semester Examination**
19. Bacterial growth- population growth and growth cycle – continuous culture -chemostat and turbidostat; synchronous culture
20. Conditions for growth - temperature requirements - aerobes and anaerobes – factors influencing growth and methods of assessment of growth
21. Nutritional types of bacteria; energetics in bacteria. Metabolic diversity/ pathways specific to bacteria
22. Microbial metabolism- Energy generation by substrate level phosphorylation, oxidative and photo phosphorylation
23. Aerobic respiration and anaerobic respiration
24. Fermentative mode of respiration
25. Viruses and their properties; bacteriophages – lytic and lysogenic and temperate phages
26. Genetic elements in bacteria – structure and functions of bacterial chromosome and plasmid
27. Mutation in bacteria – principles and types
28. Mutagens – physical, chemical and biological

29. Genetic recombination – competency - transformation
30. Genetic recombination by Conjugation – concept of Hfr
31. Genetic recombination by Transduction – generalized and specialized
32. Microorganisms as tools in genetic engineering
33. Immunology – principles – specific and non-specific defense
34. Antigen – antibody reactions – vaccines - applications

**Practical schedule**

1. Safety in Microbiology laboratory. Microscopes – handling light microscope
2. Micrometry-measurement of microorganisms
3. Aseptic techniques – working with equipment and apparatus
4. Preparation of growth media for bacteria, yeast moulds and actinobacteria
5. Isolation of microorganisms by serial dilution and plating technique
6. Purification and preservation of bacteria and actinobacteria
7. Purification and preservation of yeasts and moulds
8. Staining techniques - positive and negative staining
9. Differential staining - Gram and spore staining
10. Turbidometric assessment of growth of bacteria
11. Morphological and physiological characteristics of bacteria and actinobacteria
12. Biochemical characteristics of bacteria and actinobacteria
13. Identification of yeasts moulds and algae - morphological characterization
14. Molecular identification of bacteria by 16s r DNA sequencing
15. Isolation of bacteriophages
16. Isolation bacterial mutants by UV irradiation / chemical mutagenesis
17. **Practical Examination**

**Outcome**

1. Skill development in the safe handling, culturing and staining of microorganisms
2. Learning the laboratory procedures needed to identify a bacterial culture
3. Understanding the structural, reproductive and metabolic characteristics of bacteria and morphology of eukaryotic microorganisms
4. Acquiring knowledge about the factors that influence microbial growth and how it can be controlled
5. Exposure to the mechanisms of genetic recombination in bacteria and describe the practical applications of these methods

**Text Books**


1. Prescott, Harley and Klein, 2013. Microbiology, 9 th edition, McGraw Hill Publishing
2. Michael J. Pelczar,JR., E.C.S. Chan, Noel R.Krieg, 2005. Microbiology
3. ebook: LuisM.de la Maza, Marie T. Pezzlo and Ellen Jo Baron 1997. Color Atlas of diagnostic Microbiology, Published by Mosby- Year Book Inc.
4. ebook: Michael J. Leboffee and Burton E.Pierce 2011. A photographic Atlas for the Microbiology Laboratory 4th edition, Marton Publishing Company


**Reference Books**


1. Hans G. Schlegel, 2012. General Microbiology, 7 th edition
2. Ronald M. Atlas, 1997. Principles of Microbiology, Second edition

3. Tortora, G.J., B.R.Funke and C.L. Case, 2009. Microbiology- An Introduction, 9 th edition
4. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

**Web pages**

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

## 17 AEN 201 FUNDAMENTALS OF ENTOMOLOGY (2+1)

**Aim:**

To acquaint the students with external morphology of the insect, basic aspects of anatomy of different systems and identification of insects up to family level with hands-on experience.

**Theory**

**Unit I: History and importance**

History of Entomology in India; Position of insects in the animal kingdom and their relationship with other classes of Arthropoda; Reasons for insect dominance.

**Unit II: Morphology**

General organisation of insect body wall - structure and function, cuticular appendages, moulting; Body regions - insect head, thorax and abdomen, their structure and appendages.

**Unit III: Anatomy and physiology**

Digestive, excretory, respiratory, circulatory, nervous and 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 / coackroach – Observing the characters of agriculturally important orders and families.

**Theory lecture schedule:**

1. History of Entomology in India; Position of insects in the animal kingdom - relationship with other members of Arthropoda
2. Structural, morphological and physiological factors responsible for dominance
3. Insect body wall - its structure and function; cuticular appendages
4. Moulting process in insects

5. Structure of insect head and its appendages
6. Structure of insect thorax and its appendages
7. Structure of insect abdomen and its appendages
8. Structure of alimentary canal and its modifications; Digestive enzymes, digestion and absorption of nutrients
9. Malpighian tubules - accessory excretory organs and physiology of excretion
10. Structure of trachea - tracheoles - types of respiratory system - types of spiracles - respiration in aquatic and endoparasitic insects.
11. Haemocoel and dorsal vessel - circulation of blood -composition of haemolymph - haemocytes and their functions
12. Structure of neuron – types of nervous systems.
13. Axonic and synaptic transmissions
14. Male and female reproductive systems in insects – structure and modifications Spermatogenesis and Oogenesis
15. Oviparous, viviparous, paedogenesis, polyembryony ovoviporous and parthenogenesis
16. Embryogenesis; Types of metamorphosis – Immature stages of insects
17. Mid-semester examination
18. Structure of sense organs - types of sensilla – photoreceptors, chemoreceptors and mechanoreceptors
19. Exocrine and endocrine glands and their function - effect on metamorphosis and reproduction
20. Tropism and Biocommunication in insects — Sound and light production
21. Systematics - principles and procedures of classification and nomenclature of insects
22. Distinguishing characters of insect orders — Apterygota (Thysanura, Diplura, Protura and Collembola), Exopterygota — (Ephemeroptera, Odonata and Phasmida)
23. Orthoptera (Ensifera - Tettigonidae, Gryllidae and Gryllotalpidae; Caelifera - Acrididae and Tetrigidae), Dictyoptera, Dermaptera and Embioptera
24. Isoptera — social life in termites
25. Thysanoptera, Pscoptera, Mallophaga and Siphunculata.
26. Hemiptera – Homoptera (Delphacidae, Flatidae, Cercopidae, Cicadidae, Membracidae, Cicadellidae, Psyllidae, Aleyrodidae, Aphididae, Margarodidae, Kerridae, Pseudococcidae, Coccidae, Asterolecaniidae and Diaspididae)

26. Hemiptera - Heteroptera (Tingidae, Reduviidae, Cimicidae, Anthocoridae, Miridae, Lygaeidae, Pyrrhocoridae, Coreidae, Scutellaridae, Pentatomidae, Veliidae, Gerridae, Naucoridae, Belastomatidae, Nepidae, Notonectidae and Corixidae)

27. Endopterygota — Classification of Lepidoptera – suborders; butterfly families (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae and Hesperiidae)

29. Moth families (Psychidae, Gelechiidae, Metarbellidae, Cochlidiidae, Pyralidae, Crambidae, Pterophoridae, Geometridae, Bombycidae, Saturniidae, Sphingidae, Arctiidae, Noctuidae and Lymantriidae)

28. Classification of Coleoptera – suborders; Adephaga (Carabidae, Cicindellidae, Dytiscidae, Gyrinidae)

29. 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)

30. Diptera – Suborders; Nematocera (Tipulidae, Psychodidae, Culicidae, Bibionidae, and

Cecidomyiidae), Brachycera (Tabanidae, Asilidae and Bombylidae,),

31. Cyclorrapha (Syrphidae, Drosophillidae, Muscidae, Calliphoridae, Tachinidae, Hippoboscidae, Micropezidae, Agromyzidae, Chloropidae and Tephritidae)
32. Hymenoptera–Suborders; Symphyta (Tenthredinidae) Apocrita (Ichneumonidae, Braconidae, Evaniidae, Agaonidae, Chalcididae, Encyrtidae, Eulophidae, Trichogrammatidae, Bethylidae, Chrysididae, Scoliidae, Mutillidae, Formicidae, Vespidae, Sphecidae, Megachilidae, Anthophoridae, Xylocopidae and Apidae)
33. Neuroptera (Mantispidae, Chrysopidae, Myrmeleontidae and Ascalaphidae); Siphonaptera and Strepsiptera

**Practical schedule:**

1. Observations on external features of grasshopper / cockroach and other members of phylum Arthropoda
2. Methods of insect collection, preservation, display and storage
3. Types of insect head and antenna
4. Mouth parts of cockroach, modifications in the mouth parts in plant bug, female mosquito, honeybee, thrips, antlion grub, house fly, moths and butterflies
5. Structure of thorax and abdomen and their appendages —modifications in insect legs and wings — wing venation, regions and angles — wing coupling.
6. Types of immature stages of insects
7. Study of digestive system.
8. Study of male and female reproductive systems
9. Observing the characters of Apterygota - Collembola and Thysanura and Exopterygota - Odonata and Ephemeroptera and Phasmida
10. Observing the characters of Dictyoptera, Dermaptera, Embioptera, Orthoptera (Ensifera - Tettigonidae, Gryllidae and Gryllotalpidae; Caelifera - Acrididae and Tetrigidae), Mallophaga and Siphunculata
11. 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)
12. Observing the characters of orders Thysanoptera and Diptera- Nematocera (Tipulidae, Psychodidae, Culicidae, Bibionidae, and Cecidomyiidae), Brachycera (Tabanidae, Asilidae and Bombylidae,), Cyclorrapha (Syrphidae, Drosophillidae, Muscidae, Calliphoridae, Tachinidae, Hippoboscidae, Micropezidae, Agromyzidae, Chloropidae and Tephritidae)
13. Observing the characters of Hymenoptera-Symphyta (Tenthredinidae) Apocrita (Ichneumonidae, Braconidae, Evaniidae, Agaonidae, Chalcididae, Encyrtidae, Eulophidae, Trichogrammatidae, Bethylidae, Chrysididae, Scoliidae, Mutillidae, Formicidae, Vespidae, Sphecidae, Megachilidae, Anthophoridae, Xylocopidae and Apidae)
14. 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)

15. Observing the characters of Lepidoptera - Butterfly families (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Satyriidae and Hesperiidae), Moth families (Psychidae, Gelechiidae, Metarbellidae, Cochlidiidae, Pyralidae, Crambidae, Pterophoridae, Geometridae, Bombycidae, Saturniidae, Sphingidae, Arctiidae, Noctuidae and Lymantriidae)
16. Observing the characters of Neuroptera (Mantispidae, Chrysopidae, Myrmeleontidae and Ascalaphidae), Siphonoptera. Identification and naming of collected insects based on characters — order and family
17. Final Practical examination

**Assignment**

1. Collection and submission of 50 insects
2. Preparation and submission of one riker mount

**Outcome/Deliverables:**

The students gain knowledge on external morphology of the insect i.e., head, thorax and abdomen, their appendages and functions. Moreover, this course imparts knowledge on basic aspects of anatomy of different systems, physiology, classification and identification of insects up to family level with hands-on experience.

**References:**

**A. Text Book:**

1. 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}

**B. Reference Books:**

1. Chapman, R.F. 1998. *The Insects: Structure and Function*. Fourth Edition. Cambridge University Press. 770p. {ISBN 0 521 78732 7}
2. Snodgrass, R.E. 1994. *Principles of Insect Morphology*. CBS publishers and distributors, New Delhi. 667p.
3. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
4. Srivastava, P. D. and R. P. Singh. 1997. An Introduction to Entomology. Concept Publishing Company, New Delhi.

**C. Supplementary references:**

1. Borror, D.J., D.M. Delong and C.A. Triple Horn. 1976. *An introduction to the study of insects* (IV Edition). Holt McDougal, New York. 864p. {ISBN 978-0030884061}
2. Cedric Gillott. 2005. *Entomology* (Third Edition). Springer, Netherlands.832p. {ISBN 978-1402031823}
3. Nayar. K.K., T.N. Ananthakrishnan and B.V. David 1976. *General and Applied Entomology*. Tata Mc-Graw Hill publishing Company Ltd, New Delhi.
4. Paulson, G.S. 2005. *Hand book to the Construction and Use of Insect Collection and Rearing Devices.* Springer, New York.121p. {ISBN 1402029748}

**D. Web resources:**

1. http://www.itis.usda.gov/it is/

2. www.zin.ru/animalia
3. https://courses.cit.cornell.edu/ent201/content/*anatomy*2.pdf
4. www.*insects*explained.com/03*external*.htm
5. www.earthlife.net/*insects*/anatomy.html
6. www.*insect*identification.org/*orders_insect*.asp

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

**Aim:**

To make the students understand the importance of seed quality and principles involved in seed production.

**Theory**

**Unit I - Introduction to seed and seed quality**

Seed - definition - Seed structure - Seed development and maturation - Germination - phases of seed germination - Dormancy - types of seed dormancy - Seed senescence - causes of seed senescence - Seed quality characteristics - significance - Classes of seed - Generation system of seed multiplication in seed supply chain .

**Unit II - Principles of seed production**

Seed replacement rate and varietal replacement - Seed Multiplication Ratio - Seed renewal period - Causes of varietal deterioration and maintenance - Genetic and agronomic principles of seed production - Factors affecting quality seed production - Methods of seed production of varieties and hybrids.

**Unit III - Seed production techniques of agricultural crops**

Floral biology and pollination behavior - seed production techniques of rice, maize, sorghum and bajra varieties and hybrids - redgram varieties and hybrids - blackgam and greengram varieties - groundnut and sesame varieties - sunflower, castor and cotton varieties and hybrids – Bt cotton.

**Unit IV - Seed production techniques of vegetable crops**

Floral biology and pollination behavior - seed production techniques of tomato, chillies, brinjal, bhendi, onion, snakegourd, bittergourd, pumpkin, ashgourd, ribbedgourd and bottlegourd varieties and hybrids.

**Unit V - Post harvest seed handling techniques**

Threshing - methods - Drying - methods of seed drying - advantages and disadvantages -Seed processing – definition - importance - Seed cleaning and grading – upgrading - equipments - working principles - Seed treatment - importance - types - Seed invigouration techniques - seed hardening - seed fortification - seed priming - Seed enhancement techniques - seed coating - seed pelleting.

**Practical**

Study of seed structure of agricultural and horticultural crops - Seed dormancy - breaking methods - Seed invigouration techniques - hardening and priming - Seed enhancement techniques - seed coating and pelleting - Seed upgradation technique in rice-Acid delinting in cotton - Hybrid seed production techniques - Detasseling in maize - emasculation and dusting in cotton and vegetables - supplementary pollination in rice and sunflower – Practicing pregerminative techniques, enhancing floral ratio and improving seed set in cucurbits - Visit to seed production plot - Identification of physical and genetic contaminants, pollen shedders, partials, shedding tassels, selfed bolls and fruits - Physiological and harvestable maturity indices - Fruit grading - Seed extraction methods in vegetables - tomato, brinjal, chillies, bhendi and cucurbits - Seed cleaning and grading techniques - Detection of seed mechanical injury - Visit to seed processing plant - Seed production planning - Cost benefit ratio of hybrids and

vegetables seed production.

**Theory Schedule**

1. Seed - definition - seed structure - Seed development and maturation
2. Germination - phases of seed germination - Dormancy - types of seed dormancy
3. Seed senescence - causes of seed senescence - seed quality characteristics - significance
4. Classes of seed - Generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio - Seed renewal period
5. Causes of varietal deterioration and maintenance - Genetic and agronomic principles of seed production - Factors affecting quality seed production - Methods of seed production of varieties and hybrids
6. Floral biology and pollination behavior - seed production techniques of rice varieties and hybrids.
7. Floral biology and pollination behavior - seed production techniques in maize varieties and hybrids.
8. Floral biology and pollination behavior - seed production techniques of sorghum and bajra varieties and hybrids.
9. Mid semester examination.
10. Floral biology and pollination behavior - seed production techniques of red gram varieties and hybrids - blackgam and greengram varieties - groundnut and sesame varieties.
11. Floral biology and pollination behavior-seed production techniques of sunflower, castor varieties and hybrids.
12. Floral biology and pollination behavior - seed production techniques of cotton varieties and hybrids - Bt cotton - seed production techniques of varieties and hybrids of tomato, brinjal and chillies.
13. Floral biology and pollination behavior - seed production techniques of bhendi and onion varieties and hybrids.
14. Floral biology and pollination behavior - seed production techniques of snakegourd, bittergourd, pumpkin, ashgourd, ribbedgourd and bottlegourd varieties and hybrids.
15. Post harvest handling of seeds - Threshing - methods - Drying - methods of seed drying - advantages and disadvantages.
16. Seed processing - definition - importance - sequence - seed cleaning and grading - equipments (cleaner cum grader) upgrading - equipments (colour sorter, Indented cylinder separator, specific gravity separator, spiral separator, magnetic separator - needle separator -working principles - Seed treatment - importance - types.
17. Seed invigouration techniques - seed hardening - seed fortification - seed priming - Seed enhancement techniques - seed coating - seed pelleting.

**Practical schedule**

1. Study of seed structure of agricultural and horticultural crops.
2. Seed dormancy breaking methods.
3. Practicing seed invigouration techniques - seed hardening.
4. Practicing seed invigouration techniques - seed priming.
5. Practicing seed enhancement techniques - seed coating and seed pelleting.
6. Seed upgradation technique in rice- Acid delinting in cotton.
7. Detasseling techniques for hybrid seed production in maize.
8. Emasculation and dusting techniques for hybrid seed production in cotton and vegetables.
9. Hybrid seed production techniques - supplementary pollination in rice and sunflower.
10. Practicing pre-germinative techniques , enhancing floral ratio and improving seed set in cucurbits
11. Visit to seed production plot - identification of physical and genetic contaminants, pollen

shedders and partials, shedding tassels, selfed bolls and fruits.

12. Determination of physiological and harvestable maturity indices.
13. Fruit grading and seed extraction methods in vegetables - tomato, brinjal, chillies, bhendi and cucurbits.
14. Seed cleaning and grading techniques and detection of seed mechanical injury.
15. Visit to seed processing unit.
16. Seed production planning and determination of cost benefit ratio of hybrids and vegetables seed production.
17. Final practical examination.

**Out come**

The students will gain knowledge about the various techniques of quality seed production, processing and seed quality enhancement.

**References**

**Standard text books**


1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
2. Bhaskaran, M. *et al.*, 2004. Principles of seed production. Scientific Publishers, Ludhiana.


**Online references**

1. www.fao.org
2. www.seednet.gov.in
3. www.agricoop.nic.in
4. www.online library.willey.com
5. www.sciencedirect.com

**e-journals**

1. Seed Science Research (www.jgateplus.com)
2. Seed Science and Technology (www.jgateplus.com)
3. ―Seeds‖, Baskin, Carol. Academic Press. (Elsevier e-books) (ISBN No. 9780124166776).
4. *"Seeds" Derek Bewley, Kent. ( Springer e- books) ( www-link-springer.com) (ISBN NO. 978-1-4614-4693-4)*

**17 AGR 201 CROP PRODUCTION TECHNOLOGY – I (*Kharif crops*) 1+1**

**Theory**

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

**Practical**

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

## 17 HOR 211 PRODUCTION TECHNOLOGY FOR VEGETABLES AND SPICE CROPS (1+1)

**Theory**

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

Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu-nutritive value of vegetables –classification of vegetables – types of vegetable growing : vegetable production in kitchen garden, roof garden, truck garden, market garden,floating garden, river bed cultivation, garden for vegetable forcing – nursery management – cropping systems in vegetables. Use of growth regulators in vegetables-Protected cultivation of vegetables (tomato ,capsicum and cucumber)

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

Climate and soil – varieties and hybrids – seeds and sowing –raising nursery in protrays – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients -physiological disorders - maturity indices – harvest-Post harvest technology

**Crops:** Tomato, chilli, brinjal, bhendi, gourds (pumpkin, ash gourd, ribbed gourd, bitter gourd and snake gourd), melons (watermelon and muskmelon) onion, cassava, amaranthus and moringa, sweet potato and yams.

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

Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrient and growth regulators- physiological disorders - maturity indices and harvest- Post harvest technology

(**Crops:** Cabbage, brussel sprout, cauliflower, broccoli, potato, carrot, radish, beetroot, peas and french beans).

**Unit IV: Status of production, scope and crop production techniques of spice crops**

Spices- Scope and importance- classification of spices –role of commodity boards - Climate and soil- varieties and related species- propagation, nursery management and planting-training practices- weed and water management- nutrient management–shade regulation-harvest

**Crops:** Black pepper, cardamom.

**Unit V: Crop production techniques in spice crops**

Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices- weed and water management- shade regulation-nutrient management including drip and fertigation –harvest- Post harvest technology

**Crops:** Turmeric, ginger, coriander, clove, nutmeg, vanilla and curry leaf.

**Practical**

**Vegetable crops**

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

**Spice crops**

Black pepper- Description of varieties, study of different shoots, propagation. Cardamom- Description of varieties, propagation, shade management and processing. Coriander and curry leaf- study on varietal identification, seed treatment, sowing and harvest. Clove and nutmeg- Description of varieties, propagation, training, pruning and processing. Turmeric and ginger- description of varieties- propagation- processing and curing. Vanilla- description of varieties- propagation- processing and curing. Visit to spice gardens andcommodity boards.

**Theory schedule**

1. Importance of vegetable growing in India and Tamil Nadu and nutritive value and classification of vegetables.
2. Types of vegetable growing : Vegetable production in nutrition garden, kitchen garden, roof garden, truck garden, market garden, floating garden, river bed cultivation, garden for vegetable forcing
3. Nursery management and cropping systems in vegetable crops
4. Use of growth regulators in vegetables
5. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing, and storage of tomato.
6. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing, and storage of chilli.
7. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing, and storage of brinjal.
8. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield- pre cooling, grading, packing, and storage of bhendi
9. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield- pre cooling, grading, packing and storage of onion.
10. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield- pre cooling, grading, packing, and storage of gourds (pumpkin and ash gourd,) and melons (water melon and musk melon).
11. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield- pre cooling, grading, packing

and storage of gourds (ribbed gourd, bitter gourd and snake gourd )

12. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing and storage of cassava.
13. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield- pre cooling, grading, packing and storage of moringa and amaranthus.
14. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing and storage of cabbage – a brief account of brussel sprout.
15. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing,and storage of cauliflower- a brief account of broccoli.
16. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield- pre cooling, grading, packing and storage of potato, sweet potato and yams.
17. **Mid semester examination**
18. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing and storage of peas
19. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing and storage of carrot and radish.
20. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - nutrient management – irrigation and fertigation – weed management – use of micronutrients - physiological disorders - maturity indices – harvest and yield - pre cooling, grading, packing, and storage of beetroot and French beans.
21. Protected cultivation of vegetables (tomato,capsicum and cucumber)
22. Scope and Importance- classification of spices
23. Role of commodity boards
24. Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices of black pepper
25. Weed and water management- growth regulation - shade regulation- nutrient management including drip and fertigation – harvest - yield - post harvest technology of black pepper.
26. Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices- weed and water management- shade regulation-

nutrient management including drip and fertigation –harvest-yield- post harvest technology of cardamom.

27. Climate and soil- varieties and related species- propagation, nursery management and planting- weed and water management- inter cropping- nutrient management including drip and fertigation –harvesting and curing of turmeric.
28. Climate and soil- varieties and related species- propagation, rhizome selection and treatment - planting- weed and water management- rotation and mixed cropping – mulching - nutrient management including drip and fertigation –harvest and curing of ginger.
29. Climate and soil- varieties –seeds and sowing- propagation and planting- weed and water management- cropping system- nutrient management including drip and fertigation – harvest of coriander
30. Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices- weed and water management- cropping system nutrient management–harvest of clove.
31. Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices- weed and water management- cropping system- nutrient management–harvest of nutmeg.
32. Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices- weed and water management- shade regulation- nutrient management including drip and fertigation –harvest of vanilla
33. Climate and soil- varieties and related species- propagation, nursery management and planting- training and pruning practices- weed and water management- nutrient management including drip and fertigation –harvest of curry leaf
34. Value addition of important spices (Black pepper, nutmeg, vanilla, Turmeric, ginger)

**Practical schedule**

1. Layout of kitchen garden and roof garden.
2. Seed treatment and sowing practices in direct sown vegetables
3. Nursery management of transplanted ,bulb and tuber vegetable crops
4. Nutrient management in vegetable crops - fertigation
5. Practices in use of plant growth regulators in vegetable crops
6. Special horticultural practices in vegetable production
7. Study of maturity standards and harvesting of vegetables
8. Protected cultivation of vegetable crops
9. Visit to vegetable nurseries/protected cultivation/gardens.
10. Black pepper- Description of varieties, study of different shoots, propagation
11. Cardamom- Description of varieties, propagation, shade management and processing
12. Coriander and curry leaf- study on varietal identification, seed treatment, sowing and harvest.
13. Clove and nutmeg- Description of varieties, propagation, training, pruning and processing
14. Turmeric and ginger- description of varieties- propagation- processing and curing
15. Vanilla- description of varieties- propagation- processing and curing
16. Visit to spice gardens or commodity boards.
17. Practical Examination.

**References**


1. Gopalakrishnan, T.R. 2007. Vegetable Crops. Horticultural Science Series (Series Editor K.V.Peter). New India Publishing Agency.
2. Vishnu Swarup, S. 2012. Vegetable Science and technology in India , Kalyani publisher, New Delhi.
3. Veeraragavaththam ,D., M.Jawaharlal and SeemanthiniRamadas 2000 ― A guide on vegetable Culture‖
4. Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops., IBH Publishing Co. Pvt. Ltd., New Delhi.
5. SandhnaPandey, S.N. Pandey and P.H.Pandy, 2013. Spice crop management and technology, Kalyani publisher, New Delhi.


**Journals**


1. Indian Horticulture
2. Vegetable Science
3. Indian Journal of Horticulture Science
4. Journal of Horticultural Sciences
5. Acta Horticulturae
6. South Indian Horticulture
7. Hort Science


**Web resources**


1. http://www.idosi.org/aejb/1(1)08/2.pdf
2. http://www.academicjournals.org/ajar/PDF/pdf 2009/Sep/Baris
3. http://pods.dasnr.okstate.edu
4. http://www.avrdc.org
5. http://www.ces.ncsu.edu
6. http://www.attra.ncat.org/attra-pub//vegetables
7. http://www.icar.org.in/dipa/events/ICAR.NEWS/volume-II

**17 ENS 201 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (2+1)**

**Objective**

1. To impart basic knowledge into climate change, impact, assessment, mitigation strategies and policies.
2. To impart theoretical knowledge on disaster, impact, management and policies

**Theory**

Multidisciplinary nature of environmental studies Definition, scope and importance.

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.

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)

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-sports 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.

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.

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. dies. 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.

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.

***Disaster Management***

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.

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.

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**

Pollution case studies. Case Studies- 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.

**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.

1. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
2. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
3. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
4. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
5. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
6. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual and communities 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 ecosystems :-

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.

**Conservationof biodiversity:** In-situ and Ex-situ conservation of biodiversity. Characterization, evaluation and utilization of agrobiodiversity.

**Unit 5 :** Environmental Pollution: definition, cause, effects and control measures of :-

1. Air pollution
2. Water pollution
3. Soil pollution
4. Marine pollution
5. Noise pollution
6. Thermal pollution
7. Nuclear hazards.

**Solid Waste Management:** causes, effects and control measures of urban and industrial wastes.

Role of an individual and communities 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. dyes.

Wasteland reclamation.

Consumerism, wastage 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. Demographic patterns and impact on Agriculture

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.

**Unit 8:** 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.

**Disaster Management**

**Theory**

**UNIT-1 :**-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-2 :-**Man made disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, field fires-burning of straw, stables and residues oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

**UNIT-3:-**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.

**Theory**

**UNIT I – Climate change and it causes**

Introduction to climatic fluctuations and climate change. Climate change over India and World, issues on global climate change. IPCC assessment on climate change and International conventions, role of ocean in climate change and El nino effect, climate change and global desertification process, freak monsoon cyclone; flood, drought and cyclone.

Causes of climate change - Global C, N, S and H cycles and greenhouse effect. Greenhouse gases - $CO_2$, $CH_4$, NOx, CFCs etc. Change in concentrations of greenhouse gases in atmosphere, global warming potential, etc. Biotic and abiotic factors on production and emission of greenhouse gases from terrestrial and aquatic ecosystems

**UNIT II – Impact of climate change**

Impacts of climate change on various systems: Agriculture, hydrology and water resources; terrestrial and fresh water ecosystems; coastal and marine ecosystems; human health;

human settlements, energy, and industry; insurance and other financial services; climate change on crop diversification, loss of biodiversity, microbes and pest dynamics; climate change on weed management and soil fertility problems.

**UNIT III – Measurements of climate change factors**

GHG monitoring and measurement at atmosphere and different ecosystem.

**UNIT IV – Mitigation and adaptation to climate change**

Climatic projections from different sources. Carbon sequestration potential of various sink. Mitigation options of greenhouse gases. Physiological and biochemical effects, avoidance and adaptation mechanisms in plants and animals. $CO_2$ enrichment and plant response, change in quality and quantity of crop produce. Adaptation to climate change – types and improvement, developing adaptation strategies through crop simulation models. Government policies on Climate change.

**UNIT IV – Basic concepts of disaster:**

Definition, introduction to natural and manmade disaster, Levels of disasters, History on natural disasters in India, Disaster phenomena and events (global national and regional), Concept of risk, hazard, and vulnerability.) Hydro meteorological Disasters: Floods and flash floods: General characteristics, causes, nature and frequency of flooding, floodplains, flood hydrographs, river and coastal floods, lake outburst, cloud burst; Droughts: Causes, classification – agricultural, hydrological and meteorological droughts; drought frequency and intensity; Cyclones and Tsunami: Structure and nature of cyclones and tsunami, characteristics, factors, hazard potential; Frost, heat and cold waves: cause, intensity and extent of frost, heat and cold waves and its impact on agricultural crops. Geological disaster - Landslides: causes, susceptibility to landslides and slope failures; **Manmade Disasters**: chemical hazards, nuclear hazards, forest fire, oil spill and road accidents

**UNIT V - Disaster Impact Assessment:** Severity, extent of damage on agricultural production systems, economic losses affecting livelihood, social and economic perspective; Crop Loss: quantity, quality, yield, sustainability, insects, pest and disease incidence; Livestock/Fish/Poultry: Mortality, morbidity, health, reproduction yield, feed and fodder availability; Irrigation Infrastructure: siltation, damage to canal network, tube wells, open wells, dug wells, channels, ponds etc; Soil and Water: Impact on soil erosion, water availability, accessibility and quality.

**Unit VI - Planning and Preparedness for Disaster Management:** Strategies for disaster management planning, priority setting for preparedness strategies in agricultural production system, formulation of a disaster risk reduction plan. disaster preparedness for crops, livestock and fisheries, hazard and risk reduction strategies. role of IT, remote sensing, GIS and GPS in disaster preparedness. weather forecasting and early warning systems, flood forecasting agricultural drought monitoring and forecasting.

**Unit VII Frameworks, Approaches and Methods for Disaster Risk Reduction:** understanding resilience, linking vulnerability reduction and disaster recovery, disaster response and post-disaster recovery. nature and type of immediate response, disaster management plans, key response functions logistic, recovery rehabilitation reconstruction. Contingency Planning for Disaster Risk Reduction: agronomic, engineering other non-engineering interventions for drought, flood, cyclone and heat/cold waves, agro-met advisories,

crop advisories, community nursery, contingent seed bank, mini-kit availability, strategies for fisheries management in flood prone areas, livestock shelters, feed and fodder banks, mass vaccination of livestock, etc

**Unit VIII- Policies for Disaster Management:** Disaster Management Act and Policies in India, Organizational structure for disaster management at national, state and district levels, Existing schemes and government policies to tackle agricultural disasters. Insurance and loan schemes: criteria and constraints of crop/animal insurance and credit guarantee schemes.

**Suggested readings**

Frame,B., Y.Medury and Y.Joshi (eds.). 1992. Global climate change – Science, Impactand Response. Proc. Indo British symposium on climate change, 15 - 17,Jan. 1992, New Delhi, 267pp.

Lal. D.S., 2012. Climatology. Published by Shradha Pustak Bhavan, Allahabad. ISBN:13– 978 81 862 04122. 448 pp

De. A.K., 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp

Dhar Chakrabarti. P.G., 2011. Disaster management & climate change - India‘s risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Banaalore. 36 pp.

Proceedings of 2nd India disaster management congress, New Delhi. Organized by National Institute of Disaster Management, New Delhi during 4 – 6, November 2009.

**Theory schedule**

1. Introduction to climatic fluctuations and climate change. Climate change over India and World. Issues on global climate change.
2. IPCC assessment on climate change and international conventions.
3. Role of ocean in climate change and El nino effect. Climate change and global desertification process.
4. Freak monsoon - cyclones -flood -drought –hurricane and ongoing efforts on climate change research.
5. Impact of GHG on Global warming. Global C, N, S and H cycles, greenhouse effect and causes of climate change. Greenhouse gases - $CO_2$, $CH_4$, $NO_3$, CFCs - Change in Conc. greenhouse gases in atmosphere and global warming potential.
6. Biotic and abiotic factors on production and emission of greenhouse gases from terrestrial ecosystems and aquatic ecosystems
7. Impacts of climate change on agriculture food security and Hydrology.
8. Impacts of climate change on Terrestrial, Coastal zones, freshwater and marine ecosystems
9. Impacts of climate change on human health and human settlements. Impacts of climate change on energy, industrial, insurance and other financial services.
10. Climate change on crop diversification, biodiversity, soil fertility, weed, pest and microbes dynamics.
11. Monitoring of GHG at atmosphere and different ecosystem.
12. $CO_2$ enrichment and plant response, change in quality and quantity of crop produce.

13. Mitigation options of greenhouse gases, Physiological and biochemical effects on biota avoidance and adaptation mechanisms in plants and animals
14. Carbon sequestration and sequestration potential of various sink.
15. Adaptation to climate change – types and improvement. Crop simulation models in developing adaptation strategies.
16. Government policies on Climate change.
17. Mid semester examination
18. Definition, Introduction to natural and manmade disaster, Levels of disasters, History on natural disasters in India, Disaster phenomena and events (global national and regional), Concept of risk, hazard, and vulnerability.)
19. Hydro meteorological Disasters: Floods and flash floods: General characteristics, causes, nature and frequency of flooding, flood plains, flood hydrographs, river and coastal floods, lake outburst, cloud burst; Droughts: Causes, classification – agricultural, hydrological and meteorological droughts; drought frequency and intensity.
20. Hydro meteorological Disasters: Cyclones and Tsunami: Structure and nature of cyclones and tsunamis, characteristics, factors, hazard potential; Frost, heat and cold waves: cause, intensity and extent of frost, heat and cold waves and its impact on agricultural crops.
21. Geological disasters Landslides: causes, susceptibility to landslides and slope failures; Earthquake – Causes, magnitude and intensity
22. Manmade Disasters: chemical hazards, nuclear hazards, forest fire, oil spill and road accidents
23. Severity, extent of disaster damage on agricultural production systems, economic losses affecting livelihood, social and economic perspective; Crop Loss: quantity, quality, yield, sustainability, insects, pest and disease incidence;
24. Severity, extent of disaster damage on livestock/Fish/Poultry: Mortality, morbidity, health, reproduction yield, feed and fodder availability;
25. Severity, extent of disaster damage on Soil, Water and Irrigation Infrastructure. Soil erosion, water availability, accessibility and quality. Siltation, damage to canal network, tube wells, open wells, dug wells, channels, ponds etc.
26. Strategies for disaster management planning, priority setting for preparedness strategies in agricultural production system, livestock and fisheries, formulation of a disaster risk reduction plan.
27. Role of IT, remote sensing, GIS and GPS in disaster preparedness.
28. Weather forecasting and early warning systems, flood forecasting agricultural drought monitoring and forecasting.
29. Understating resilience, linking vulnerability reduction and disaster recovery, disaster response and post-disaster recovery.
30. Nature and type of immediate response, disaster management plans, key response functions logistic, recovery rehabilitation reconstruction.
31. Contingency Planning for Disaster Risk Reduction: agronomic, engineering other non-engineering interventions for drought, flood, cyclone and heat/cold waves, agro-met advisories, crop advisories, community nursery, contingent seed bank, mini-kit availability.
32. Strategies for fisheries management in flood prone areas, livestock shelters, feed and fodder banks, mass vaccination of livestock, etc
33. Disaster Management Act and Policies in India, Organizational structure for disaster

management at national, state and district levels.

34. Existing schemes and government policies to tackle agricultural disasters. Insurance and loan schemes: criteria and constrains of crop/animal insurance and credit guarantee schemes.
35. Final theory examination

**17 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**

| S.No. | Lecture Unit | Reference Book & Page No |
|---|---|---|
| 1 | 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, 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 |
| 7 | Housing management-farm site selection and floor space requirement for calves, heifer, milch animal and work bullocks. | 364-379 Handbook of Animal Husbandry - ICAR |
| 8 | 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 |
| 9 | Care and management of new born calf and heifers | 358-362 Handbook of Animal Husbandry - ICAR |
| 10 | Care and management of pregnant animal and lactating animals. | 362-363 Handbook of Animal Husbandry - ICAR |
| 11 | Care and management of dry cows and work bullock. | 756-757 Handbook of Animal Husbandry - ICAR |
| 12 | 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 |
| 13 | 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 |
| 14 | 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 |

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|---|---|---|
| 16 | 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 |
| 17 | **Mid semester examination** | |
| 18 | Sheep and goat farming-classification of breeds of Indian and exotic origin – economic traits. | 54-120 Handbook of Animal Husbandry - ICAR |
| 19 | Systems of rearing-housing management - type design-floor diagram-space requirement for adult and young stock. | 101 Handbook of Animal Husbandry - ICAR |
| 20 | Care and management of ram, ewe and lamb-nutrition-feeds and fodder for small ruminants. | 99-101 Handbook of Animal Husbandry - ICAR |
| 21 | Care and management of buck, doe and kid- nutrition-flushing. | 102 Handbook of Animal Husbandry - ICAR |
| 22 | 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 |
| 23 | Swine husbandry –Common breeds of exotic origin-Large White Yorkshire, Landrace and Duroc -economic traits- housing of Swine. | 256-271Handbook of Animal Husbandry - ICAR |
| 24 | Care and management of sow, boar and piglets-nutrition-creep feeding. | 256-271Handbook of Animal Husbandry - ICAR |
| 25 | Disease prevention and control of swine diseases –hog cholera, foot and mouth, ecto and endo parasites. | 448-551 Handbook of Animal Husbandry - ICAR |
| 26 | Classification of breeds - commercial strains of layer and broiler. | 206-255 Handbook of Animal Husbandry - ICAR |
| 27 | Care and management of Chicks-brooder management. | 206-255 Handbook of Animal Husbandry - ICAR |
| 28 | 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 |
| 29 | Care and management of Grower and Layers-vaccination schedule. | 206-255 Handbook of Animal Husbandry - ICAR |
| 30 | Care and management of broilers-vaccination schedule. | 206-255 Handbook of Animal Husbandry - ICAR |
| 31 | Incubation and hatching of eggs. | 206-255 Handbook of Animal Husbandry - ICAR |
| 32 | 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 |
| 33 | Classification of disease –viral – bacterial - protozoan-causative organisms, symptoms and prevention – viral diseases- Ranikhet – IBD-avian flu | 448-551 Handbook of Animal Husbandry - ICAR |

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|---|---|---|
| 34 | Bacterial disease-E.coli-coryza-salmonellosis-protozoan–coccidiosis-casuative organism, symptoms and preventive measures. Management of dead birds and manure | 448-551 Handbook of Animal Husbandry - ICAR |

**Practical:**

1. Study of external parts of livestock
2. Identification of livestock and poultry
3. Common restraining methods of livestock
4. Disbudding, Dehorning, Castration and Dentition of livestock
5. Study of type design of animal and poultry houses
6. Selection of dairy cow and work bullock
7. Determination of specific gravity, fat %, total solids, solids not fat
8. Demonstration of cream separation
9. Identification of feed &fodder
10. Economics of dairy, goat and swine Farming
11. Study of external parts of fowl. Preparation of brooder house
12. Identification of layer and non- layer
13. Debeaking, delousing, deworming of poultry Vaccination schedule for broiler and layer
14. Demonstration of dressing of broiler. Economics of layer and broiler farming
15. Visit to a modern dairy and commercial layer and broiler farms
16. Demonstration of incubator and setter
17. **Practical examination**

**Reference books:**

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

**E- reference:**

http://www.elearnvet.net/
http://agridr.in/expert_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html

## 17 AEC 201 FARM MANAGEMENT, PRODUCTION AND RESOURCE ECONOMICS 1+1

**Objectives**

This course aims at imparting knowledge on principles of farm management. This course also would help the Under Graduate students in using different methods and tools for decision making in farm management, which would facilitate profit maximization through optimizing farm resource use.

**Theory**

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

Production Economics: Meaning, Definition and Nature and Scope – Farm Management: Definition and Objectives of farm management – Production Economics Vs. Farm Management – Farm Management Decisions: Decision making process – Scope of farm management – Types and Systems of farming: Types – Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.

**Unit 2: Factor – Product Relationship**

Factor – Product relationship: Meaning – Agricultural Production Function: Meaning, Definition – Laws of Returns: Increasing, Constant and Decreasing Returns – Classical production function and Three stages of production – Elasticity of production –Types / Forms of Production functions – Linear, Cobb–Douglas and Quadratic – Cost Concepts and Cost curves: Total, Average and Marginal Costs – Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum.

**Unit 3: Factor – Factor Relationship**

Factor – Factor relationship: Meaning - Isoquant: Definition and Types, Isoquant map – Marginal Rate of Technical Substitution – Factor Intensity – Isocline – Ridge Line – Returns to Scale – Elasticity of Factor Substitution – Isocost line – Principle of Factor Substitution and Least Cost Combination of inputs – Expansion Path – Effect of input price changes on the least cost combination.

**Unit 4: Product – Product Relationship**

Product – Product relationship: Meaning – Production Possibility Curve – Marginal Rate of Product Transformation – Enterprise relationship: Joint Products, Complementary, Supplementary and Competitive Products – Isorevenue line – Optimum Combination of Products – Principle of Equi–Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle.

**Unit 5: Farm Planning and Budgeting**

Farm Planning: Importance – Characteristics of good Farm Plan – Farm planning procedure – Budgeting: Definition and Types: Partial budgeting, Enterprise budgeting, Complete budgeting and Cash flow budgeting – Limitations of budgeting – Linear Programming: Assumptions – Linear Programming Model: Definition, Graphical solution, Advantages and Limitations – Risk and Uncertainty: Definition – Types of Risk and Uncertainty – Safeguards against Risk and Uncertainty.

**Practical**

Problems on Factor – Product relationship – Determination of Least Cost Combination – Determination of Optimum Product Combination – Computation of cost concepts – Cost of cultivation and Cost of production of agricultural crops, horticultural and livestock products –

Depreciation: Methods of calculation of depreciation – Farm records and accounts: Analysis of farm records and accounts – Farm inventory analysis – Cash Flow statement - Net Worth statement – Profit and Loss statement – Break – even analysis – Preparation of Complete and Partial budgets – Preparation of farm plan – Graphical solution to Linear Programming problem.

**Theory Schedule**

1. Production Economics: Meaning, Definition, Nature and Scope – Farm Management: Definition and Objectives of Farm Management – Production Economics Vs. Farm Management.
2. Farm Management Decisions: Decision making process – Scope of farm management.
3. Types and Systems of farming, Types of farming: Specialized, Diversified and Mixed – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co–operative Farming.
4. Factor – Product relationship: Meaning – Agricultural Production Function: Meaning and Definition – Laws of Returns: Increasing, Constant and Decreasing Returns.
5. Classical Production Function and Three stages of production – Elasticity of Production.
6. Types / Forms of Production Functions – Linear, Cobb–Douglas and Quadratic Functions.
7. Cost concepts and Cost curves: Total, Average and Marginal Cost Concepts and Curves - Economies of Size and Minimum Loss principle.
8. Determination of Optimum Input and Output: Input Approach and Output Approach – Physical and Economic Optimum.
9. **Mid Semester Examination**
10. Factor – Factor relationship: Meaning – Isoquant: Definition and Types – Isoquant map – Marginal Rate of Technical Substitution – Factor Intensity – Isoclines – Ridge Line.
11. Returns to Scale and Economies of Scale – Elasticity of Factor Substitution– Isocost line - Principle of Factor Substitution and Least Cost Combination of Inputs – Expansion Path - Effect of input price changes on the least cost combination.
12. Product – Product relationship: Meaning – Production Possibility Curve – Marginal Rate of Product Transformation – Enterprise relationship and Types of Products: Joint Products, Complementary, Supplementary and Competitive Products – Isorevenue line – Optimum Combination of Products.
13. Principle of Equi–Marginal Returns – Principle of Opportunity Cost.
14. Farm Planning: Importance – Characteristics of good Farm Plan – farm planning procedure
15. Budgeting: Definition and Types – Partial budgeting, Enterprise budgeting, Complete budgeting and Cash flow budgeting – Limitations of budgeting.
16. Linear Programming: Assumptions – Linear Programming Model: Definition – Advantages and Limitations.
17. Risk and Uncertainty: Definition – Types of Risk and Uncertainty – Safe guards against Risk and Uncertainty.

**Practical Schedule**

1. Estimation of Optimum Input – Output combination.
2. Determination of Least–Cost Combination.
3. Determination of Optimum Product combination.
4. Cost of Cultivation and Cost of production of agricultural crops.
5. Cost of Cultivation and Cost of production of perennial crops / horticultural crops.
6. Cost of production of livestock products.

7. Farm Records and Accounts: Usefulness, types of farm records: farm production records and farm financial records.
8. Visit to a private agricultural farm to collect information on farm business.
9. Depreciation: Methods of calculating depreciation.
10. Computation of Cost concepts – Farm inventory analysis: Valuation of assets by different methods.
11. Preparation of Cash flow statement.
12. Preparation and Analysis of Net worth Statement and Profit and Loss statement.
13. Estimation of Break–even analysis.
14. Preparation of Complete Budget and Partial Budgets.
15. Preparation of Farm Plan.
16. Graphical solution to Linear Programming problem.
17. **Final Practical Examination.**

**References**


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

**17 SAC 201 SOIL RESOURCE INVENTORY 1+1**

**Aim:**

To impart proficiency to the students in exploring the problems and potentials of soil and water so as to decide the most appropriate land and water use.

Syllabus - Theory

**Unit-I - Concepts of soil survey**

Soil resource inventory - Early and modern concepts - Standard soil survey - Scope and objectives - Soil systematics - Soil mapping units - Methods and types of soil survey - Soil maps.

**Unit-II - Soil taxonomy**

Soil Classification - Earlier and genetic systems - Modern Soil Taxonomy - USDA System - Salient features, structure - Diagnostic horizons - Differentiating characteristics - Soil orders - Characteristics and distribution - Soils of India and Tamil Nadu.

**Unit-III - Soil Survey Interpretations and Land Use Planning**

Soil survey reports - Soil Survey Interpretations - Land Capability Classification - Soil and Land Irrigability Classification - Storie's Index Rating - Productivity potential - Fertility Capability Classification- Land suitability for field crops, horticultural crops and forest trees - Land Use Planning concepts and objectives.

**Unit-IV- Soil constraints**

Problem soils - physical and chemical constraints - Slow permeable, Excessively permeable, surface crusting, sub surface hard pan and fluffy paddy soils - Acid soils, Acid sulphate soils, ill drained and Aeolian soils and salt affected soils - Genesis, characteristics, effects on plant growth and management - Reclamation of problem soils .Polluted soils and their management.

**Unit-V- Irrigation water quality and use**

Quality of irrigation water - Criteria used for assessing the quality of irrigation water - Water quality appraisal - Effect of poor quality water on soil and crop growth.

**Practical**

Morphological study of soil profile - Study of base maps, aerial photographs and satellite imagery -Interpretation of soil survey data and maps. Nomenclature of soils-Estimation of CEC, exchangeable cations and ESP. Analysis of problem soils - Lime requirement of acid soil — Gypsum requirement of sodic soils. Analysis of irrigation waters - pH, EC, TSS , anions and cations - Quality appraisal of irrigation waters and computation of salts. Field visit to problem soil area.

**Lecture Schedule**

1. Early and modern concepts of soil resource inventory, Concepts of Standard Soil Survey, its scope and objectives
2. Soil systematics - Characteristics of genetic horizons, subordinate distinctions, pedon, polypedon and control section, Soil mapping units - Soil series, soil association, soil complex, variants, inclusions and miscellaneous land types.

3. Method and types of soil survey - Free and grid survey, Reconnaissance, Detailed, Semi detailed, Exploratory and Rapid reconnaissance survey
4. Soil classification - Purpose, early, genetic and modern systems of classification - USDA Soil taxonomy - Structure and differentiating characters - Appreciation and Criticism.
5. USDA Soil taxonomy – Epipedons and Endopedons
6. Diagnostic organic materials, diagnostic soil characteristics - Soil moisture and Temperature regimes.
7. Soil orders - Characteristics and distribution in world , Soils of India and Tamil Nadu
8. Soil maps, kinds of soil maps and their preparation
9. Midsemester Examination
10. Soil survey report preparation and interpretation
11. Land Evaluation - Land Capability Classification (LCC)- Fertility Capability Classification (FCC) Soil and Land Irrigability Classification, Storie's Index Rating and Productivity potential - Land Suitability Classification
12. Land Use Planning - Concepts and objectives - Tropical, subtropical and Temperate regions.
13. Soil physical constraints - slow permeable, excessively permeable soils, Soil crusting, sub soil hard pan, fluffy paddy soil, shallow soil - Characteristics and management
14. Acid soil and Acid sulphate soils - Genesis and characteristics. Lime requirement of acid soil, liming materials and reclamation / management of acid soil
15. Genesis and classification of salt affected soils - Effect of salts on plant growth, Saline soil, sodic and saline sodic soil - characteristics and their management
16. Aeolian , ill drained and polluted soils- Characteristics and their management
17. Quality of irrigation waters - quality criteria and appraisal- USSL and other systems-- Effect of poor quality water on soil health, crop growth and management.

**Practical schedule**

1. Profile description
2. Estimation of CEC in soil- Part-I
3. Estimation of CEC in soil- Part-II
4. Estimation of Exchangeable cations and working out ESP
5. Estimation of lime requirement of acid soil
6. Estimation of gypsum requirement of sodic soil
7. Nomenclature of soil as per Soil Taxonomy
8. Land suitability for field crops, horticultural crops and forest trees
9. Estimation of pH, EC, TSS and chloride in irrigation water
10. Estimation of carbonate and bicarbonate in irrigation water
11. Estimation of sulphate in irrigation water by turbidimetry
12. Estimation of calcium and magnesium in irrigation water
13. Estimation of sodium and potassium in irrigation water
14. Classification of irrigation waters as per USSL and other systems
15. Computation of salts in irrigation water
16. Field visit to problem soils area
17. Practical Examination

**Text Books**

1. Sehgal,J. 2005. A Text Book of Pedology Concepts and Application, Kalyani Publishers, New Delhi

2. Brady, N.C. and Weil, R.C.2012.The nature and properties of soils.14th Edn,Pearson Publication
3. Soil Survey Staff, 2003. Keys to soil taxonomy, USDA, NRCS publication
4. Jean Paul Legros, 2013.Major soil groups of the world, Ecology, Genesis, Properties and Classification, CRC Press, Taylor and Francis, Florida
5. David Wynne Thorne and Howard Boyd Peterson, 2010. Irrigated soils, their fertility and Management, 2nd Edn in India, biotech Books, New Delhi
6. Richards, L.A,.1954, USDA hand book No.60, U.S.dept. of Agriculture
7. Thorne, D.W. and Peterson,H.B. 2010. Irrigated soils, their fertility and Management, 2nd Edn in India, biotech Books, New Delhi
8. Somani, L.L.1991.Crop production with saline water, Agro Botanical Publishers, Bikaner

**References**

1. Boul, S.W., R.J. Southard, R.C.Graham and P.A.McDaniel. 2005. Soil genesis and classification. 5th Ed. Iowa State University Press, Ames, IA.
2. Eswaran, H., T.Rice, R.Ahrens and B.A.Stewart (Eds.) 2003. Soil classification: A global desk reference. CRC Press, Boca Raton, FL. *f-\ 7.* FAO, 2004. Soil salinity assessment. Scientific Publishers.
3. Field Book for Describing and Sampling Soils (Version 3.0). 2012. National Soil Survey Center, Natural Resources Conservation Service and U.S.Department of Agriculture.
4. Gupta, S.K. and I.C. Gupta 2014. Salt affected soils : Reclamation and Management. Scientific Publishers.
5. Gupta, I.C., N.C.S. Yaduvanshi and S.K.Gupta. 2012. Standard Methods for Analysis of soil, plant and water. Scientific Publishers.
6. Sehgal, J. 2005. Pedology concepts and applications, Kalyani Publishers, New Delhi.
7. Richards, L.A. 2012. Diagnosis and improvement of saline and alkali soils. Scientific Publishers
8. Sanchez, P.A., C.A. Palm and S.W.Boul. 2003. Fertility Capability soil classification: A tool to help assess soil quality in the tropics. Geoderma. 114:157-185.
9. Soil Survey Division Staff 1999. Soil Survey Manual, United States Department of Agriculture. Handbook 18. Soil Conservation Service.
10. Soil Survey Staff. 2006. Keys to Soil Taxonomy. United States Department of Agriculture, Natural Resources Conservation Service.
11. Somani, L.L. and K.L.Totawat 1993. Management of Salt Affected Soils and Water.
12. Sree Ramulu, U.S. 2003. Principles in the quantitative analysis of waters, fertilizers, plants and soil. Scientific Publishers.
13. Subramanian.S., G.V. Kothandaraman, S. Natarajan, and P.P. Ramaswami. 1987. Soil Survey and Land Use Planning for Watershed Management. Directorate of Soil and Crop Management Studies, Tamil Nadu Agricultural University, Coimbatore - 641 003.
14. USDA 1954. Diagnosis and improvements of Saline and alkali soils. (Ed) L.A.Richards. Handbook No.60. USDA Washington DC.

**e-references**

1. ftp://ftp-fc.sc.egov.usda.gov/NSSC/NCSS/Conferences/scanned/
2. ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab References/SSIR 51.pdf
3. tp://ftp-fc.sc.egov.usda.gov/NSSC/Lab_References/SSIR 51 .pdf
4. www.iuss.org/Bulletins/00000096.pdf

5. www.oosa.unvienna.org/pdf/sap/centres/rscurrE.pdf-
6. www.csre.iitb.ac.in/~dd/detail.html
7. www.dvsinstitute.org/forms/pg/M.Sc.%20-%20RS%20&%20GIS-350.pdf
8. inkinghub.elsevier.com/retrieve/pii/S0166248197800335
9. www.scribd.com/doc/40246764/Description-Pedon-Copy-
10. www.angrau.net/BSc(Aq)CourseCurriculum.htm
11. ww.SDringerlink.com/index/BJGOOEL8FLNTFUNL.pdf
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13. inkinghub.elsevier.com/retrieve/pii/S0166248197800335
14. www.springerlink.com/index/R177R744722222UN.pdf-Similar
15. content.alterra.wur.nl/lnternet/webdoc$/ilri-publicaties/.../Bib10.pdf
16. www-wds.worldbank.org/external/.../INDEX/multi_..page.txt-Cached
17. http://www-ds.worldbank.orq/external/default/WDSContentServer/ WDSP/IB/1999/09/14/000094946 990617055 13766/Rendered/INDEX/multi_page.txt
18. openaccess.icrisat.org/.../Proceedings-integrated-watershed-management-for-land-Asia.pdf
19. www.springerlink.corn/inde)(/ilu87tk58363.pdf
20. www.buc.edu.in/sde_book/msc_soil.pdf

**Outcome:**

The students will gain a comprehensive knowledge and skills in assessing land suitability for various agricultural and non-agricultural uses. Further, the knowledge and skill gained in this course can be applied by the students in solving / managing the soil related problems and poor quality irrigation waters.

**17 AGR 202 STUDY TOUR (NON-GRADIAL; COMPULSORY COURSE) (0+1)**

The students will undertake the short tour during fourth semester for ten days covering all important KVK's, TNAU campuses, TNAU Research stations and ICAR institutes in 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 | 17 PBG 201 | Fundamentals of Genetics | 2+1 |
| 2 | 17 AEX 201 | Communication Skills and Personality Development | 1+1 |
| 3 | 17 STA 211 | Statistical Methods | 1+1 |
| 4 | 17 PAT 202 | Principles of integrated plant disease management | 1+1 |
| 5 | 17 AEN 202 | Management of beneficial and harmful insects | 2+1 |
| 6 | 17 AGR 203 | Crop Production Technology – II (*Rabi* crops) | 1+1 |
| 7 | 17 AGR 204 | Farming System & Sustainable Agriculture | 1+1 |
| 8 | 17 SAC 202 | Problematic soils and their management | 2+0 |
| 9 | 17 HOR 212 | Production Technology for Ornamental Crops, MAP and Landscaping | 1+1 |
| 10 | 17 ANM 201 | Introductory Nematology | 1+1 |
| 11 | 17 NST 201 | Fundamentals and Applications of nanotechnology | 1+0 |
| 12 | 17 ERG 211 | Renewable Energy and green technology | 1+1 |
| | | **Total** | **14+10=24** |

## 17 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, Bchromosomes, 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 Punnet. 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 Monad – Lac and Trp operons.Cistron,muton and recon.Mutation – characteristics of mutation – micro and macro mutation – ClB 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 F2 data – Drawing of genetic map – interference and coincidence.Studies on sex linked inheritance in Humans and Drosophila

**Theory schedule**

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics.
2. Physical basis of heredity: Structure and function of cell and cell organelles –
3. Differences between Prokaryotes and Eukaryotes.Cell division – mitosis
4. Cell division - meiosis and their significance
5. Gametogenesis and syngamy in Plants- identical and fraternal twins
6. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram

7. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, Bchromosomes, ring and isochromosomes.
8. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications.
9. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome;
10. Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, *Brassica*
11. 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.
12. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
13. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.
14. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance,threshold characters
15. 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)
16. ii.) Recessive epistasis(9:3:4) iii.) Duplicate and additive epistasis(9:6:1). iv.) Duplicate dominant epistasis(15:1)
17. **Mid Semester Examination**
18. v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i)to (vi).
19. Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.
20. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.
21. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers;
22. Linkage - coupling and repulsion; Experiment on Bateson and Punnet
23. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.
24. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
25. Strength of linkage and recombination; Two point and three point test cross.
26. Double cross over, interference and coincidence; genetic map, physical map.
27. 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.
28. Genic balance theory of Bridges - Gynandromorphs
29. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders

30. 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
31. 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.
32. 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
33. Regulation of gene expression – Operon model of Jacob and Monad – Lac and Trp operons. Cistron,muton and recon.
34. Mutation – characteristics of mutation – micro and macro mutation – ClB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

**Practical Schedule**

1. Use of microscopes
2. Principles of killing and fixing; preparation of stains and preservatives.
3. Study of behavior of chromosomes in mitosis.
4. Study of mitotic phases in root tips of onion / *Aloe sp*.
5. Procedure for fixing and observing different meiotic phases in the inflorescence of rice, maize
6. Procedure for fixing and observing different meiotic phases in the inflorescence in pearl millet, sorghum
7. Repetition of meiotic studies in maize/ sorghum/ pearl millet and making temporary and permanent slides.
8. 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.
9. Dihybrid ratio with dominance, with incomplete dominance and test cross
10. Simple interaction of genes-comb character in fowls; Dominant epistasis.
11. Recessive epistasis, Duplicateand additive epistasis.
12. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
13. Multiple alleles and polygenic inheritance
14. Estimation of linkage with F2 and test cross data; Coupling and repulsion.
15. Problems on three point test cross; Working out interference, coincidence and drawing genetic maps.
16. Studies on sex linked inheritance in Humans and Drosophila
17. **Final Practical examination.**

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1. Gupta P.K., 1997. Cytogenetics. Rastogi Publications, Meerut
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and Plant Breeding. Popular Book Depot, Chennai –15.
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**E- References**

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2. www.biology200.gsu.edu

## 17 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

1. Communication – meaning and process –Functions and Types of communication
2. 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
3. Verbal and Non verbal communication – Verbal communication – definition and meaning – Verbal vs Oral communication – Types – Styles - Barriers to effective verbal communication ;
4. Non verbal communication – definition and meaning – Proxemics, Chronemics, Movement and body position, Posture, Facial Expression, Gestures and Eye Contact – importance of non verbal communication
5. Listening – Definition – Listening vs Hearing – Active listening – Types of listening – Guidelines for effective listening – Developing listening skills - Barriers to listening – Listening misconceptions

6. 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
7. 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
8. Field diary – Definition – Components to be included – Parts of field diary – Field diary in social sciences
1. Lab record : Definition –Importance of keeping a lab record - Features of a lab record - Contents of lab record – Guidelines for keeping a lab record
2. **Mid semester examination**
3. Indexing – Definition – Importance – Types of indexing with advantages and limitations
4. 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)
5. 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
6. Precise writing – Derivation and Meaning – Skills required – Method or procedure – Guidelines; Summarising – Meaning- Steps to write a summary
7. Abstracting : Definition - Purpose of abstract – Types of abstract - Abstract Styles – Steps for Writing Effective Abstracts- Some Do's Don'ts in preparing abstracts
8. Individual presentation - Meaning –Steps for individual presentation; Group presentation – Meaning – Stages of group presentation ; Impromptu presentation
9. 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**

1. Practicing active listening
2. Exercise on note taking methods
3. Exercise on technical writing and practicing proof correction
4. Practicing oral presentation
5. Exercise on writing field diary and Lab record
6. Visit to library and learn indexing
7. Exercise on preparing foot notes and citations
8. Practice on effective reading skills
9. Comprehension of technical article
10. Comprehension of general article

11. Exercise on precise writing
12. Practice on summarizing articles
13. Practice on preparing abstracts

14&15 Developing skill on individual presentation

16. Developing skill on group presentation
17. **Practical Examination**

**Referecnce**

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

2. Sagar Mondal. 2016. Agricultural extension , Kalyani publishers

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

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

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

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

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

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

**Referecnce**

1. www.managementstudyguide.com
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3. www.mindtools.com

## 17 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 x n contingency table – 2 x 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**

1. 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.
2. Measures of Central Tendency – meaning – limitations – properties – mean, median mode geometric mean and harmonic mean for ungrouped and grouped data.
3. 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.
4. Probability – basic concepts – axioms – mathematical and statistical probabilities – additive and multiplicative laws (without proof). Theoretical discrete distributions – Binomial and Poisson distribution and its applications.
5. Theoretical continuous distribution – Normal distribution and its properties and importance – standard normal distribution.
6. Sampling theory – population – sample – sampling vs complete enumeration – parameter and statistic – need for sampling – sampling distribution – standard error.
7. Sampling methods – probability sampling method – simple random sampling – Selection using random number tables and lottery method.
8. Tests of significance – basic concepts – null and alternative hypotheses – critical region – level of significance – degrees of freedom.
9. **Mid Semester Examination**

10 Large sample test – single proportion and difference between two proportions – single mean and difference between two means
11. Small sample tests – F-test – t-test for testing the significance of single mean independent t test and paired t test
12. 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
13. Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties.
14. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.
15. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – randomization, replication and local control.
16. Completely Randomized Design (CRD) – Randomized Block Design (RBD).
17. Latin Square Design (LSD).

**Practical schedule**

1. Construction of frequency distribution tables.
2. Diagrammatic representation – simple, multiple, component and percentage bar diagrams, pie diagram. Graphical representation – frequency polygon, frequency curve and histogram.
3. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode for ungrouped and grouped data.
4. Computation of range, standard deviation, variance, coefficient of variation for ungrouped and grouped data. Computation skewness and kurtosis for ungrouped and grouped data.
5. Simple problems in Binomial distribution and Poisson distribution.
6. Simple problems in Normal distribution.
7. Selection of simple random sample using simple random sampling method.
8. Large sample test – test for single proportion and difference between two proportions.
9. Large sample test – test for single mean and difference between two means.
10. Small samples test – t-test for single mean – independent t test for difference between two sample means (equal variances only) – Paired t-test.
11. Chi square test for goodness of fit – Chi square test for testing the association of attributes.
12. Computation of Karl Pearson's correlation coefficient.
13. Fitting of simple linear regression equation y on x.
14. One way ANOVA – analysis of experimental data using Completely Randomised Design (CRD) (for equal replications only).
15. Two way ANOVA – analysis of experimental data using Randomised Block Design (RBD).
16. Analysis of experimental data using Latin Square Design (LSD).
17. **Final Practical Examination**

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2. K.P. Dhamu and K. Ramamoorthy, 2007, Statistical Methods, Agrobios (India), Jodhpur.
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3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 2003, Sultan Chand and Sons, New Delhi.
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6. http://davidmlane.com/hyperstat/
7. http://www.stattrek.com/
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9. http://www.stat-help.com/
10. www.statsci.org/jourlist.html

## 17 PAT 202 Principles of Integrated 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 - 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- Pest risk analysis.

### 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, Biotechnological approaches and IPM module

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. Implementation and impact of IPM. IPM module for Soil borne, air borne, Seed borne and vector borne plant 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 asperellum*, *Pseudomons 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**

1. Plant diseases – abiotic , biotic diseases, classification based on mode of infection, multiplication of inoculum , spread, symptoms, occurrence & distribution
2. Epidemiology – disease triangle/ disease Pyramid - role of weather factors in plant disease development. Boom and bust cycle in disease outbreak
3. Disease surveillance –different methods- surveillance report-disease surveillance programme in Tamil Nadu.
4. Assessment of plant diseases- different methods- measurement of disease growth rate by Area Under Disease Progressive Curve (AUDPC)
5. Forecasting of plant diseases- forecasting models in plant disease management
6. Diagnosis of plant diseases-seed health tests, chemodiagnosis, serodiagnosis and molecular diagnosis
7. Avoidance and Exclusion- plant quarantine – domestic, international and embargo - phytosanitary certificate- Quarantine in India. Post entry quarantine in India. Exotic diseases introduced into India
8. Eradication: Role of cultural practices in plant disease management- different methods of eradication of plant diseases
9. **Mid semester examination**
10. Protection –physical methods of protection- chemical fungicides – ideal characters-formulations and adjuvants- safety measures to be followed while handling fungicides
11. Sulphur and copper fungicides,- classification -phytotoxicity, mode of action and uses
12. Mercury fungicides, Heterocyclic nitrogen compounds , Organo tin, Quinone, Benzene and Miscellaneous compounds , mode of action and uses
13. Systemic fungicides including antibiotics – classification – mode of action - uses.
    New generation fungicides, plant activators/ SAR inducing chemicals in plant disease management. Methods of application of fungicides: seed treatment, foliar spray, soil drenching and special methods of application.
14. Biological control – definition - mechanism of action – mass production of *Trichoderma asperellum* , *Pseudomonas fluorescens* & *Bacillus subtilis* - methods of application - plant products – antiviral principles – preparation – methods of application
15. Disease resistance- types- resistant varieties. methods of developing resistant varieties- Mechanisms of resistance- structural and bio chemical resistance in plants- cross protection
16. Biotechnological approaches in plant diseases management: Tissue culture techniques-meristem tip culture, somoclonal variation and transgenic plant production by genetic engineering.
17. IPM module for soil borne , Airborne , Seed borne and vector borne plant diseases

**Practical Schedule**

1. Survey and assessment of important plant diseases
2. Diagnosis of plant diseases: Tetrazolium test, Iodine test , ELISA test and ooze test, paraquat test
3. Seed health tests for diagnosis of seed borne pathogens - dry seed examination, seed washing, blotter tests

4. Classification and grouping of fungicides.
5. Preparation of Bordeaux mixture (1%) and Bordeaux paste (10%)
6. Calculation of spray fluid and methods of application of fungicides – seed (wet and dry) soil, foliar and post harvest dipping
7. Special methods of application: swabbing, acid delinting, pseudostem injection, capsule application
8. Special methods of application: corm injection, paring and prolinage, root feeding and trunk injection.
9. *In vitro* assay of fungicides against fungal pathogens
10. *In vitro* assay of biocontrol agents and their compatibility with agrochemicals
11. *Trichoderma viride* -mass production and methods of application
12. *Pseudomons fluorescens* and *Bacillus subtilis* -mass production & methods of application
13. Visit to commercial biocontrol production unit /seed and pesticide testing laboratories
14. Preparation of leaf extracts, oil emulsion of neem and antiviral principles.
15. Cross protection: production of pre immunized citrus seedlings against tristeza virus.
16. Tissue culture – Production of virus free plants through meristem tip culture technique.
17. Practical Examination

***Reference Books***


1. Arjunan.G. Karthikeyan, G, Dinakaran ,D. Raguchander,T. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
2. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi
3. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K.Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.


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## 17 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, moultinism, 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 limitaitons
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

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## 17 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 - 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:**

1. Wheat- Origin, geographic distribution, economic importance, soil and climatic requirement,
2. Wheat - varieties, cultural practices and yield.
3. Barley and oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
4. Chickpea- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
5. Lentil and peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
6. Peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

7. Rapeseed and Mustard - Origin, geographic distribution, economic importance, Classification , soil and climatic requirement, varieties
8. Rapeseed and mustard - cultural practices, yield.
9. **Mid semester examination**
10. Sunflower- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
11. Sugarcane - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties,
12. Sugarcane - cultural practices and yield.
13. Sugarcane- package of practices for SSI
14. Sugarcane - Crop logging, maturity and ripening
15. Sugarcane - Gur manufacture , Value addition and byproduct utilization.
16. Berseem and Lucerne - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
17. Fodder maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

**Practical Schedule:**

1. Identification of rabi crops and recording their importance in the crop cafeteria.
2. Acquiring skill in field preparation, sowing and manuring of rabi crops under pure and intercropping situations.
3. Acquiring skill in different seed treatment techniques and foliar nutrition of rabi crops.
4. Estimation of plant population per unit area for rabi crops.
5. Nursery preparation for Sugarcane.
6. Acquiring skill in after - cultivation practices in sugarcane - detrashing, and Propping.
7. Study on growth parameters of sugarcane.
8. Study on yield parameters and estimation of yield in sugarcane.
9. Study on yield parameters and estimation of yield in rabi crops.
10. Estimating Cost and returns of important rabi crops.
11. Visit to Sugarcane Breeding Institute/ Research Station to study cultivation of sugarcane and its by products.
12. Visit to - nearby sugar mill, for observing juice extraction, quality assessment, sugar manufacture and by products.
13. Silage making.
14. Practicing field preparation and sowing Lucerne.
15. Practicing field preparation and sowing for fodder maize.
16. Visit to Wheat research station, Wellington to study rabi crops – wheat, barley, rye, oats.
17. **Practical Examination.**

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1. 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
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4. Crop production guide.2012. Directorate of Agriculture, Chennai
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## 17 AGR 204 Farming System and Sustainable Agriculture (1+1)

**Theory :**

**Unit - I: Cropping System**

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

1. Cropping system: Definition, Principles and basic concepts.
2. 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.

4. Complementary and competitive interaction in different cropping system - light, nutrient, water and weed.
5. Cropping system management: agronomic requirement for crops and cropping system selection of crops and varieties, tillage and land shaping, plant population and crop geometry.
6. Cropping system management: agronomic requirement for crops and cropping system - water management, soil fertility management and plant protection.
7. Indices for evaluation of cropping system - land use, yield advantage and economics.
8. Farming system: definition, principles and concepts and factors influencing choice and size of enterprises
9. **Mid Semester Examination.**
10. Scope and advantages of integrated farming system.
11. Allied enterprises for wetland, irrigated upland and dryland - selection and management and their interaction.
12. Resource recycling in integrated farming system.
13. Integrated Farming System evaluation indicators.
14. Integrated farming system - models for wetland, irrigated upland and dryland eco system.
15. LEISA and HEIA - principles and concepts and Labour management in integrated farming system.
16. Conservation agriculture and environmental impact of integrated farming system.
17. Cost reduction technologies and non monetary inputs in integrated farming system.

**Practical Schedule:**

1. Visit to cropping system experiments in wetland.
2. Visit to cropping system experiments in irrigated upland and dryland.
3. Preparation of cropping scheme for wetland and working out input requirement.
4. Preparation of cropping scheme for irrigated upland and working out input requirement.
5. Calendar of operations for wet land and irrigated upland cropping system.
6. Working out indices for evaluating the cropping system - land use, yield advantage.
7. Working out indices for evaluating the cropping system - Economics, sustainability.
8. Visit to dairy, goat and poultry units.
9. Visit to mushroom unit.
10. Visit to sericulture and biogas unit.
11. Preparation of integrated farming system models : wetland eco-system.
12. Preparation of integrated farming system models : irrigated upland and dryland eco systems.
13. Resource recycling in integrated farming system models of different eco systems.
14. Evaluation of integrated farming system models : wetland eco-system.
15. Evaluation of integrated farming system models : irrigated upland and dryland eco systems.
16. On-farm visit to cropping fields and integrated farming system units.
17. **Practical examination**.

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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


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## 17 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:**

1 Soil health - Definition - Soil Quality Indices – Physical indicators
2 Soil Quality Indices - Chemical and biological indicators
3 Distribution of waste lands and problem soils in India and Tamil Nadu
4 Categorization of waste lands based on properties
5 Soil physical constraints – slow permeable, excessively permeable soils and fluffy paddy soils - Characteristics and management
6 Soil crusting, soil compaction, sub soil hard pan, sand dunes and shallow soils – characteristics and management
7 Eroded soil – Genesis, types and characteristics: water- sheet, rill, gully, ravines, wind – Aeolian, loess, saltation, suspension , soil creep
7 Universal soil loss equation and erosion control measures
8 Flooded soils – Formation, characteristics and management
9 Acid soil and acid sulphate soil – Genesis and characteristics.
10 Lime requirement of acid soil, liming materials, reclamation and management of acid soil
11 Formation and classification of Saline, Sodic and saline sodic soils
12 Effects of Salts on soils- Physical: Clay swelling and Dispersion, permeability, Infiltration, Crust, Water transmission. Chemical: pH and EC. Biological : Microbial activity.
13 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.

14 Salts and plant mineral nutrition- Salinity and nutritional effects: Salinity and N, P, K, Ca, Mg, S, and Micronutrients. Alkalinity and nutritional effects.
15 Saline, Sodic, saline sodic, and degraded alkali soils- characteristics and their management
16 Saline soil-reclamation – Leaching requirement. Sodic soil – reclamation -gypsum requirement – calculations.
17 **Mid semester examination**
18 Polluted soils- industrial effluent s- Characteristics, reclamation and management
19 Polluted soils- mine spoils- Characteristics, reclamation and management
20 Irrigation water – quality and standards - EC, SAR, RSC, RSBC SSP, PSI and PS
21 Irrigation water – quality and standards -USDA system and specific ion toxicity-USSL system
22 Factors affecting suitability of irrigation water and Management of poor quality water in agriculture
23 Remote sensing and GIS in assessment of wastelands and problem soils
24 Remote sensing and GIS in monitoring and management of wastelands and problem soils
25 Multipurpose tree species for waste lands and problem soils
26 Bio remediation through MPTs of soils
27 MPTs - Nutrient cycling under waste lands and problem soils
28 Land capability and classification
29 Land suitability classification
30 Problematic soils under different Agro ecosystems- coastal salinity, inland salinity
31 Problematic soils under different Agro ecosystems- marshy, swampy soils, red sand dunes (Theri soils) Tsunami affected soils.
32 Agricultural Ecosystem services- Soil fertility improvement in problem soils
33 Potential of agro forestry systems in management of problem soils
34 Carbon sequestration and its role in problem soil management

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## 17 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, lilium 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**

1. Importance and scope of ornamental crops and landscaping.
2. Principles of landscaping
3. Landscape uses of trees, shrubs and climbers.
4. Production technology of cut rose under protected conditions
5. Production technology of gerbera and carnation under protected conditions
6. Production technology of lilium and orchids under protected conditions
7. Production technology of gladiolus and tuberose under open conditions
8. Production technology of chrysanthemum and marigold under open conditions
9. **Mid Semester Examination**.
10. Production technology of jasmine under open conditions.
11. Processing and value addition in ornamental crops.
12. Scope and Importance of medicinal & aromatic crops– current status - conservation methods
13. Periwinkle, Asparagus and Aloe - varieties –- soil and climate – propagation- sowing and planting, nutrient, water management – harvest and processing
14. Costus, Isabgol and Glory lily - Propagation- soil and climate – propagation and planting- standards - pollination-nutrient, irrigation management – harvest, yield and processing
15. Ocimum, Mint, Geranium - varieties – soil and climate- propagation - planting - nutrient, water management – harvest - distillation of essential oil
16. Citronella, Lemon grass, Palmarosa and Vetiver - varieties – soil and climate- propagation - planting

– nutrient- water and weed management – harvest- distillation of essential oil.

17. Processing and value addition in medicinal and aromatic plants.

**Practical schedule**

1. Identification, planting, care and maintenance of trees, shrubs and climbers used in garden
2. Identification of varieties in cut flowers under protected conditions.
3. Identification of varieties in flowers under open conditions.
4. Practices of nursery bed preparation, seed sowing in ornamental plants.

5. Training and pruning and intercultural operations in Ornamental plants
6. Planning and layout of garden.
7. Protected structures – care and maintenance.
8. Harvesting and post harvest handling of cut and loose flowers.
9. Identification of medicinal and aromatic plants –economic parts
10. Propagation techniques, planting, cultural operations in Periwinkle, Asparagus and Aloe.
11. Propagation techniques, planting, cultural operations in Costus, Isabgol and poppy.
12. Propagation techniques, planting, cultural operations in Ocimum, Mint, Geranium
13. Propagation techniques, planting, cultural operations in lemon grass, palmarosa, vetiver and citronella
14. Extraction and distillation of medicinal & Aromatic crops.
15. Visit to commercial floriculture and floral oil extraction units
16. Visit to commercial medicinal and aromatic crops field and extraction unit.

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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

## 17 ANM 201 INTRODUCTORY NEMATOLOGY (0+1)

### PRACTICAL

Usage and handling of microscopes (binocular, trinocular, zoom and compound microspores) -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) – Morpholoy of orders *Tylenchida* (*Hoplolaimus*), and *Dorylaimida* (*Xiphinema*) – Identification of important nematodes (*Tylenchorhynchus, Helicotylenchus, Pratylenchus, Hirschmanniella. Hemicriconemoides* / *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 – *Hemicriconemoides – 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.

## 17 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 Epitoxy – 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:**


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

## 17 ERG 211 RENEWABLE ENERGY AND GREEN TECHNOLOGY (1+1)

### 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- comparion 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 | **TB-1**: 101-105 |
| 13. | Solar thermal devices – solar water heater – solar cooker – solar pond – solar distillation – working principles and applications. | **TB-1**: 105-114<br>**TB-2**: 138-142, 195-197 |
| 14. | Solar PV systems – principle – solar lantern - water pumping applications. | **TB-1**: 117-123 |
| 15. | Solar driers – natural and forced convection types – solar tunnel drier – | **TB-1:** 115- |

| | | |
|---|---|---|
| | working principles and operation. | 117 |
| 16. | Wind mills – types – horizontal and vertical axis – components – working principles – applications. | **TB-1**: 136 - 144 |
| 17. | Energy from ocean, waves, tides. Geothermal energy sources – principles and operation. | **TB-1**: 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 No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 PBG 301 | Fundamentals of Plant Breeding | 2+1 |
| 2. | 17 AEC 301 | Agricultural Marketing, Trade and Prices | 2+1 |
| 3. | 17 AGM 301 | Soil and Applied Microbiology | 1+1 |
| 4. | 17 PAT 301 | Diseases of Horticultural Crops and their Management | 1+1 |
| 5. | 17 AEX 301 | Entrepreneurship Development and Business Communication | 1+1 |
| 6. | 17 AGR 301 | Practical Crop Production - 1 (Kharif Crops) | 0+2 |
| 7. | 17 HOR 311 | Post harvest management and value addition of fruits and vegetable crops | 1+1 |
| 8. | 17 SAC 301 | Manures, ferilizers and soil fertility management | 2+1 |
| 9. | 17 ABT 301 | Plant Biotechnology | 2+1 |
| 10. | 17 AGR 302 | Rainfed Agriculture and Watershed Management | 1+1 |
| 11. | 17 RES 301 | Research Methodology | 0+3 |
| | | **Total** | **13+14=27** |

**17 PBG 301 FUNDAMENTALS OF PLANT BREEDING 2+1**

**Aim** To expose the students to basic and applied principles of plant breeding

**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, Zhukovosky – law of homologous series. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation – agencies – quarantine. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations. Sterility – male sterility – classification – CMS, GMS, CGMS - inheritance and applications. TGMS, PGMS, Gametocides, Transgenic Male sterility and applications. Apomixis – introduction – classification - applications; Parthenocarpy and its types.

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

Basic biometrics - nature and significance of qualitative and quantitative variation - phenotypic, genotypic and environmental - 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 principle of progeny selection - Johannsen‘s pure line theory. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – merits and demerits – achievements; Mass selection in self pollinated crops – types – comparison of mass and pureline selection – achievements. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection — choice of parents – combining ability - combination breeding and transgressive breeding – kinds of emasculation. Pedigree breeding – mass pedigree – merits – demerits – achievements; Bulk breeding – merits – demerits – achievements. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – application – merits and demerits. Backcross breeding – prerequisites – procedures for transferring dominant and recessive genes – merits – demerits – multi lines and multi blends - population improvement approach in self-pollinated crops.

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

Genetic structure of a population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – unit selection – mass selection with progeny testing – half sib family selection – full sib family 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 – development of inbreds. Heterosis breeding – procedure – use of male-sterility systems and manual emasculation in hybrid seed production – maintenance of parental lines -types of hybrids – achievements – merits and demerits – hybrid variety – merits and demerits. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements; Chimeras and its types; Tree breeding – clonal orchards.

**Unit IV: Special breeding methods**

Polyploidy breeding – classification – induction of polyploidy – diploid x tetraploid and diploid x hexaploid crosses - achievements – limitations. Wide hybridization-history - importance-barriers and techniques for overcoming barriers-utilization. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations. Ideotype concept. Somaclonal variation - utilization in crop improvement; *In vitro* selection techniques – – Use of doubled haploids in crop improvement. Concept of biotic and abiotic stress resistance Breeding. Introduction to markers – morphological – biochemical- DNA markers – uses of marker assisted selection - major genes – merits – demerits – achievements.

**Unit V: Maintenance breeding**

Types of cultivars – procedure for release of new varieties – stages in seed multiplication – concept of seed certification and TC plants certification. Maintenance Breeding: General seed production techniques – steps in nucleus and breeder seed production – varietal rundown and renovation. Current trends in Plant Breeding: Marker assisted breeding , Transgenic crops. Concept of Plant Varietal protection, geographical indications and DUS.

**Practical**

Observation on pollination and reproduction in plants - Alternation of generation and life cycle. Description and drawing different pollination systems - Mechanisms enforcing self and cross pollination in crops; Pollen morphology - Exine structure of different crops. Assessment of pollen fertility and sterility in A, B, R and TGMS lines. Breeder kit and its components – uses; Basic steps of selfing and crossing techniques. Emasculation and pollination techniques in field crops and horticultural crops. Studies on segregating generation and maintenance of records. Maintenance of A, B and R line and TGMS lines - Hybrid seed production techniques. Estimation of heterosis. Induction of polyploidy using colchicines. Studies on different wild species in crop plants and wide hybridization. Irradiation - dosimetry - half life period - procedure for irradiation of seeds and planting materials. Chemical mutagenesis - molar solution preparation - procedure for chemical mutagenesis of seeds and planting materials. Germplasm preservation – conservation - records maintained in research stations. Calculation of PCV, GCV, heritability, genetic advance. Layout of different yield trials - Observing the experimental plots - nucleus and breeder seed production plots. Screening methods – laboratory and field – for biotic and abiotic stresses -marker assisted selection.

**Theory schedule**

1. Objectives and role of plant breeding - historical perspective – activities in Plant Breeding.
2. Centres of origin – contribution of Vavilov, Harlan, Zhukovosky – law of homologous series.

3. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation – agencies – quarantine.
4. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine.
5. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination.
6. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations.
7. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance and applications.
8. TGMS, PGMS, Gametocides, Transgenic Male sterility and applications.
9. Apomixis – introduction - classification-applications; Parthenocarpy and its types.
10. Basic biometrics-nature and significance of qualitative and quantitative variation-phenotypic, genotypic and environmental-heritability and genetic advance
11. Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits.
12. Genetic basis of self pollinated crops – Vilmorin principle of progeny selection - Johannsen's pure line theory.
13. Breeding methods for self pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection in self pollinated crops – procedure - types – comparison of mass and pureline selection – achievements.
14. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection – objectives types – choice of parents – combining ability - combination breeding and transgressive breeding – steps in hybridization - kinds of emasculation.
15. Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements.
16. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits.
17. **Mid Semester examination**
18. Backcross breeding – genetic principles – prerequisites – procedures for transferring dominant and recessive genes
19. Back cross breeding – merits – demerits – multi lines and multi blends - population improvement approach in self-pollinated crops.
20. Genetic structure of a population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement.
21. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – unit selection – mass selection with progeny testing – half sib family selection – full sib family selection.
22. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits.

23. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression – development of inbreds.
24. Heterosis breeding – procedure – use of male-sterility systems and manual emasculation in hybrid seed production – maintenance of parental lines -types of hybrids – achievements – merits and demerits – hybrid variety – merits and demerits.
25. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits
26. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements; Chimeras and its types; Tree breeding – clonal orchards.
27. Polyploidy breeding – classification – induction of polyploidy – diploid x tetraploid and diploid x hexaploid crosses - achievements – limitations.
28. Wide hybridization-history-importance-barriers and techniques for overcoming barriers-utilization
29. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations. Ideotype concept
30. Somaclonal variation - utilization in crop improvement; *In vitro* selection techniques — Use of doubled haploids in crop improvement. Concept of biotic and abiotic stress resistance Breeding
31. Introduction to markers – morphological – biochemical- DNA markers – uses of marker assisted selection - major genes – merits – demerits – achievements.
32. Types of cultivars – procedure for release of new varieties – stages in seed multiplication – concept of seed certification and TC plants certification.
33. Maintenance Breeding: General seed production techniques – steps in nucleus and breeder seed production – varietal rundown and renovation.
34. Current trends in Plant Breeding: Marker assisted breeding, Transgenic crops. Concept of Plant Varietal protection, geographical indications and DUS

**Final theory examination**

**Practical schedule**

1. Pollination and reproduction in plants - Alternation of generation and life cycle.
2. Description and drawing different pollination systems - Mechanisms enforcing self and cross pollination in crops; Pollen morphology - Exine structure of different crops. Fertility and sterility in A, B, R and TGMS lines.
3. Breeder kit and its components – uses; Basic steps of selfing and crossing techniques.
4. Emasculation and pollination techniques in field crops.
5. Emasculation and pollination techniques in horticultural crops.
6. Studies on segregating generation and maintenance of records.
7. Maintenance of A, B and R line and TGMS lines - Hybrid seed production techniques
8. Estimation of heterosis.
9. Induction of polyploidy using colchicine
10. Studies on different wild species in crop plants and wide hybridization.
11. Irradiation - dosimetry - half life period - procedure for irradiation of seeds and planting

materials. Chemical mutagenesis - molar solution preparation - procedure for chemical mutagenesis of seeds and planting materials.

12. Germplasm preservation – conservation - records maintained in research stations
13. Calculation of PCV, GCV, heritability, genetic advance
14. Layout of different yield trials - Observing the experimental plots - nucleus and breeder seed production plots.
15. Screening methods – laboratory and field – for biotic and abiotic stresses.
16. Procedure for marker assisted selection.
17. **Final Practical examination**

**OUTCOME**

The plant breeding methodologies and applications employed for self, cross and vegetatively propagated crops will be exposed.

**References**


- Singh, B.D. 2005. Plant breeding - Principles and methods. Kalyani Publishers, New Delhi.
- Allard, R. 1989. Principles of Plant breeding. John Wiley and Sons, New Delhi.
- D.N.Bharadwaj.2012. Breeding Field Crops. Agrobios (India), Jodhpur
- Chahal, G.S. and S.S.Gosal. 2002. Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches. Narosa Publishing House (India)


**Further Reading**


- Phundhan Singh. 2001. Essentials of plant breeding, Kalyani publishers, New Delhi.
- Daniel Sundararaj, G. Thulasidas and M. Stephen Dorairaj. 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot. Chennai – 15.
- Chopra, V. L., 1994. Plant breeding theory and practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi
- Sharma, J. R. 1994. Principles and practice of plant breeding. Tata McGraw-Hill publishing Co., New Delhi.
- Chaudhary, H. K. 1980. Elementary Principles of plant breeding. Oxford and IBH publication Co., New Delhi


**Web resources**

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

**17 AEC 301 AGRICULTURAL MARKETING, TRADE AND PRICES 2+1**

**Theory**

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets**;** demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; 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 & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel;number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions-CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

**Practical**

Plotting and study of demand and supply curves and calculation of elasticities**;** Study of relationship between market arrivals and prices of some selected commodities; Computation of

marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Application of principles of comparative advantage of international trade.

**Objective**

The aim of the course is to give exposure to the Under Graduate students on market concepts, marketing of agricultural commodities, intermediaries involved, domestic and export trade, risk in agricultural marketing, marketing institutions involved, price dynamics and the role of Government in regulation of markets.

**Theory**

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

Market and Marketing: Definitions, Components and Dimensions of a market - Agricultural Marketing: Definition, Scope and Subject matter - Classification of markets and Approaches to the study of marketing - Market functionaries and Market forces, Price Determination - Marketing of agricultural Vs manufactured goods - Producer surplus of agricultural commodities - Types: Marketable and Marketed surplus, importance, relationship between marketable and marketed surplus and factors affecting marketable surplus.

**Unit 2: Marketing Functions and SCP Paradigm**

Marketing Functions: Buying and Selling, Packaging and Transportation, Grading and 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.

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

Marketing Channels: Definition, Channels for different products and Factors affecting marketing channels - Marketing costs, Margins and Price Spread. Marketing efficiency: Meaning, Definition and Types. Market Integration: Definition and Types - Market Research: Steps in market research - Marketing of agricultural inputs and its channels - Role of

Government in promoting agricultural marketing viz., Regulated Markets, Co-operative Markets and Farmers‘ Markets - Problems in traditional marketing systems - Advantages of modern marketing system over traditional agricultural marketing system.

Marketing Institutions: Directorate of Marketing and Inspection – Grading and Quality Control - AGMARK – Market Intelligence - NAFED, TANFED, State Agricultural Marketing Boards, FCI, National Horticultural Board, NDDB and Commodity Boards - Legal measures for improving agricultural marketing: APMC Act.

**Unit 4: Trade in Agricultural Products**

International Trade - Free trade and Autarky - Theories of Trade: Absolute and Comparative Advantage - Status 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: Market Access, Domestic Support and ExportSubsidies - New EXIM policy of India – Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, NHB and Commodity boards.

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

Agricultural Prices: Price characteristics of agricultural products - 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: Speculation and Hedging and Forward and Futures trading – Role of Contract Farming in risk mitigation.

**Practical**

Preparation of farm survey schedule - Farmers' marketing practices - Farmers' Market - Regulated Market and its role in marketing of farm produce- Cooperative Marketing Society –- Estimation of marketed and marketable surplus- Identification of marketing channels - Price spread estimation for agricultural / horticultural products – Marketing efficiency – Market integration - Role of Food Corporation of India (FCI) / Civil Supplies Corporation in Marketing of Agricultural Produce - Central Warehousing Corporation (CWC) / State Warehousing

Corporation (SWC) and their role in storage of farm produce – AGMARK Laboratory / Grading institutions Farm input marketing - Commodity Boards - Export oriented units - Time Series Analysis of prices - Trend and Seasonal Variations, Cyclical and Irregular Variations – Index Numbers.

**Lecture Schedule**

1. Market and Marketing: Definition, Components and Dimensions - Agricultural Marketing: Definition, Scope and Subject matter - Classification of market and Approaches to the study of marketing - Functional, Institutional, Commodity and Behavioral system.
2. Market Functionaries and Market Forces - Price Determination - Marketing of agricultural Vs manufactured goods. Characteristics of agricultural and horticultural commodities in relation to marketing.
3. Producer Surplus of agricultural commodities: Definition and Types of producer surplus - Marketable and Marketed surplus: Importance and Relationship and Factors affecting marketable surplus.
4. Marketing Functions: Buying and Selling, Packaging and Transportation, Grading and Standardization, Market Finance, Storage and Warehousing, Processing and Value Addition and Risk Taking.
5. Market structure: SCP paradigm. Market Structure, Conduct and Performance – Definitions, Components and their dynamics - Market Structure and Price Determination.

6. Marketing Channels: Definition - Channels for different products - Marketing costs, Margins and Prices. Price spread – Factors affecting cost of marketing.
7. Marketing Efficiency: Types: Operational and Pricing - Market Integration - Vertical, Horizontal and Conglomeration - Market Research and Steps in market research.
8. Factor Market: Marketing of various agricultural inputs: seed, fertilizers, pesticides - Channel of distribution.
9. **Mid -Semester Examination**
10. Problems in traditional marketing systems - Advantages of modern marketing system over traditional system - Role of Government in promoting agricultural marketing viz., Regulated Markets, Cooperative Markets and Farmers Markets.
11. Marketing institutions: Directorate of Marketing and Inspection – Grading and Quality Control – AGMARK – Market Intelligence. NAFED and TANFED, State Agricultural Marketing Boards, FCI, National Horticultural Board, NDDB and Commodity Boards.
12. Legal measures for improving agricultural marketing - APMC Act.
13. International Trade: Free trade and Autarky Theories of trade: Absolute and Comparative advantage trade theories – Share of agricultural commodities in total trade - Major exports and imports of agricultural and Agri-allied commodities - Barriers to Trade: Tariff and non tariff barriers.
14. Trade policy instruments - Terms of trade - Institutions for promoting trade in agricultural commodities – National and International - GATT, UNCTAD and WTO - Free Trade Agreements - Agreement on Agriculture – Market Access, Domestic Support and Export Subsidy.
15. New EXIM Policy of India – Advantages of Agri. Export Zones, ITPO, Export promotion Councils, APEDA, MPEDA, NHB and Commodity boards.
16. Agricultural Prices: Function and Scope - Price characteristics of agricultural products – Price Policy and Price Stabilization – Role of CACP - Role of administered prices – MSP, SMP and SAP - Procurement of food grains - Buffer Stock.
17. Risk in marketing: Types of risk - Speculation and Hedging - Forward and Futures market - Role of Contract farming in risk management.

**Practical Schedule**

1. Preparation of farm survey schedule.
2. Visit to Farm to collect information on marketing practices of agricultural commodities and marketing problems.
3. Estimation of marketable and marketed surplus and study of marketing channels.
4. Price spread estimation for major agricultural and agri-allied products to assess the marketing efficiency.
5. Visit to weekly shandy / Farmers‘ market.
6. Visit to Regulated Market to study its role in marketing of farm produce.
7. Visit to Cooperative Marketing Society to study the services and marketing of farm produce.
8. Visit to Whole sale vegetable market / Commission mandy.
9. Estimation of Market Integration.
10. Visit to FCI / TNCSC.

11. CWC/ SWC and their role in storage of farm produce.
12. Visit to AGMARK Laboratory/Grading institutions.
13. Visit to farm input dealer to study marketing of farm inputs.
14. Visit to Commodity Boards / AEZ / Export oriented Units.
15. Time series analysis of prices - TCSI.
16. Index number-construction and uses.
17. **Practical Examination.**

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1. Acharya S.S. and N.L.Agarwal. 2002. Agricultural Marketing in India. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Acharya S.S. and N.L.Agarwal. 1994. Agricultural Prices - Analysis and Policy. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Kahlon A.S. and S.D.Tyagi, 2000. Agricultural Price Policy in India - Allied Publishers Pvt. Ltd. Bombay.
4. SakOnkvisit. John J.Shaw.1999. International Marketing Analysis and Strategy. Prentice Hall of India. New Delhi.
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**17 AGM 301 SOIL AND APPLIED MICROBIOLOGY 1+ 1**

**Aim**

- To enlighten the students with the knowledge of microbial diversity in soils
- To high lighten the role of soil microorganisms in soil fertility and plant growth promotion
- To develop experimental skills in soil microbiology which includes isolation of
- beneficial microorganisms from soil and plant and their mass production
- To make students gain expertise in practical aspects of production of industrial products

**Theory**

**Unit I Introduction to Soil Microbiology**

Soil Microbiology- definition and scope. Historical developments in soil microbiology. Diversity of soil microorganisms - culturable (bacteria, actinobacteria, yeasts, moulds and algae) and unculturable microorganisms - metagenomic approach - factors influencing the microbial diversity

**Unit II Microbial Processes in soil**

Organic matter decomposition and humus formation- C:N ratio.. Carbon cycle. Nitrogen cycle - biological nitrogen fixation (BNF) – nodulation and biochemistry of BNF. Phosphorus cycle and sulphur cycle. Microbial transformation of potassium, zinc and silica in soil – role of soil enzymes

**Unit III Soil Microorganisms and plants**

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

**Unit IV Microbial inoculants**

Bioinoculants – types of bioinoculants – nitrogen fixers, P, K, Zn and Si solubilizers and phosphate mobilizers, sulphur oxidizers and PPFM. BGA and Azolla. Mass production and quality control of bacterial and fungal bioinoculants. Methods of application of bioinoculants.

**Unit V Industrial Microbiology**

Industrial utilization of microorganisms - Alcohol fermentation – wine and beer. Antibiotics and vitamin production. Microbes in food industry – single cell protein, baker‘s and brewer‘s yeast and dairy products – cheese and yoghurt. Biofuels- ethanol and biodiesel.

**Practical**

Enumeration of soil microbial population - quantitative and qualitative methods. Organic matter decomposition. 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 and 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. Isolation

of Blue Green algae. Mass production of bacterial bioinoculants, blue green algae, azolla and AM fungi. Isolation of yeast and *Lactobacillus*. Industrial products – wine and sauerkraut fermentation.

**Theory schedule**

1. Introduction and historical developments in soil microbiology. Contributions of Beijerinck, Winogradsky, Fleming and Waksman
2. Diversity of soil microorganisms - culturable and unculturable microbial diversity. Factors influencing the activities of soil microorganisms
3. Carbon cycle – C:N ratio. Role of soil microorganisms in the decomposition of organic matter and humus formation
5. Nitrogen cycle – microbiology and biochemistry of mineralization, ammonification, nitrification and denitrification
6. Biological nitrogen fixation – free living, associative, endophytic and symbiotic microorganisms
7. Nodulation in *Rhizobium*- legume and *Frankia* – actinorhizal symbioses. Biochemistry of nitrogen fixation
8. Phosphorus cycle and microbial transformation of phosphorus - phosphate solubilizer and mycorrhizae
9. **Mid Semester Examination**
10. Sulphur cycle - sulphur oxidizers; microbial transformation of K, Zn and Si. Role of soil enzymes in nutrient transformation
11. Importance of soil and plant associated microorganisms – rhizosphere, spermosphere phyllosphere, epiphytic and endophytes
12. Soil microorganisms and their interactions – positive and negative interactions. Bioinoculants - types - bacterial, fungal (AMF) and algal bionoculants
13. Mass production of bioinoculants
14. Industrial utilization of microorganisms –alcohol fermentation – alcoholic beverages
15. Antibiotics production (Penicillin and Streptomycin) and Vitamin production (Vitamin B2 and Vitamin B12).
16. Microbes in food industry – Single Cell Protein, Baker‘s and Brewer‘s yeast, Dairy products – cheese and yoghurt
17. Biofuels – alcohol and biodiesel production

**Practical schedule**

1. Enumeration of soil microorganisms - quantitative Conn‘s direct microscopic method – qualitative buried slide technique
2. Enumeration of rhizosphere microorganisms and determination of R:S ratio
3. Studying organic matter decomposition by measurement of $CO_2$ evolution
4. Antibiosis in soil – Crowded plate technique
5. Isolation of *Rhizobium* from root nodules
6. Isolation of *Azospirilum* and *Azotobacter*

7. Isolation of *Gluconoacetobacter* from sugarcane
8. Isolation of phosphobacteria and PPFM
9. Isolation of PGPR (*Pseudomonas* sp)
10. Examination of AM infection in roots and recovery of spores from soil
11. Mass production of bacterial bioinoculants and AM fungi
12. Mass multiplication of blue green algae and *Azolla*
13. Methods of application of different bioinoculants
14. Isolation of yeast and *Lactobacillus*
15. Wine fermentation
16. Yoghurt and sauerkraut fermentation
17. **Practical Examination**

**Outcome**

- Students will be imparted with the knowledge of microorganisms in soil
- The contribution of soil microorganisms in soil fertility and plant growth promotion will be made clear
- Students will acquire experimental skills in Soil microbiology which includes isolation of beneficial microorganisms from soil and plant and their mass production
- Students will gain expertise in practical aspects of production of industrial products.

**Text Books**


1. Alexander, M. 1977. Soil Microbiology. John Wiley and Sons. New York
2. Waiter.M.J.,N.L.Morgan,J.S.Rocky and G.Higton.1999. Industrial Microbiology – An Introduction. Blackwell Scientific
3. e book: Paul , E .A. 2007. Soil Microbiology, Ecology and Biochemistry. 3rd Ed., Academic Press, USA
4. e book: Waksman, S. A 1952.Soil Microbiology John Wiley & Sons, Inc.


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


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## 17 PAT 301 DISEASES OF HORTICULTURAL CROPS AND THEIR MANAGEMENT (1+1)

**Theory**

**UNIT I Diseases of fruit crops**

Etiology, symptoms, mode of spread, survival and integrated management of important diseases due to fungi, bacteria, viruses, phytoplasma, phanerogamic parasites and non-parasitic causes of the following crops, viz**.,**

**Fruit Crops:** Mango, banana, citrus, grapes, guava, sapota, pomegranate, annona, papaya, jack, pineapple, ber, aonla, apple, pear, peach, plum.

**UNIT II Diseases of vegetable crops**

**Vegetable Crops:** Brinjal, tomato, bhendi, cucurbits, crucifers, beans, peas, potato, sweet potato, beet root, raddish, cassava, yam and colacasia

**UNIT III Diseases of spices and condiments**

**Spices and condiments:** chillies, cardamom, turmeric, ginger, Onion, garlic, pepper, betel vine, fenugreek, coriander, Clove, Nutmeg and Cinnamon

**UNIT IV Diseases of Plantation crops**

**Plantation crops:** Tea, coffee, cocoa, rubber, coconut, arecanut and vanilla.

**UNIT V Diseases of flower crops, medicinal plants and mushroom cultivation**

**Flower crops:** Jasmine, rose, crossandra, chrysanthemum,Tuberose, Carnation, Lillium and Marigold; **Medicinal plants**-Gloriosa, Stevia, Coleus, Aloe. **Mushroom cultivation:** Cultivation of oyster mushroom, Milky mushroom, button mushroom and Paddy straw mushroom.

**Theory Schedule**

Etiology, symptoms, Mode of spread, survival, Epidemiology and management of diseases of the following crops.

1. Mango
2. Banana
3. Citrus and Grapes
4. Guava, Sapota, Pomegranate, annona and jack.
5. Papaya, pineapple, ber, aonla.
6. Apple, pear, plum, peach.
7. Post harvest diseases – Apple, Mango, banana, citrus, grapes, papaya
8. Brinjal and bhendi
9. Tomato
10. Cucurbits,
11. Cabbage, cauliflower, radish and beetroot
12. Potato, Sweet potato, and Cassava
13. Yam , colacasia, bean and peas
14. Onion and Garlic.
15. Post harvest diseases – Tomato, potato, carrot, and onion
16. Chillies,
17. Mid semester examination
18. Pepper and Betelvine,

19. Fenugreek, cinnamon, nutmeg, clove and coriander
20. Turmeric and ginger.
21. Tea
22. Coffee.
23. Coconut and Areca nut
24. Rubber
25. Cocoa , vanilla and cardamom
26. Jasmine and rose.
27. Crossandra and chrysanthemum.
28. Marigold, carnation, lilium and tuberose
29. Medicinal plants – *Gloriosa*, *Stevia*,
*30. Coleus* and *Aloe*
31. Mushroom cultivation : *Agaricus*
32. Mushroom cultivation : *Pleurotus* and *Calocybe*
33. Mushroom cultivation : *Volvariella*
34. Biotic and abiotic stresses of mushroom

**PRACTICAL SCHEDULE**

Study of symptoms and host parasite relationship of:

1. Diseases of mango and banana.
2. Diseases of Citrus and Grapes.
3. Diseases of Guava, sapota, pomegranate, annona, jack, papaya, pineapple, ber and aonla.
4. Diseases of apple, pear, plum, peach.
5. Diseases of tomato and brinjal.
6. Diseases of cucurbits and crucifers.
7. Diseases of bean, peas and potato.
8. Diseases of cassava, sweet potato, yam and colacasia.
9. Diseases of onion, garlic , chillies, pepper and betel vine
10. Diseases of turmeric, ginger, cardamom, fenugreek, coriander, Clove, Nutmeg, and Cinnamon
11. Diseases of tea, coffee and rubber.
12. Diseases of coconut, arecanut and vanilla.
13. Diseases of rose, jasmine, crossandra and chrysanthemum, Tuberose, Marigold, Lillium and Carnation
14. Diseases of Medicinal Plants – Coleus , Gloriosa, Stevia and Aloe
15. Mushroom cultivation: *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella*
16. Field visit
17. Practical examination.

Note: Students should submit 50 well-pressed diseased specimens.

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14. Sonia Ahuja**, 2005,** Plant Diseases**.** New Delhi, Vishvabharti, viii, 286 p, ISBN 81-89000-42-X.
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2. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi

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2. www.ictv.org
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## 17 AEX 301 ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION 1 + 1

**Theory**

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agrienterprises, Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship and rural enterprise.

**Practical**

Assessing entrepreneurial traits, problem solving skills, managerial skills and achievement motivation, exercise in creativity, time audit through planning, monitoring and supervision, identification and selection of business idea, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

**Setting**

- The course is designed so that the student would use the knowledge and skill gained for starting new agribusinesses and managing the business.

**Objectives**

To enable students to start new agribusiness
To enable students to manage agribusiness

**Theory**

**Unit I – Agribusiness Management**

Concept – components of agribusiness – forms of agribusiness firms. Management - concept – functions of management – managerial roles and skill (Mintzbergs) required at various levels of management.

**Unit II – Management Functions**

Planning – steps and types of plans. Organizing – basis for Departmentation. Staffing – human resource planning process. Directing –techniques of direction. Coordination and control - types.

**Unit III Functional Area – I**

Operations management - planning and scheduling - supply chain management in agribusiness. Human resource management – job analysis, recruitment and selection process

**Unit IV Functional Area – II**

Marketing Management – market segmentation, consumer buying behaviour and marketing mix. Financial management – concept and financial planning for agribusinesses

**Unit V – Entrepreneurship**

Entrepreneur – entrepreneurship – types, characteristics and process. Innovation, business incubation and financing entrepreneurs.

**Practical**

Mapping opportunities in Agribusiness sectors – functional areas of agribusiness firm - Identification of the form of agribusiness organization - Business plan and information needs - procedure for establishing agro business firms - forecasting demand for products - Production planning – Exercise on Inventory Management - Purchase management and vendor rating methods - Assessment of entrepreneurial skills and competency - Market survey for understanding client needs and satisfaction - Pricing methods for small agribusinesses - Market promotion programs for an agribusiness firm - Assessing and acquiring finance for agribusiness firms – Financial Performance of a firm – Ratio Analysis - Presentation of business plan and discussion

**Theory schedule**

1. Agribusiness – components of agribusiness – Management
2. Levels of management – top, middle and junior levels - Managerial Roles (Mintzbergs) – interpersonal, informational and decisional. Managerial skills – technical, human, conceptual and design.
3. Management functions – planning - steps and types of plans for agribusiness
4. Organizing - basis of departmentation; staffing – human resource planning process
5. Directing – techniques; coordination – types; and controlling – types
6. Operations management - meaning, scope, production planning and scheduling
7. Supply Chain Management – drivers, flows and importance
8. Human resource management – job analysis, job description and specification
9. **Mid Semester Examination**
10. Role of HR manager - Recruitment and selection process
11. Marketing management – basis of market segmentation and consumer buying behaviour
12. Marketing mix – product, price, placement and promotion
13. Entrepreneur –Entrepreneurship – types of entrepreneur- characteristics
14. Entrepreneurship Process – identification and evaluation of opportunities, writing business plan, identification of resources and managing the firm
15. Business Incubation –meaning, process and role in entrepreneurship
16. Financial management - Assessing and acquiring finance for agribusiness firms
17. Financing entrepreneurs –Venture capital financing– stages and process and Angel investors

**Practical schedule**

1. Mapping opportunities in Agribusiness sectors and selecting an agribusiness (The classes that follow could be based on building up this idea into a business)

2. Guest lecture by entrepreneur / Visit – understanding functional areas of agribusiness firm.
3. Discussion on Sole Proprietorship, Partnership, and Public Limited, One Man Company, Cooperative Society and Farmer Producer Company
4. Business plan - components and models. Identifying information needs for business plan preparation.
5. Documenting the procedure for establishing agribusiness firms – guest lecture / visit to District Industries Centre
6. Exercise on forecasting demand for agricultural products
7. Preparation of production plans for agribusiness firm
8. Exercise on Inventory Management – types, cost and basic EOQ model
9. Purchase management and Vendor rating methods
10. Market survey for understanding customer needs and satisfaction
11. Pricing of products of small agribusinesses
12. Preparation of advertisement and sales promotion programs for an agribusiness firm
13. Balance sheet and Income Statement of agribusiness and Ratio analysis.
14. Cost, Volume Profit analysis and Investment Analysis
15. Assessment of entrepreneurial skills and competency
16. Presentation of business plan and discussion
17. **Final Practical examination**

**Books**


1. Koontz.H and Weihrich.H, 2013, _Principles of Management‘, Tata McGraw Hill, New Delhi.
2. Rao, V.S.B, and P.S. Narayana, 2004, _Principles and Practices of Management‘, Konark Publishing Pvt. Ltd. New Delhi.
3. Prasad, L.M, 2005, _Principles and Practices of Management‘, Sultan Chand and Sons Educational Publishers, New Delhi.
4. Howard H Fredrick and Donald F Kuratko, 2010, _Entrepreneurship – Theory, Process, Practice‘, Cengage Learning Publishers, Melbourne
5. Veerabhadrappa Havinan , 2009 _Management and Entrepreneurship‘, New Age International Publishers, New Delhi

**17 AGR 301 PRACTICAL CROP PRODUCTION – I (*Kharif crops*) 0+2**

Crop planning, raising field crops in multiple cropping systems: 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. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

- Each student will be allotted a minimum land area of 100/200 $m^2$ and he / she will do all field operations in the allotted land from field preparation to harvest and processing.
- Under exigencies like water scarcity to raise wetland rice of the crop production programme shall be with two irrigated dry crops, with an area of not less than five cents.
- Irrigated puddled lowland rice / any irrigated dry crop (maize / sorghum / pearl millet / finger millet / cotton / groundnut / sunflower / sesame).

**OUTLINE**

- Rice *(Transplanted and direct seeded rice)*
- Rice ecosystems - Climate and weather - Seasons and varieties of Tamil Nadu.
- Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery.
- 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.
- Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

**Practical Schedule for Transplanted rice:**

1 Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu.
2 Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery.
3 Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management.
4 Study and Practice of main field preparation and puddling operations.
5 Practicing of field preparatory operations - sectioning of field bunds and plastering, leveling and basal application of fertilizers.
6 Practicing transplanting techniques in lowland rice.

7 Estimation of plant population and acquiring skill in gap filling and thinning.
8 Study of weeds and weed management in rice.
9 Study and practice of green manuring and bio-fertilizer application in rice.
10 Acquiring skill in nutrient management and practicing top dressing techniques.
11 Study of water management practices for lowland rice.
12 Observation of insect pests and diseases and their management.
13 Recording growth and other related characters of rice.
14 Estimation of yield and yield parameters in rice.
15 Harvesting, threshing and cleaning of the produce.
16 Working out cost of cultivation and economics.
17 **Practical Examination.**

**References:**

Ahlawat, I.P.S., Om Prakash and G.S.Saini. 1998. Scientific Crop Production in India. Rama Publishing House, Meerut.

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K Annadurai and B Chandrasekaran. 2009. A Text Book Of Rice Science. Scientific Publishers

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www.crri.nic.in
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## 17 HOR 311 POST HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLE CROPS (1+1)

**Theory**

Importance of post-harvest processing of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning -– Concepts and Standards, packaging of products.

**Practical**

Applications of different types of packaging, containers for shelf life extension. Effect of temperature on shelf life and quality of produce. Demonstration of chilling and freezing injury in vegetables and fruits. Extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products. Quality evaluation of products -- physico-chemical and sensory. Visit to processing unit/ industry.

## 17 SAC 301 MANURES, FERTILIZERS AND SOIL FERTILITY MANAGEMENT 2+1

**Aim:**

To impart knowledge on essential nutrients, soil fertility, nutrient transformations in soil, manures, fertilizers and soil fertility management through various approaches.

**Syllabus-Theory**

**Unit-l-Essential Nutrients**

Soil fertility and productivity. Essential nutrients- functions, deficiency and toxicities. Concepts and methods of soil fertility evaluation.

**Unit-ll- Nutrient Dynamics**

Nutrients - sources, forms, mobility, transformations, fixation, losses and availability of nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, manganese, zinc, copper, boron, molybdenum, nickel, chloride in soils - Beneficial elements -Nutrient interactions

**Unit-III-Classification of Fertilizers**

Fertilizers - Definition and classification, sources, properties and reactions of primary, secondary and micro nutrient fertilizers in soil - Manufacture of urea, ammonium sulphate, SSP, DAP, MOP and SOP. Complex, mixed fertilizers, customized / Specialty fertilizers - Water soluble fertilizers, liquid fertilizers. Micro nutrient mixtures and chelated micronutrients - Preparation, characteristics and compatibility -Fertilizer Control Order (FCO). Manures- classification, nutrient contents. Composting techniques.

**Unit-IV-Application Methods**

Methods of fertilizer application - Seed coating, pelletization, seedling dipping - Nutriseed pack - Soil Application - Foliar spray - Fertigation - water soluble fertilizers, fertigation scheduling ( Fertilizer- water interaction, fertilizer solubility, comparison of fertilizer application methods)

**Unit-V-Nutrient Management**

Nutrient management concepts - INM, STCR, IPNS, SSNM and RTNM. Nutrient use efficiencies of major and micronutrients and enhancement techniques (Soil, Cultural and Fertilizer strategies). Soil health -Quality indices and their management - Organic farming and Precision Farming - Long term effect of fertilization on soil

**Practical Syllabus**

Soil Nutrient Analysis - Available nutrient status (N, P, K, S and DTPA extractable micronutrients) in soils- Fertilizer Nutrient Analysis- Analysis of nutrient contents in urea, ammonium nitrate, SSP, RP, MOP and SOP- Manure Analysis- Determination of nutrient contents (N, P& K) in FYM/GM - Colloquium on Soil testing laboratories - Soil test based fertilizer prescription - Visit to fertilizer mixing unit.

**Theory- Lecture shedule**

1. Soil fertility and productivity - essential nutrients- criteria of essentiality - N, P and K nutrients -functions, deficiency and toxicity symptoms
2. Secondary nutrients, micro nutrients and beneficial elements - functions, deficiency and toxicity symptoms
3. 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
4. Techniques/ methods of soil fertility evaluation - Inductive, deductive, 'A' value technique,
   crop logging, critical level, DRIS and agronomic approach
5. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil
6. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorus in soil
7. Sources, forms, mobility, transformation, fixation, losses and availability of potassium in soil
8. Sources, forms, mobility, transformation, fixation, losses and availability of calcium magnesium and sulphur in soil
9. Sources, forms, mobility, transformation, fixation, losses and availability of micro
   nutrients in soil
10. Nutrient interactions in soil
11. Fertilizers - Definition, classification of N,P and K fertilizers
12. N fertilizers- Urea, ammonium sulphate, ammonium nitrate, CAN, properties and their reactions in soil
13. Manufacture of urea and ammonium sulphate
14. P fertilizers- Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate, triple super phosphate, properties and their reactions in soil
15. Manufacturing of SSP and DAP
16. K fertilizers- MOP and SOP- properties and reactions in soil
17. Mid Semester Examination
18. Synthesis of MOP and SOP
19. Complex fertilizers- definition, manufacture of ammonium phosphate, nitro phosphate and N,P,K complexes
20. Mixed fertilizers-definition, preparation and compatibility
21. Preparation and characteristics and compatibility - Specialty/ Customized fertilizers, Water soluble fertilizers, liquid fertilizers, Micro nutrient mixtures and chelated micronutrients
22. Fertilizer Control Order
23. Organic manures- Definition, classification and sources- Fortified organics
24. Composting techniques- Aerobic and anaerobic (Bangalore & Coimbatore method)

enriched FYM and vermicompost. Composting of organic waste-Sugarcane trash and coir waste

25. Methods of fertilizer application for different soil types - Fertigation - Definition - water soluble fertilizers
26. Types of fertigation - Fertilizer schedule
27. Fertilizer application methods - Seed coating, pelletization, seedling dipping - Nutriseed pack - Soil Application - Foliar spray
28. Nutrient management concepts - INM, STCR, IPNS, SSNM and RTNM - Tools - DSSIFER and VDK
29. Nitrogen use efficiency - Slow release N fertilizers - Significance and enhancement techniques
30. Nutrient use efficiency of P, K and micronutrients and their enhancement techniques
31. Soil health - Definition - Soil Quality Indices - Physical, chemical and Biological indicators-Soil enzymes
32. SOM maintenance - Role of SOM in sustaining soil health
33. Precision farming and organic farming - Concepts and applications
34. Long term effect of fertilization on soil

**Practical schedule**

1. Estimation of alkaline $KMnO_4$ N in soil
2. Estimation of Olsen P and Bray P in soil
3. Estimation of Neutral Normal $NH_4OAc$ K in soil
4. Estimation of available sulphur in soil by turbidimetry
5. Estimation of DTPA extractable micronutrients in soil
6. Identification of fertilizers - Fertilizer sampling techniques
7. Estimation of N in urea
8. Estimation of ammoniacal and nitrate N in ammonium nitrate
9. Estimation of water soluble P in SSP
10. Estimation of citric acid soluble P in rock phosphate - Pemberton's method
11. Estimation of K in KCI and $K_2SO_4$
12. Estimation of N in FYM / Compost by Macro Kjeldahl method
13. Preparation of triple acid extract - Estimation of P in FYM / Compost by Vanado molybdate yellow colour method
14. Estimation of K in FYM / Compost by Flame Photometry.
15. Colloquium on establishment of soil testing laboratories -Fertilizer calculations-Soil test based fertilizer prescription
16. Visit to STL and FTL, Visit to fertilizer manufacturing / mixing unit
17. Practical Examination.

**Text books**

1. 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

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

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2. 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.
3. Das, P.C. 1999. Manures and Fertilizers, Kalyani Publishers, New Delhi.
4. Dilip Kumar Das, 2007. Micronutrients : Their Behvaiour in soils and plants. Kalyani Publishers, New Delhi.
5. Epstein, E. and A.J.Bloom. 2005. Mineral Nutrition of Plants: Principles and perspectives (2nd ed!). Sinauer Associates, Sunderland, MA.
6. FAO, 2000. Manual on integrated soil management and conservation practices. FAO land and water bulletin. No. 8. Food and Agriculture Organization of the United Nations, Rome.
7. Fertilizer Manual. 1998. UN Industrial Development Organization and International Fertilizer Development Center.
8. Horst Marschner. 1995. Mineral Nutrition of Higher Plants, 2nd edition. Academic Press Inc. San Diego, CA.
9. John Havlin, James Beaten, Samuel Tisdale, Werner Nelson, 2006.Soil Fertility and Fertilizers - An Introduction to Nutrient Management. 7th Edition, Prentice Hall. Upper Saddle River, NJ.
10. Kanwar. J.S. 1976. Soil fertility - Theory and Practice. ICAR- New Delhi.
11. Mengel, K., E.A. Kirkby, H.Kosegarten and T.Apple. 2006. Principles of Plant Nutrition, $5^{th}$ ed. Springer International.
12. Page, A.L, R.H.Miller and D.R.Keeney. 1982. Methods of Soil Analysis. Part 2. Chemical and Microbiological properties. Madison Wiscinsonin, USA.
13. Russell. E.J.1973.Soil conditions and plant growth, Tenth edition English Language Book Society, London.
14. Sree Ramulu, U.S. 2003. Principles in the quantitative analysis of waters, fertilizers, plants and soil. Scientific Publishers, Jodhpur
15. Tandon, H.LS. 1994. Fertilizer, Organic Manures, Recyclable Wastes and Biofertilizers. Fertilizer Development and Consultation Organization, New Delhi
16. Westerman, R.L. (ed.) 1990. Soil Testing and Plant Analysis, 3rd. edition. Soil Science Society of America, Inc., Madison, Wl.
17. Yawalkar, K.S., J.P. Agarwal and S.Bokde.2008. Manures and Fertilizers. Agri -

Horticultural Publishing House, Nagpur.

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2. www.springerlink.com/index/IQ11256h8t325054.pdf
3. www.ipni.net/ppiweb/bcrops.nsf/$webindex/.../Better_Crops_2009-4 J_.pdf
4. onlinelibrary.wiley.com/doi/10.1002/9780470431771 .index/pdf
5. agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.,./Module4.htm
6. www.uoa.edu.er/academics/graduate/.../courses.html -
7. www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm
8. www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm
9. www.uoa.edu.er/academics/graduate/.../courses.html -
10. www.ncpahindia.com/articles/article17.pdf-Similar
11. www.energy.ca.gov/process/agriculture/ag_pubs/fertigation.pdf -
12. www.soilandhealth.org/.../010117attrasoilmanual/010117attra.html
13. goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html-

**Out come**

The knowledge gained by students through this course will be useful in making decisions on nutrient dose, choice of fertilizers and method of application etc. practiced in crop production. The skill acquired from this course can be practiced for assessing soil fertility. The students will also gain confidence in managing soil health for sustained productivity.

**17 ABT 301 PLANT BIOTECHNOLOGY 2+1**

**Aim**

To impart knowledge on basic and applied aspects of plant biotechnology

**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

**References**

Text book


- Chawla. H S. 2009. **Introduction to Plant Biotechnology (3/e).** CRC Press , London. 730 P ISBN 9781578086368


**Additional resources**


- Neal Stewart, Jr. C. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications John Wiley & Sons, Inc ISBN: 978-0-470-04381-3
- George, E.F, Hall M. A. and Geert-Jan De Klerk. 2009. **Plant Propagation by Tissue Culture,** 3rd Edition, Springer, The Netherlands. 501p.
- 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 Company.
- Brown,T. A. 2010. **Gene Cloning and DNA Analysis: An Introduction,** 6th Edition, Wiley-Blackwell- Companion site (Chapters 1 to 12 and 15)
- Xu **,**Y 2010. **Molecular Plant Breeding.** International Maize and Wheat Improvement Centre (CIMMYT). 752 Pages
- H.P. Singh, S. Uma, R. Selvarajan and J.L. Karihaloo. 2011. **Micropropagation for Production of Quality Banana Planting Material in Asia-Pacific.** Asia-Pacific Consortium on Agricultural Biotechnology, New Delhi, India. P. 92.
- Kranthi, K.R. 2012. **Bt cotton – Questions and answers** -Indian Society for Cotton Improvement, Central Institute for Research on Cotton Technology, Mumbai 400 019. 70p.
- http://www.isaaa.org/india/- Briefs


**Lecture Schedule**

1. Plant tissue culture: Concepts, history and scope
2. Media and Culture Conditions and Sterilization techniques
3. Regeneration methods - morphogenesis, organogenesis and embryogenesis
4. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture
5. Anther and pollen culture; ovule and embryo culture
6. Micropropagation - banana and ornamental plants
7. National certification and Quality management of TC plants
8. Meristem tip culture (virus free plants) and anther culture (doubled haploids)
9. Protoplast isolation and fusion- somaclonal variation-synthetic seeds
10. Secondary metabolite production, *invitro* germplasm conservation
11. Genome organization- prokaryotes vs eukaryotes
12. Central dogma of life - Structure of nucleic acids
13. DNA replication

14. Aminoacids and their classification and genetic codes, transcription
15. Translation and protein synthesis
16. Structure of a gene
17. Mid semester Examination
18. Regulation of gene expression, Operon concept
19. Blotting techniques and Polymerase chain reaction
20. DNA sequencing methods
21. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases
22. Different types of vectors: plasmids, phagemids, cosmids, BAC
23. Construction of recombinant DNA molecules- Bacterial transformation
24. **D**irect and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method
25. Tissue specific promoters, selectable and scorable markers, reporter genes,Molecular analysis of transgenic plants
26. Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant,
27. Transgenic plants: nutritional enhancement and traits for improved quality
28. Detection of GMOs – regulations and biosafety.
29. DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs
30. DNA fingerprinting of crop varieties
31. Development of mapping populations
32. Linkage and QTL analysis
33. Principles, methods and applications of Marker Assisted Selection in crop improvement
34. Applications of Plant Genomics and genome databases

**Practical schedule**

1. Biotech Laboratory organization, safety regulations
2. basics of reagents and solution preparation-
3. Plant tissue culture media preparation- shoot tip culture (rose)
4. Meristem culture (tapioca)
5. Micro propagation of banana
6. Callus culture
7. Culturing of *E.coli* and determination of growth curve
8. Isolation of bacterial plasmid DNA
9. Restriction Digestion and Ligation
10. Competent cell preparation and Bacterial transformation
11. Confirmation of transformation through colony screening
12. DNA extraction from plants
13. Quantification of DNA and quality check through Agarose gel electrophoresis
14. DNA fingerprinting using RAPD/SSR markers
15. NTSys- analysis of diversity in crop plants
16. Visit to tissue culture units /biotech lab in seed industry/Bt cotton field/tissue culture banana field
17. Practical examination

**Outcome**

The students will be exposed to plant biotechnology comprehensively and will also have hands on expereince in plant tissue culture and molecular techhiques.

## 17 AGR 302 RAINFED AGRICULTURE AND WATERSHED MANAGEMENT (1+1)

**Theory**

Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India; Problems and prospects of rainfed agriculture in India ; Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio-morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices,Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management.

**Practical**

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed**.**

**17 RES 301 Research Methodology (0+3)**

**AIM:**

To create a basic appreciation towards research process and awareness of various research publication

**OBJECTIVES:**

- To understand the steps in research process and the suitable methods.
- To identify various research communications and their salient features
- To carry out basic literature survey using the common data-bases
- To give exposure to standard laboratory precautions and best practices for experimental work
- To provide orientation for basic mathematical computation useful in basic research

**OUTCOME:**

Ability to carry out independent literature survey corresponding to the specific publication type and assess basic experimental as well as conceptual set up.

**PREREQUISITES:**

Basic mathematical and experimental skills and exposure to window-based computer operation system.

**UNIT I**

Research – Definition, Objectives, Motivation and purpose – types of research – Pure and applied, survey, case study experimental, exploratory – Research Design – Steps in selection and formulation of research problem - Steps in research – Criteria of Good Research, Problems Encountered by Researchers in India. General guidelines for Good housekeeping & Lab-safety- Hygiene (Eye, foot, skin and hand protection) – Safety rules -Equipment protection – Respiratory protective equipment – safety equipment – Leaking, compressed gas cylinders – electrical safety. Fire – extinguishers.

**UNIT II**

Research Problem: Definition of research problem, Types & selection of proper research question and suitable research design with Examples, Development of a research plan,

Formulation of Hypothesis – Sampling techniques –Sampling error and sample size. Literature types- compendia and tables of information, Reviews, General treatises, Monographs.

**UNIT III**

Methods of data collection – Primary and secondary data – observation – interview – Questionnaire – Tools for questionnaire; surveying & literature survey, spreadsheets, Technical writing, Construction of tools for data collection – testing validity – pilot study and pre-testing, Survey vs Experiment, Practical Exercises.

**UNIT IV**

Processing and analysis of data – editing – coding – transcription – tabulation –outline of statistical analysis- Uncertainty, accuracy and precision- Mean value; standard deviation; error on the mean-Using a spreadsheet for data analysis- Graphs and graph plotting-Least squares methods – descriptive statistics – elements of processing through computer- packages for analysis (Excel).

**UNIT V**

Review of literature, Report writing – target audience – types of reports – contents of reports – styles and Conventions in reporting – steps in drafting a report. Basic concept of research paper writing for Journals and formats of publications in Journals, Report Structure - writing research abstract - introduction, review of literature, result, conclusions, Concepts of Bibliography and references, Technical Presentation.

**References**:

1. R. Gopalan, Thesis writing, Vijay Nicole Imprints Private Ltd., 2005.
2. S.P.Gupta, “Statistical Methods”, 7th Edition, S. Chand and Co. Ltd., 2004.
3. R.A Day and A.L. Underwood, Quantitative analysis, Prentice Hall, 1999.
4. C.R. Kothari, Research Methodology-Methods & Techniques, 2nd Edition, New Age Int. (P) Ltd, 2004.
5. Ajai.S.Gaur, Sanjaya S.Gaur, Statistical Methods for Practice and Research, Response, 2009
6. Christa van der Walt; Gisela van Rensburg; Fundamentals of Research Methodology for Health Care Professionals, JUTA, 2nd edition, 2009.

## VI Semester

| S.No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AEC 302 | Agricultural Finance, Banking and Co-operation | 2+1 |
| 2. | 17 PAT 302 | Diseases of Field Crops and their Management | 2+1 |
| 3. | 17 COM 311 | Agriculture Informatics | 1+1 |
| 4. | 17 ENS 301 | Environmental Pollution and Management | 1+1 |
| 5. | 17 APE 311 | Post Harvest and Food Engineering | 1+1 |
| 6. | 17 AEN 302 | Pests of Crops, Stored Grain and their Management | 2+1 |
| 7. | 17 AGR 303 | Practical Crop Production – II (Rabi crops) | 0+2 |
| 8. | 17 AGR 304 | Principles of Organic Farming | 1+1 |
| 9. | 17 PBG 302 | Crop Improvement | 2+1 |
| 10. | 17 OPT 301 | Optional Course | 1+1** |
| 11. | 17 RES 302 | Participation in bounded research | 0+2 |
| | **Total** | | **13+13=26** |

** Elective courses (List of options given in page No. 8)

## 17 AEC 302 AGRICULTURAL FINANCE, BANKING AND COOPERATION

**(2+1)**

**Objectives**

This course aims at imparting knowledge on principles of finance, banking and co – operation, and farm financial analyses. This course will also help the Under Graduate students in understanding the functions of various institutions involved in farm financing and different crop insurance products implemented in India.

**Theory**

**Unit 1: Agricultural Finance – Nature and Scope**

Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural credit: Meaning, Definition, Need and Classification - Sources of credit – Role of institutional and non - institutional agencies: Advantages and Disadvantages - Rural indebtedness: Consequences of rural indebtedness - History and Development of rural credit in India.

**Unit 2: Farm Financial Analysis**

Principles of Credit - 5C's, 3R's and 7 P's of Credit – Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and Discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow Statement – Financial Ratio Analysis.

**Unit 3: Financial Institutions**

Institutional Lending Agencies – Commercial banks: Nationalization, Agricultural Development Branches – Area Approach – Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India – Microfinance and Its role in poverty alleviation – Self-Help Groups – Non-Governmental Organizations - Rural credit

policies followed by State and Central Government – Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme.– Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).

**Unit 4: Co-operation**

Co-operation: Philosophy and Principles - History of Indian Co-operative credit movement: Pre and Post - Independence periods and Co-operation in different plan periods - Co-operative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit: Salient features of Vaithiyanathan Committee Report on revival of rural co-operative credit institutions, Reorganization of Co-operative credit structure in Andhra Pradesh and single window system and Successful co-operative credit systems in Gujarat, Maharashtra, Punjab, etc. - Special Co-operatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd. (NAFSCOB): Objectives and functions.

**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) - Assessment of crop losses, Determination of compensation - Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation - Estimation of Crop Yields - Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

**Lecture Schedule**

1. Agricultural Finance: Definition, Importance, Nature and Scope –- Agricultural credit: Meaning, Definition, Need and Classification.
2. Sources of credit – Role of institutional and non - institutional agencies: Types, Roles, Advantages and Disadvantages - Rural indebtedness: Consequences and Control measures of rural indebtedness - History and Development of rural credit in India.
3. Principles of Credit - 5C's, 3R's and 7 P's of Credit – Project Cycle and Management - Preparation and Appraisal of Bankable Projects / Farm Credit Proposals – Preparation of Feasibility Report of Project.
4. Time value of money: Compounding and Discounting Techniques – Project Appraisal: Undiscounted and Discounted measures.
5. Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow Statement – Financial Ratio Analysis.
6. Institutional Lending Agencies – Commercial banks: Nationalization, Agricultural Development Branches – Area Approach – Priority Sector Lending - Regional Rural Banks.
7. Lead bank: Role and Functions, Preparation of District Annual Credit Plan and Scale of finance, Kisan Credit Card (KCC) Scheme and Know Your Customer (KYC) - Rural credit policies followed by State and Central Government – Subsidized farm credit, Differential Interest Rate (DIR) Scheme – Relief Measures and Loan Waiver Scheme.
8. Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India: Role and their functions in rural credit.
9. **Mid Semester Examination**
10. Microfinance: Definition and Its role in poverty alleviation – Self-Help Groups: Characteristics, role, functions, growth and development in India – Role of Non-Governmental Organizations in promoting SHGs.
11. Co-operation: Philosophy and Principles - History of Indian Co-operative credit movement: Pre and Post - Independence periods and Co-operation in different plan periods.
12. Co-operative credit institutions: Two tier and three tier structure, Functions: Provision of short term and long term credit and Strength and weakness of co-operative credit system.
13. Policies for revitalizing co-operative credit: Salient features of Vaithiyanathan Committee Report on revival of rural co-operative credit institutions, Reorganization of Co-operative

credit structure in Andhra Pradesh and single window system and Successful co-operative credit systems in Gujarat, Maharashtra, Punjab, etc.

14. Special Co-operatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd. (NAFSCOB): Objectives and functions.
15. 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.
16. Financial Inclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non- Banking Financial Institutions (NBFI).
17. Assessment of crop losses, Determination of compensation - Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation - Estimation of Crop Yields - Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

**Practical Schedule**

1. Visit to a farm to study the credit needs, problems and suggestions in the use of farm credit.
2. Preparation of Bankable Projects / Farm Credit Proposals.
3. Project preparation and appraisal – Undiscounted methods.
4. Project preparation and appraisal – Discounted methods.
5. Preparation of Balance Sheet and Income Statement.
6. Preparation of Cash flow Statement and Exercise on preparation of Repayment plans.
7. Exercise on Financial Ratio Analysis.
8. Appraisal of farm credit proposals.
9. Guest lecture on Role and functions of Commercial Bank and Lead Bank.
10. Guest lecture on NABARD and its Role and Functions.
11. Visit to Regional Rural Bank to study its role and functions.
12. Visit to Primary Agricultural Co-operative Bank (PACB) to study its role, functions and procedures for availing loan.
13. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance.
14. Visit to Cooperative Agricultural and Rural Development Bank **(**Land Development Bank**)** to study procedures for availing long term credit.
15. Visit to Self-Help Group to study its characteristics, roles and functions.
16. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.
17. **Practical Examination**

**References**


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

## 17 PAT 302 DISEASES OF FIELD CROPS AND THEIR MANAGEMENT (2+1)

**Theory**

Symptoms, etiology, disease cycle and management of major diseases of following crops:

Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro;Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt. Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle; Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng;

Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot; Gram: wilt, grey mould and Ascochyta blight; Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust.

Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight;Tobacco: black shank, black root rot and mosaic.

**Practical**

Identification and histopathological studies of selected diseases of field crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium; Note: Students should submit 50 pressed and well-mounted specimens.

***Note:*** Students should submit 50 pressed and well-mounted specimens

**17 COM 311 AGRICULTURE INFORMATICS (1+1)**

**Text book**

1. Pearson , Introduction to Information Technology, 2013 Second Edition, ITL Education Solutions Limited.

**Reference book**

1. Pearson , Express Learning: Introduction to Information Technology, 2012 Edition, ITL Education Solutions Limited.

**e-reference :**
http://pearsoned.co.in/ITLEducationSolutionsLimited/

**Theory**

Introduction to Computers, Operating Systems, definition and types, Applications of MS-Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations.

e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop-planning using IT tools.

**Practical**

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system.

Introduction to World Wide Web (WWW). Introduction of programming languages. Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools. Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.

**Theory**

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS)

- definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.

**Practicals**

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

**17 ENS 301 ENVIRONMENTAL POLLUTION AND MANAGEMENT 1+1**

**Scope :**

It deals with the scientific study of environmental system (air, water, soil land), the inherent or induced changes on organisms and the environmental damages incurred as a result of human interaction with the environment.

**Objectives:**

- Imparting basic knowledge about the environment and its allied problems.
- Developing an attitude of concern for the environment.
- Motivating the students to participate in environment protection and environment improvement.
- Acquiring skills to help the concerned individuals in identifying and solving environmental problems and striving to attain harmony with nature.

**Unit-I-Pollution in Environment-**Introduction-Pollution- Pollutants – Contaminants – Source and types of pollution inSoil-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 anddomestic 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: S**olid 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 Normsfor 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:**

1. Introduction-Pollution- Pollutants – Contaminants – Source and types of pollution inSoil-Water-Air-Impact on environment-Pollution Status in India
2. Waste water – Different types of waste water-pollutants and contaminants-Impact of waste water on ecosystem –Eutrophication – Biomagnification – Water borne diseases –
3. Wastewater treatment methods – Physical, chemical and Biological – General water treatments-
4. Wastewater recycling – Constructed wetlands-Reed bed system -Legislation and standards
6. 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

7. Air pollutants from industrial anddomestic sources – Fate of air pollutants-Air pollution indicators – Air pollution episodes-Monitoring and Control measures–
8. Role of plants in controlling air pollutants- Legislation and Air quality standards,
9. **Mid Semester Examination**
10. Noise Pollution, Sources, Effect and Control Measures, Indoor air pollutants and control measures
11. **S**olid waste –Sources – Sludge from Industry and farm waste-Characteristics – Environmental problems
12. Management of solid waste, Disposal methods, Sanitary land fills, Incineration, Pyrolysis
13. Recycling –Energy recovery –Composting – Vermicomposting – Maturity indices assessment-Standards and Legislation
14. Environmental standards-CPCB Normsfor discharging industrial effluents to public sewers
15. Environment Impact Assessment,Introduction,Stages of EIA, -Monitoring and Auditing
16. CDM and Carbon foot print
17. Environmental clearance procedure in India

**Practical Schedule**

1. Sample collection and preservation from contaminated sites.
2. Waste water treatment by physical (column study with vermiculite and activated charcoal ) and chemical (Alum treatment)
3. Waste water treatment through constructed wetland system and characterization
4. Estimation of Chlorides, Phosphates in waste water
5. Analysis of Nitrogen in industrial effluent and sludge
6. Collection of PAH‘s contaminated soils and analysis by GC-MS
7. Biosorption of heavymetal (Cr) by using Water hyacinth and analysis through AAS
8. Pesticide Residue analysis in contaminated water
9. Analysis of SPM in air, Methane and $CO_2$ in Municipal dumping site
10. Assessing the efficiency of plants to control Indoor air pollutants
11. Analysis of Organic carbon in Sludge and Organic manure
12. Composting and Vermicomposting of farm wastes
13. Energy recovery from wastes
14. Maturity indices of compost- C:N ratio and Phytotoxicity test
15. Maturity indices of compost: starch iodine test and sulphide test
16. Visit to water treatment plant
17. Final practical examination

**Reference:**

1. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (*Concepts, Connections, and Solutions).* Brooks/cole, Cengage learning publication, Belmont, USA

2. 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

**17 APE 311 POST HARVEST AND FOOD ENGINEERING 1+1**

**Unit I: Post harvest losses, moisture content and properties**

Post harvest losses – causes and estimates – unit operations of crop processing – moisture content – methods of estimation - engineering properties of grains – mass, volume, density, porosity, sphericity – Thermal properties- applications .

**Unit II: Threshing, cleaning and grading**

Threshing – threshers for different crops - parts, terminology – operational safety and maintenance - winnowing – manual and power operated winnowers- cleaning, grading and sorting - types of screens - air screen cleaners- construction and operation-care and maintenance –Screen effectiveness-construction and working principles of spiral separator, magnetic separator, specific gravity separator, colour sorter and inclined belt separator.

**Unit III: Shelling, drying and storage**

Shelling equipments - maize sheller, husker sheller, hand and power operated groundnut decorticator - construction and working – performance evaluation - grain drying – principles - advantages - types - batch and continuous, mixing and non mixing – LSU drier – construction and operation - performance of dryers - storage of food grains – factors affecting storage, traditional and improved methods - modified atmosphere storage.

**Unit IV: Cereals, pulses and oilseed processing**

Rice processing – Parboiling- traditional and modern methods - , modern rice milling –Size reduction – principles- equipment used- wheat milling – process flow chart – roller flour mill - construction and operation - pulse milling - wet, dry and CFTRI methods of pulse milling – equipment – construction and operation - oilseed processing – methods and machineries used – ghani, rotary and expeller - filter press – construction and operation – solvent extraction process.

**Unit V: Material handling and Food Plant layout**

Material handling equipments – bucket elevator, screw conveyor, belt conveyor – construction and operation –Food plant location – selection- layout-types- Food Packaging-requirements- types- Packaging of raw and processed foods.

**Practical**

Determination of moisture content - study of threshers, winnowers and graders – components, operations, adjustment and performance - determination of efficiency of maize shellers, groundnut decorticators, cleaners and graders, rice milling and pulse milling - experiments on tray and thin layer drier- experiments on screw conveyor and bucket elevator, study of improved grain storage structures – Study of packaging machine – visit to food processing industry.

**Theory schedule**

1. Post harvest losses – causes and estimates – unit operations of crop processing – moisture content – methods of estimation – direct and indirect methods – wet basis and dry basis.
2. Engineering properties of grains – mass, volume, density, bulk density, true density, porosity, surface area and sphericity– Thermal properties-applications.
3. Threshing – threshers for different crops - parts, terminology - operational safety and aintenance.

4. Winnowing – winnowers- cleaning, grading and sorting- Types of screens - air screen cleaners- construction and operation- screen effectiveness
5. Construction and working principles of spiral separator, magnetic separator, specific gravity separator, colour sorter and inclined belt separator
6. Construction and working of maize sheller, husker sheller, hand and power operated groundnut decorticator -care and maintenance.
7. Grain drying – principles - advantages - types - batch and continuous, mixing and non mixing – LSU drier – construction and operation - heat sources - performance of dryers.
8. Storage of food grains – factors affecting storage, traditional methods - types -bag and bulk storage - CA and MA storage.
9. **Mid Semester Examination**
10. Rice processing – Parboiling- traditional and modern methods -modern rice milling - layout of modern rice mills.
11. Size reduction – principles- laws in size reduction- equipment used.
12. Wheat milling – process flow chart – roller flour mill - important machineries used in wheat milling – construction and operation.
13. Pulse milling - wet, dry and CFTRI methods of pulse milling – equipment – construction and operation.
14. Oilseed processing – methods and machineries used – ghani, rotary and expeller - filter press – construction and operation – solvent extraction process.
15. Material handling equipments – bucket elevator, screw conveyor, belt conveyor – construction and operation.
16. Introduction to food plant design – selection of plant location - layout – types.
17. Food Packaging – requirements-types- packaging of raw and processed foods..

**Practical schedule**

1. Determination of moisture content by direct and indirect methods
2. Study of types of thresher and components.
3. Performance evaluation of grain winnower.
4. Performance evaluation of grader.
5. Study of maize sheller / husker sheller for maize.
6. Study of groundnut decorticator.
7. Performance evaluation of cleaner cum grader.
8. Study on paddy parboiling .
9. Study of shelling equipment for paddy .
10. Study of pulse milling equipment.
11. Experiment on tray dryer / thin layer dryer to determine drying characteristics.
12. Performance evaluation of screw conveyor
13. Performance evaluation of bucket elevator
14. Study of improved grain storage structures
15. Study of packaging machine
16. Visit to modern rice mill / oil mill / pulse mill.
17. **Final Practical Examination**.

**References**

1. Chakraverty,A. 2000. Third Edition. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing & Co. Pvt. Ltd., New Delhi.
2. Sahay. K.M. and Singh,K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd. New Delhi.

**Web resources**

1. www.foodnetbase.com
2. www.fao.org
3. food.oregonstate.edu/security/preserve.html
4. www.postharvest.ucdavis.edu.

## 17 AEN 302 PESTS OF CROPS, STORED GRAIN AND THEIR MANAGEMENT 2+1

**Aim:**

To impart knowledge on distribution, bionomics, symptoms of damage and management strategies of pests of crops.

**Theory**

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

**Practical**

Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce: (a) Field Crops; (b) Vegetable Crops; (c) Fruit Crops; (d) Plantation, gardens, Narcotics, spices & condiments. Identification of insect pests and Mites associated with stored grain. Determination of insect infestation by different methods. Assessment of losses due to insects. Calculations on the doses of insecticides application technique. Fumigation of grain store / godown. Identification of rodents and rodent control operations in godowns. Identification of birds and bird control operations in godowns. Determination of moisture content of grain. Methods of grain sampling under storage condition. Visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

**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, jatropa, 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 chemcial 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

**ASSIGNMENT:**

- Collection and submission of 50 pests of field crops
- Rearing a minimum of 15 insect pests attacking field crops and preparation and submission of two riker mounts of field crop pests.

**Outcome/Deliverables:**

The students develop skills for the identification and management of pests of field crops

**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}


**B. Reference Books:**


1. Awasthi, V.B. 2007. *Agricultural Insect Pests and their Control*, Scientific publishers (India), Jodhpur, 267p. {ISBN 81-7233-491-5}
2. Dhaliwal, G.S. and Ramesh Arora. 2004. *Integrated pest management Concepts and Approaches*, Kalyani Publishers, Ludhiana, 427p. {ISBN: 81-7663-904-4}
3. Regupathy, A. and R.Ayyasamy. 2013. *A Guide on Crop Pests*. Namrutha Publications, Chennai, 368 p. {ISBN: 978-81-921477-1-0}
4. 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}


**C. SUPPLEMENTARY REFERENCES:**


1. Nair, M.R.G.K. 1995. *Insects and Mites of Crops in India.* Indian council of Agricultural Research, New Delhi, 408p.
2. Ayyar, T.V.R. 1963. *Hand Book of Economics Entomology for South India.* Govt. Press Madras.
3. Sivasubramanian, P., K.Samiayyan, N.Ganapathy, K. Bhuvaneswari and S.Jayaprabhavathi.2012. *A treatise on Integrated Pest Management.* Associated Publishing Company, New Delhi. 287 p.


**D. WEB 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/

**Unit I: Pests of Vegetable Crops**

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.

**Unit II: Pests of Fruit Crops**

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Mango, Citrus, Banana, Guava, Grapevine, Sapota, Pomegranate, Papaya, Aonla, Apple, Pine apple, Custard apple and Jack

**Unit III: Pests of Tuber Crops**

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Potato, Sweet potato, Tapioca, Yam and Colocasia

**Unit IV: Pests of Spices and Plantation Crops**

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Coconut, Arecanut, Tea, Coffee, Cashew, Cocoa, Betelvine, Ginger, Turmeric, Coriander, Cardamom, Pepper, Curry leaf and Tamarind

**Unit V: Pests of Flower Crops, Medicinal Plants, Lawn and Stored products**

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Cut flowers, Gloriosa, Coleus, Phyllanthus, Aswagantha, Senna, Periwinkle, Lawn and Stored products.

**Practical**

Identification of symptoms of damage and life stages of important pests of different horticultural crops: vegetables, fruits, spices, tubers, plantation crops, flower crops, medicinal plants, lawn and stored products.

**Theory lecture schedule:**

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

1. Brinjal, Bhendi and Tomato
2. Chillies, Onion, Garlic, Moringa and Amaranthus
3. Crucifers and Cucurbits
4. Mango and Citrus
5. Banana, Guava, Grapevine and Sapota
6. Pomegranate, Papaya and Aonla
7. Apple, Pine apple, Custard apple and Jack
8. Potato, Sweet potato, Tapioca, Yam and Colocasia
9. Midsemester examination
10. Coconut and Arecanut

11. Tea and Coffee
12. Cashew, Cocoa and Betelvine
13. Ginger, Turmeric, Coriander, Cardamom, Pepper, Curry leaf and Tamarind
14. Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose and Cut flowers
15. Gloriosa, Coleus, Phyllanthus, Aswagantha, Senna, Periwinkle and lawn
16. Stored product pests
17. Strategies for stored product pest management

**Practical schedule:**

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

1. Pests of Brinjal, Bhendi and Tomato
2. Pests of Chillies, Onion, Garlic, Moringa and Amaranthus
3. Pests of Crucifers and Cucurbits
4. Pests of Mango, Citrus and Sapota
5. Pests of Banana, Grapevine and Guava
6. Pests of Pomegranate, Aonla, Papaya
7. Pests of Jack, Pine apple, Custard apple, Ber and Apple
8. Pests of Potato, Sweet potato, Tapioca, Yam and Colocasia
9. Pests of Coconut and Arecanut
10. Pests of Coffee and Tea
11. Pests of Cashew, Cocoa and Betelvine
12. Pests of Turmeric, Ginger and Coriander
13. Pests of Cardamom, Pepper, Curry leaf and Tamarind
14. Pests of Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose and Cut flowers
15. Pests of Gloriosa, Coleus, Phyllanthus, Aswagantha, Senna and Periwinkle
16. Pests of Lawn and stored products
17. Final Practical Examination

**Assignment:**

- Collection and submission of 50 pests of horticultural crops
- Rearing of 15 insect pests

**Outcome/Deliverables:**

The students develop skills for the identification and management of pests of vegetables, fruits, tubers, plantation crops, spices, commercial flowers, medicinal plants, lawn and stored products.

**References:**

**A. Text Book:**

1. 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}

**B. Reference Books:**

2. Nair,M.R.G.K.1986. *Insects and mites of crops in India.* Publications and Information Division, ICAR, NewDelhi. 408p.
3. ParvathaReddy.2010. *Insect, Mite and Vertebrate Pests and their Management in Horticultural Crops.* Scientific Publishers, Jodhpur. 384p. {ISBN: 978-81-7233-628-8}

4. David, B.V. and V.V.Ramamurthy.2011. *Elements of Economic Entomology*. Namrutha Publications, Chennai. 386 p. {ISBN: 978-81-921477-0-3}

5. Butani, D.K. and M.G.Jotwani.2013. *Insects in Vegetables.* Daya Publishing House, NewDelhi. 356p.
6. Regupathy,A. and R.Ayyasamy.2013. *A Guide on Crop Pests.* Namrutha Publications, Chennai.368p. {ISBN: 978-81-921477-1-0}

**C. Supplementary references:**

1. 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}
2. Ayyar, T.V.R. 1963. *Hand Book of Economics Entomology for South India.* Govt. Press Madras.
3. Sathe,T.V. 2012. *Pests of Ornamental Plants.* Daya Publishing House, New Delhi.199p. {ISBN: 978-81-7035-757-5}

**D. Web resources:**

1. http://agritech.tnau.ac.in/horticulture/horti_plantprotection_pest.html
2. http://www.nbaii.res.in/insectpests/pestsearch.php?cropname=Mango
3. http:www.ncipm.org.in/data bases.htm
4. ipm.illinois.edu

**Theory**

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

**Practical**

Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce: (a) Field Crops; (b) Vegetable Crops; (c) Fruit Crops; (d) Plantation, gardens, Narcotics, spices & condiments. Identification of insect pests and Mites associated with stored grain. Determination of insect infestation by different methods. Assessment of losses due to insects. Calculations on the doses of insecticides application technique. Fumigation of grain store / godown. Identification of rodents and rodent

control operations in godowns. Identification of birds and bird control operations in godowns. Determination of moisture content of grain. Methods of grain sampling under storage condition. Visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

## 17 AGR 303 PRACTICAL CROP PRODUCTION – II (*Rabi Crops*) 0+2

**Practical**

Crop planning, raising field crops in multiple cropping systems: 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. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

**Any irrigated dry crop (maize / sorghum / pearl millet / finger millet / cotton / groundnut / sunflower / sesame)**

**Practical Schedule for Irrigated dry crop (Eg. Maize):**

- Ecosystem - Climate and weather - Seasons and varieties of Tamil Nadu
- 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
- Harvesting, threshing and cleaning the produce - Cost of cultivation and economics

**Practical Schedule:**

1. Study of ecosystems, climate, weather, seasons and varieties of Tamil Nadu
2. Selection of field for maize cultivation
3. Acquiring skill in seed treatment practices
4. Study and Practice of main field preparation for maize
5. Practicing of application of manures and fertilizers for maize
6. Practicing sowing of maize
7. Acquiring skill in pre-emergence application of herbicides
8. Estimation of plant population and acquiring skill in gap filling and thinning
9. Observation on nutritional deficiency symptoms and corrective measures
10. Study of weeds and weed management in maize
11. Recording growth parameters and assessing dry matter production
12. Study of water management practices for maize
13. Observation of insect pests and diseases and their management
14. Estimation of yield and yield parameters in maize
15. Harvesting, threshing and cleaning of the produce
16. Working out cost of cultivation and economics
17. **Practical Examination**

**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.

**E-References:**

www.cimmyt.org

**17 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.

**Practical:**

Experiencing organic farming practices - soil, seed, nutrient, weed, water, pest and diseases, post - harvest management - hands on experience on bio composting, vermicomposting, ITK based biological preparations, bio - inoculants - quality aspects of inputs and products - grading, packaging - visit to organic farms, market outlets and organic certification (TNOCD).

**Theory - Lecture Schedule:**

1. 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.
2. Introduction to bio - diversity; importance and measures to preserve bio - diversity.
3. Pre-requisites and basic steps for organic farming; conversation to organic farming - planning and processes in practices - IFS approach - Integration of animal components.
4. 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.
6. Off-farm resources; coir pith, press mud, oilcakes, flyash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations.
7. Organic waste recycling methods and techniques - composting, vermicomposting, *in situ* composting - system approach.
8. **Mid-Semester Examination.**

9. Soil and crop management in organic farming; Inter cropping and companion planting, crop rotation , green manures and cover crops, mulching.

10. 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.

11. Integrated pest and diseases management - bio control agents, bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations - sanitation.

12. Organic certification - procedures - certification agencies in India - labeling and accreditation processes.

13. Crop production standards - NPOP guidelines - principles, recommendations and standards - Quality considerations - assessment methods - premium and export opportunities.

14. 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.

15. Benefits and problems in organic farming.

16. Organic farming; Promotional activities; role of government and NGO‘s - action plan - policy considerations.

17. Economic evaluation of organic production systems - cost - benefit analysis and comparison with conventional systems.

**Practical:**

1. Resource inventory of organic farm- Soil sampling and analysis for organic carbon and pesticide residues / contaminants.
2. Raising of green manures (Sunnhemp / Daincha / Fodder cowpea).
3. Incorporation of green manure - seed treatment and raising of field crop (Rice / Maize / Cowpea / Cotton / Gingelly).
4. Hands on practice on preparatory cultivation; soil and water conservation methods.
5. Hands on experience on recycling techniques; bio-composting and vermicomposting.
6. Quantification of nutrients from organic sources and application of manures and bio-fertilizers.
7. Exposure visit to an organic farm to learn ITK based preparations.
8. Organic crop production and weed management.
9. Exposure visit to bio-pesticide and pheromone manufacturing units.
10. Organic crop production and pest management.
11. Exposure visit to bio-control agent (*Pseudomonas, Trichoderma* etc.,) production units.
12. Organic crop production and diseases management.
13. Exposure on macro quality aspects of crop produces in laboratories.
14. Hands on training on grading, packaging and post-harvest management.
15. Exposure visit to organic market out lets.
16. Exposure visit to organic certification agencies / Directorate of Organic Certification, Tamil Nadu.

**17. 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.

**E:References:**

www.ifoam.org

www.apeda.org

www.cowindia.org

www.ncof.org

www.earthfooda.co.uk

www.newfarm.org/training

**17 PBG 302 CROP IMPROVEMENT (2+1)**

**Theory**

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

**Practical**

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

**Aim**

Knowledge about the breeding of field and horticultural crops will be exposed to the students

**SYLLABUS FOR THEORY**

**Unit I: Cereals**

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – Quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in following crops:

Cereals: Rice, Wheat, Grain and fodder Maize, Grain and fodder Sorghum, Pearl millet, Finger millet, Foxtail millet, Kodo millet, Little millet, Proso millet and Barn yard millet.

**Unit II: Pulses, Oilseeds and Fibres**

Pulses: Redgram , Bengal gram, Greengram, Blackgram, Grain and fodder Cowpea, Soybean, Horsegram and lab-lab ; Oilseeds: Groundnut, Gingelly, Mustard, Castor, Sunflower, Safflower, Niger, Jatropha, Coconut and Oilpalm; Fibres: Cotton,Jute and Mesta

**Unit III; Sugars, Starch, Forages, Fumitories, Masticatories and Green manures**

Sugars: Sugarcane, Sugar beet; Starch: Potato, Tapioca; Beverages: Coffee and Tea;Fumitories: Tobacco, Masticatories - Betelvine;Forage grasses: Guinea grass, Napier, Pearl millet – Napier, *Cenchrus sp*., Paragrass; Forage legumes: Lucerne, *Stylosanthes*, Desmanthus, Desmodium, Siratro, Subabul Green manures and green leaf manures: Daincha, Sunnhemp, Tephrosia, Glyricidia, Neem and Pungam

**Unit IV: Horticultural crops**

Breeding for other sexually propagated horticultural crops-Bhendi, tomato; Breeding for other sexually propagated horticultural crops- chilli, Brinjal, Papaya;Breeding for other clonally propagated horticultural crops- Banana, Rose, Jasmine

**Unit V: Breeding for Biotic and Abiotic stresses and Quality**

Breeding for pest and disease resistance - mechanisms of resistance; Breeding for Abiotic stress – drought and cold – salinity and alkalinity- mechanisms of resistance; Breeding for Abiotic stress –mechanisms of resistance; Breeding for quality produce; Ideotype breeding, PPV &FR act, 2001- Plant breeders‘ right, Farmers right, Biodiversity act, 2002; Germplasm registration.

**SYLLABUS FOR PRACTICAL**

Observation on floral biology – anthesis and pollination – selfing and crossing techniques – observation on wild species – maintenance of crossing ledger – pedigree record – in following crops.

- Cereals: Rice, Wheat, Maize, Sorghum, Pearl millet, Finger millet, Little millet, Kodo millet, Barn yard millet, Proso millet and Foxtail millet.
- Pulses: Redgram and Bengal gram, Green gram, Black gram and Cowpea; Soybean, Horse gram and Lab-lab.
- Oilseeds: Groundnut, Sesame, Sunflower, Safflower, Niger, Mustard. Castor, Jatropha, Coconut and Oilpalm
- Fibres: Cotton, Jute and Mesta
- Sugars: Sugarcane and sugar beet
- Starch: Potato and tapioca
- Beverages: coffee and tea
- Narcotics: Fumitories - tobacco
- Masticatories : betel vine
- Forages: Guinea grass, fodder Sorghum, fodder maize fodder pearl millet, Pearl millet – Napier hybrids, *Cenchrus*, Lucerne, fodder cowpea, *Desmanthus*, desmodium, *Stylosanthes*, siratro, subabul

- Green manures – Daincha, sunnhemp.
- Other sexually propagated horticultural crops: Chillies, bhendi, brinjal , tomato, papaya
- Other clonally propagated horticultural crops: Banana, Rose, Jasmine
- Screening techniques for biotic and abiotic stresses

  - Parental seed maintenance of hybrids, Field visit to hybrid seed production plots in Rice, Sorghum, Pearl millet, Maize, Cotton and Redgram.

**Theory schedule**

Place of origin – putative parents – related wild species – classification – objectives of breeding – methods of breeding – quantity – Quality – stress – conventional – innovative – heterosis breeding – distant hybridization and important varieties in following crops:

1. Cereals: Rice.
2. Cereals: Rice.
3. Cereals: Rice.
4. Cereals: Wheat
5. Cereals : Grain and fodder Maize
6. Cereals: Grain and fodder Sorghum, Pearl millet.
7. Cereals: Finger millet, Foxtail millet, Kodo millet, Little millet, Proso millet and Barn yard millet.
8. Pulses: Redgram , Bengal gram
9. Pulses: Greengram, Blackgram, Grain and fodder Cowpea
10. Pulses: Soybean, Horsegram, lab-lab
11. Oilseeds: Groundnut
12. Oilseeds: Gingelly and Mustard
13. Oilseeds: Castor and Sunflower
14. Oilseeds: Safflower, Niger and Jatropha
15. Oilseeds: Coconut and Oilpalm
16. Fibres: Cotton
17. Fibres:Jute, Mesta
18. **Mid Semester Examination.**
19. Sugars: Sugarcane, Sugar beet
20. Starch: Potato, Tapioca
21. Beverages: Coffee and Tea
22. Fumitories: Tobacco, Masticatories - Betelvine
23. Forage grasses: Guinea grass, Napier, Pearl millet – Napier, *Cenchrus sp*., Paragrass
24. Forage legumes: Lucerne, Stylosanthus, Desmanthus, Desmodium, Siratro, Subabul
25. Green manures and green leaf manures: Daincha, Sunnhemp, Tephrosia, Glyricidia, Neem and Pungam
26. Breeding for other sexually propagated horticultural crops-Bhendi, tomato
27. Breeding for other sexually propagated horticultural crops- chilli, Brinjal, Papaya
28. Breeding for other clonally propagated horticultural crops- Banana, Rose, Jasmine

29. Breeding for pest resistance - mechanisms of resistance
30. Breeding for disease resistance - mechanisms of resistance
31. Breeding for Abiotic stress – drought and cold. – mechanisms of resistance
32. Breeding for Abiotic stress – salinity and alkalinity - mechanisms of resistance
33. Breeding for quality produce.
34. Ideotype breeding, PPV &FR act, 2001- Plant breeders‘ right, Farmers right, Biodiversity act, 2002; Germplasm registration.

**Final theory examination**

**Practical schedule**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on wild species – maintenance of crossing ledger – pedigree record in following crops.

1. Rice
2. Wheat and Maize.
3. Sorghum and Pearl millet. Finger millet, Little millet, Kodo millet, Barn yard millet, proso millet and Foxtail millet.
4. Redgram and Bengal gram
5. Green gram, Black gram and Cowpea; Soybean, Horse gram and Lab-lab.
6. Groundnut, Sesame and Sunflower.
7. Safflower, Niger, Mustard. Castor, Jatropha, Coconut and Oilpalm
8. Cotton, Jute and Mesta.
9. Sugarcane, sugar beet, potato, tapioca, coffee, tea, tobacco and betel vine.
10. Guinea grass, fodder Sorghum, fodder maize, fodder pearl millet, Pearl millet – Napier hybrids, *Cenchrus.*
11. Lucerne, fodder cowpea, *Desmanthus*, desmodium, stylo, siratro, subabul ; Green manures – daincha, sunnhemp.
12. Chillies, bhendi, brinjal , tomato, papaya Banana
13. Rose, Jasmine
14. Screening techniques for biotic stresses
15. Screening techniques for abiotic stresses.
16. Parental seed maintenance of hybrids, Field visit to hybrid seed production plots in Rice, Sorghum, Pearl millet, Maize, Cotton and Redgram.
17. **Final Practical Examination**

**Outcome**

The concepts of genetics and plant breeding, methodologies employed for self, cross and vegetatively propagated crops and current trends in plant breeding will be exposed.

**References**


- ✓ Singh, B.D. 2007. Plant breeding - Principles and methods. Kalyani Publishers, New Delhi.
- ✓ Phoelman, J.N. and Borthakur, 1969. Breeding Asian field crops Oxford & IBH Publishing Co.,

New Delhi.

- ✓ Harihar Ram and Hari Govind Singh, 1994. Crop breeding and Genetics. Kalyani Publishers, New Delhi.
- ✓ D.N.Bharadwaj.2012. Breeding Field Crops. Agrobios (India), Jodhpur - 342002
- ✓ Hari Har 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)

## Further reading

- ❖ 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.

## Web resources

- ❖ www.cimmyt.org
- ❖ www.nbpgr.nic.in
- ❖ www.irri.org
- ❖ www.icrisat.org

## VII Semester

| S.No | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 AEX 401 | Rural Agricultural Work Experience - RAWE (VSP+ADA+NGO+INDUSTRY) | 0+20 |
| 2. | 17 PRJ 401 | Project Work | 0+2 |
| 3. | 17 AEX 402 | All India Study Tour (21 days) | 0+1 |
| | | Total | 0+23=23 |

## 17 AEX 401 RURAL AGRICULTURAL WORK EXPERIENCE (RAWE) 0+20

**Objective**

To enable the students to learn and understand issues related to farming and rural development in a natural setting on real-time basis. The course also provides opportunities for the students to learn about the functioning of the extension machinery, Non-Governmental Organizations (NGOs) and Agri-business firms.

**UNIT I Village Resource Inventory and Planning** (using PRA tools, Rich pictures, GIS maps, secondary data, interview, etc.)

1. 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.
2. 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.
3. Explain the Demographic details – population, literacy, land holdings, farmers, farm women, youth, caste, labour, etc.
4. Analyze the Social factors – social structure, social stratification, social change, social groups, culture, social control, leadership, social processes, migration, social customs, social issues, etc.
5. Study the Socio-psychological factors – group processes / dynamics, attitude towards innovations, etc.
6. 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.
7. Analyze the Problems / Constraints – Problem / Constraints related to farming, marketing,

processing, transport, communication, access to extension and other services, etc.

8. 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.)

1. Describe the Farm boundaries, topography, water resources, soil resources, vegetation, animal enterprises, etc.
2. Describe the cropping pattern, cropping system, farming system, agri-business, etc.
3. Explore Farmers Practices – Indigenous Technical Knowledge (ITK).
4. Identify the constraints of the system environment (natural, economic, social, political, legal).
5. Assess the linkages with Extension agencies, Markets, Input agencies, Media, Development departments, etc.
6. Identify and describe all the people involved in the farm, their work, roles, visions, needs, values, interests and relationships.
7. 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?
8. 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.
9. Identify the linkages with the Supra System viz., economic, political, legal and social.
10. Find out the adoption pattern of recommended varieties / hybrids, technologies, machinery / implements, etc.
11. Analyze the financial status and performance of the system - Economics of production (area, production, productivity, yield gaps, net returns, cost benefit ratio, etc).
12. 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.

## 17 AEX 402 ALL INDIA STUDY TOUR (0+1)

**Objective**

The course will provide an opportunity to the students to study the functioning of important national and international institutes related to agriculture and allied fields.

**Syllabus**

- 21 days visit to important National and International institutes related to agriculture, horticulture, forestry and allied fields in various regions of our 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

| S.No. | Course No. | Course Title | Credit Hours |
|---|---|---|---|
| 1. | 17 EXP 401 | Experiential Learning – Module I | 0+10*** |
| 2. | 17 EXP 402 | Experiential Learning – Module II | 0+10*** |
| | | **Total** | **0+20= 20** |

*** Experiential Learning Courses (List of options given in page No. 9)

Elective courses : A student can select one optional course out of the following offered during VI semester.

| S.No | Code No. | Courses | Credit Hours |
|---|---|---|---|
| 1 | 17 CRP 311 | Physiological Techniques in crop production | 2 (1+1) |
| 2 | 17 SAC311 | Designer fertilizer Production | 2 (1+1) |
| 3 | 17 SAC312 | Rejuvenation of Deteriorated lands | 2 (1+1) |
| 4 | 17 SAC313 | Soilless crop production | 2 (1+1) |
| 5 | 17 SAC314 | Instrumental methods of analysis | 2 (1+1) |
| 6 | 17 SST 311 | Seed entrepreneurship skill development and management | 2 (1+1) |
| 7 | 17 AGR 311 | Weed and water management | 2 (1+1) |
| 8 | 17 PGP 311 | Plant Genetic Resources Collection, Conservation and Utilization | 2 (1+1) |
| 9 | 17 NEM 311 | Commercial Production of Nematode Antagonistic bio-agents | 2 (1+1) |
| 10 | 17 AGM 311 | Downstream Processing for Industrially Important Microbial Products | 2 (1+1) |
| 11 | 17 AGM 312 | Microbial Enzymes | 2 (1+1) |
| 12 | 17 AGM 313 | Microbial Quality and Safety of Foods | 2 (1+1) |
| 13 | 17 AGM 314 | Plant –Microbe Interaction | 2 (1+1) |
| 14 | 17 AGM 315 | Quality Control of Bio-inoculants | 2 (1+1) |
| 15 | 17 SAC 315 | Crop and Pesticide Chemistry | 2 (1+1) |

## 17 CRP 311 Physiological Techniques in crop production (1+1)

**Aim**

To impart basic knowledge on various functions and processes related to stress physiology, nutrio physiology, hormonal physiology, production physiology, post harvest physiology etc., and their application in crop production.

**Unit I Stress physiology**

Abiotic Stress: Water deficit – impact of drought on crop productivity -characteristic features of drought tolerant plants, Drought resistance and tolerance mechanisms, Osmotic adjustment and osmoregulation, stress proteins, Water use efficiency – carbon isotope discrimination-Physiological traits associated with drought and Mitigation techniques. Flooding: Physiological mechanism of adaptation, Mitigation techniques, Temperature stress: High and Low Temperature, Tolerance mechanisms - Functions of HSPs and CSPs, Oxidative stress: Reactive Oxygen Species (ROS). Role of scavenging systems – Enzymatic and Non-Enzymatic, Physiological traits associated with high and low temperature, Mitigation techniques. Salt stress: Physiological basis of tolerance mechanisms, Physiological traits associated with salt stress, Mitigation techniques. UV stress and climate change: Physiological adaptation of crops to UV radiation and tolerance mechanisms.

**Unit II Nutriophysiology**

Diagnosis and correction measures for nutritional disorders including Macro, Micro and secondary nutrients in Cereals, Pulses, Oilseeds, Fibre and Sugar crops; Fruits, Vegetables, Flowers, Spices, Plantation and Aromatic crops. Impact of heavy metals on physiology and productivity of crops, Phytoremediation, Importance of beneficial elements – Na, Si, Se, Co.

**Unit III Hormonal physiology**

Role of hormones in plant growth and yield enhancement, stress management and quality improvement - Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene and Brassinosteroids. Role of other phytohormones in crop production-triacontanol, polyamines, jasmonates and salicylic acid, New generation PGRs - 1- MCP, Triazoles, strigalactone, pro-hexadione Ca.

**Unit IV Production Physiology**

Physiological limitations of crop productivity, Physiological and genetic basis of crop environment interaction, Plant architecture – Ideotype concept, Crop photosynthetic efficiency –

$C_3$ , $C_4$ and CAM Strategies to improve the crop photosynthesis,Source- sink balance and Harvest Index.

**Unit V Postharvest physiology**

Environmental factors influencing senescence, ripening and postharvest life of fruits, flowers, vegetables and seeds. Physiological and biochemical aspects of senescence and fruit ripening. Regulatory role of ethylene in senescence and ripening, Pre and post harvest measures to influence shelf life.

**Theory Lecture schedule**

1. Classification of abiotic stresses - Drought – types-Drought resistance and tolerance mechanisms- adaptations-Physiological traits associated with drought -osmotic adjustment.
2. Reactive Oxygen Species- scavenging enzymes- stress proteins-water use efficiency – carbon isotope discrimination- concept -mitigation techniques.
3. Flooding - Physiological mechanism of adaptation- physiological traits associated with flooding- Role of ethylene.
4. Temperature stress-High and Low Temperature -Tolerance mechanisms-Functions of HSPs and CSPs - Physiological traits associated with high and low temperature.
5. Salt stress - Physiological basis of tolerance mechanisms –adaptations- Physiological traits associated with salt stress.
6. Physiological adaptation of crops to high and low light and UV radiation.
7. Impact of heavy metals on physiology and productivity of crops –Phytoremediation.
8. **Mid Semester examination**
9. Diagnosis and correction measures for nutritional disorders in Cereals, Millets, Pulses, Oilseeds.
10. Diagnosis and correction measures for nutritional disorders in Fibre, Sugar crops, Fruits and Vegetable, Flowers, Spices, Plantation, Medicinal and Aromatic crops.
11. Importance of beneficial elements – Na, Si, Se, Co- Effect of crop specific application of beneficial elements.
12. Role of hormones in plant growth and yield enhancement, stress management and quality improvement – Auxins, Gibberellins and Cytokinins.
13. Role of hormones in plant growth and yield enhancement, stress management and quality improvement –Abscisic acid, Ethylene and Brassinosteroids.

14. Role of other phytohormones -triacontanol, polyamines, jasmonates and salicylic acid. New generation PGRs - 1- MCP, Triazoles, strigalactone, pro-hexadione Ca.
15. Physiological limitations of crop productivity, Physiological and genetic basis of crop environment interaction, Plant architecture – Ideotype concept.
16. Crop photosynthetic efficiency – $C_3$, $C_4$ and CAM Strategies to improve the crop photosynthesis, Source- sink balance and harvest index.
17. Environmental factors influencing senescence and ripening-Physiological and biochemical aspects of senescence and fruit ripening-Factors affecting post harvest life of fruits- measures for enhancing the shelf life of fruits, vegetables and flowers.

**Practical schedule**

1. Determination of osmotic potential
2. Gas Exchange measurements using Infra Red Gas Analyzer
3. Stress induction response techniques
4. Water Use Efficiency or Transpiration Efficiency of crops
5. Estimation of anti oxidant enzymes activity – Catalase and peroxidase
6. Estimation of Membrane thermal stability
7. Bioassay for Cytokinins
8. Effect of PGRs on flowering
9. Effect of PGRs on fruit ripening
10. Influence of ABA on stomatal regulation
11. Diagnosis of nutritional disorders and their amelioration measures
12. Nutrient application techniques
13. Estimation of Macro nutrients in plant samples
14. Estimation of micro and secondary nutrients using AAS
15. Field Visit I- Diagnosis of nutrient disorders
16. Field Visit II-Postharvest storage facilities
17. Final practical

**Outcome**

Students will acquire basic knowledge on various functions and processes related to stress physiology, nutrio physiology, hormonal physiology, production physiology and post harvest physiology. In addition, hands on exposure to determine osmotic potential, influence of PGRs in fruit ripening, stomatal regulation, Stress induction response techniques and estimation of macro

and micro nutrient will help the student gain confidence in skill oriented education. Student will also get exposure in diagnosis of nutrient disorders which will augment in recommending remedial measures to nutrient disorders and extending the storage life of harvested produce.

**Text books**


1. Barker AB &Pilbeam DJ. 2007. Handbook of Plant Nutrition. 2nd Edition, CRC Press, Taylor & Francis Group. Pp 1-773.
2. Bewley, J.D. and Black, M. 1985. Seed Physiology of Development and Germination. Plenum Publishing Corp. New York, NY.pp 70-73.
3. Bleasdale, J.K.A. 1984. Plant Physiology in Relation to Horticulture. 2nd Ed. MacMillan & Avi Publishing Company, USA.
4. Leopold, A.C. and Kriedemann, P.E. 1985. Plant Growth and Development. 3rd Ed. McGraw-Hill, New York, pp 545.
5. Madhava Rao KV, Raghavendra, AS and Janardhan Reddy K. 2006. Physiology and Molecular Biology of Stress Tolerance in Plants. Springer publishers, Netherland.
6. Taiz. L. and Zeiger. E., 2015 (Sixth edition). Plant Physiology and Development. Publishers: Sinauer Associates, Inc., Massachusetts, USA.
7. Wilkins MB. 1969. Physiology of Plant Growth and Development. Tata McGraw-Hill, New York, pp 127-162.


**e- books and e-references**

1. http://www.plantphys.net
2. http://www.plantstress.com
3. http://www.ipni.net
4. http://www.edis.ifas.ufl.edu
5. http://www.greenair.com/plantlnk.htm
6. http://www.tvdsb.on.ca

## 17 AGR 311 WEED AND WATER MANAGEMENT (1+1)

**Unit - I**

Weeds: Introduction, Definitions; harmful and beneficial effects, classification,; crop weed competition and allelopathy. Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management.

**Unit - II**

Herbicides - Classification, characteristics, formulations, methods of application; advantages-.Weed management in major field crops - aquatic and problematic weeds and their control.

**Unit – III**

Role of water in plant growth - Importance of irrigation- Soil - water - plant relationship - Soil Plant Atmospheric Continuum (SPAC) - Hydrological cycle - Soil water movement - soil moisture constants - Moisture extraction pattern - Absorption of water.

**Unit IV**

Crop water requirement- Factors affecting water requirement- Factors affecting water requirement. Scheduling of irrigation – Water use efficiency

**Unit V**

Methods of irrigation: surface, sub-surface sprinkler and drip irrigation – Micro irrigation: layout, suitability, merits and scope.

**Practical**

Identification of weeds in wetlands, gardenland and drylands – Practicing different methods of weed control -Calculations on weed control efficiency and weed index; Classification and characteristics of herbicides - Computation of herbicide doses- Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application;

Estimation of soil moisture - Measurement of irrigation water through water measuring devices (flumes, weirs and water meter) - Calculation of irrigation water requirement (problems)- Acquiring skill in land shaping for different surface irrigation methods - Operation and economics of drip and sprinkler irrigation systems - Estimation of crop water requirement - Irrigation efficiency (problems) –

**Theory**

**Lecture Schedule :**

1. Weeds - Definition, classification
2. Characteristics of weeds, harmful and beneficial effect of weeds.
3. Crop weed interactions - Critical crop weed competition, competitive and allelopathic effects of weeds and crops.
4. Methods of weed control: physical, cultural
5. Methods of weed control: chemical and biological methods. Integrated weed management.
6. Herbicides - Classification, characteristics, formulations,
7. Methods of herbicide application
8. Weed management in major field crops - aquatic and problematic weeds and their control.
9. **Mid semester examination**
10. Role of water in plants - Importance of irrigation
11. Soil - Plant -water relationship - Soil-plant-atmospheric continuum - Hydrologic cycle - absorption of water and evapotranspiration.
12. Soil water movement - saturated and unsaturated flow and vapour movement - soil moisture constants and their importance in irrigation.
13. Available soil moisture - definition and importance - moisture extraction pattern
14. Crop water requirement - factors affecting crop water requirement -Critical stages for irrigation - water requirement for different field crops.
15. Scheduling of irrigation - Different approaches- Water use efficiency
16. Methods of irrigation - surface (flooding, beds and channels, border strip, ridges and furrows, broad bed and furrows, surge irrigation) and sub-surface methods.
17. Micro irrigation system (drip and sprinkler irrigation) - suitability, components, layout, operation, advantage and disadvantage.

**Practical schedule:**

1. Identification, classification and characterization of wetland weeds.
2. Identification, classification and characterization of gardenland and dryland weeds.
3. Practicing skill development on cultural and non chemical weed management.
4. Identification, classification and characterization of herbicides.
5. Practicing skill development on herbicide application techniques.
6. Practicing Skill development on spray equipment’s and spray fluid calibration.

7. Calculation of herbicide quantity and recommendation for different eco systems
8. Working out weed index, weed control efficiency and economics in weed management studies.
9. Estimation of soil moisture by gravimetric method and tensiometer.
10. Estimation of soil moisture by resistance blocks and neutron probe and other improved devices.
11. Measurement of irrigation water with flumes and weirs.
12. Calculation of irrigation water based on source, water flow, soil moisture status and depth of irrigation.
13. Land leveling and land shaping - Beds and channels - ridges and furrows.
14. Layout, operation and maintenance of drip and sprinkler irrigation systems.
15. Estimation of crop water requirement by direct and indirect methods.
16. Calculations on irrigation efficiency parameters.
17. **Practical examination**

**References:**


Gupta, O. P. 1998. Modern Weed Management. Agro Botanica Bikaner, India.

Subramanian, S. A. Mohammed Ali and R. Jayakumar. 1991. All about Weed Control. Kalyani Publishers, New Delhi.

Jaganathan R., and R.Jayakumar. 2003. Weed Science Principles, Kalyani Publishers, New Delhi.

Das, P.C. 2015. Weed Science. New India Publishing Agency, Jaipur

Michael, A.M. 1997. Irrigation: Theory and Practice Vikas Publishers.

Sankara Reddy, G.H. and T. Yellamanda Reddy. 1997. Efficient use of irrigation water. Kalyani Publishers

Reddy, S.R.2012.Irrigation Agronomy. Kalyani publishers, NewDelhi

Nirmal Tripathy.2014. Irrigation,Watershed and Drainage. Agrotech Press, Jaipur

Gupta,A.K. 2014. Irrigation and Drainage. Oxford Book Company, Jaipur

Israelsen, O.W. 2012. Irrigatiom Principles and Practices. Axis Books (India), Jodhpur.

Michael, A.M. 2009. Irrigation- Theory and Practice, Vikas Publishing House, Noida


**E-References:**


www.tnau.ac.in

www.fao.org

www.tnau.ac.in/agriportal

www.irri.org

www.wcc.nrcs.usda.gov/nrcsirrig

www.wcc.nrcs.sda.gov/irrig.info.html

www.croinfo.net/irrigschedule.html

## 17 AGM 311 DOWNSTREAM PROCESSING FOR INDUSTRIALLY IMPORTANT MICROBIAL PRODUCTS (1+1)

**Aim** : This course aims to develop the skills of the students in the area of Downstream processing of important microbial products.

**Objective**: At the end of the course, student would have learnt about various purification techniques available for industrially important microbial products like, antibiotics, amino acids proteins, enzymes, organic acids etc

**Unit I - Introduction to Bio separation Processes**

Role and importance of bioseparations in biotechnological processes.Problems and requirements of bioproduct purification. Cost- cutting strategies. Characteristics of biological mixtures. Classification of bioproducts - Biological activity, Analysis of purity-Process economics- Capital and operating cost analysis

**Unit II - Physical Methods of Separation**

Centrifugation and filtration. Cell disruption methods; enrichment operations: precipitation methods- with salts, organic solvents, and polymers; extractive separations - aqueous two-phase extraction, supercritical extraction; adsorption methods; membrane based separation theory - types of membranes, types of membrane processes - dialysis; ultrafiltration; microfiltration and reverse osmosis.

**Unit III Physical and chemical methods - Isolation of products**

Physico-chemical basis of bio-separation processes. Removal of particulate matter, biomass and insolubles: flocculation; sedimentation; adsorption: isotherm, batch, continuous and scale-up of adsorption; extraction: solvent separation, equipment and modes of extraction. Aqueous-two-phase extraction process, supercritical fluid extraction.Precipitation of proteins-methods and scale-up.

**Unit IV Isolation of Products - Chromatographic methods of purification**

Chromatography - principles, instruments and performance parameters. Paper, TLC, adsorption, gel filtration, reversephase, ion-exchange, hydrophobic interaction, bioaffinity, pseudo affinity

chromatographic techniques; GC, HPLC, HPTLC, FPLC, parafusion chromatography and membrane based chromatographic techniques and sample preparation. Electrophoretic separations.

**Unit – V Finishing Operations**

Products polishing: Crystallization and drying; Purification of antibiotics, amino acids, enzymes and organic acids, proteins, pigments, plant growth hormones, monoclonal antibodies, human growth hormones – Insulin etc.

**Practical**

Kinetics of a bacterium / yeast in batch culture- doubling time, specific growth rate and growth curve. Batch cultivation of microbes for product formulation; calibration of pH probe, medium preparation, sterilization, and calibration of $dO_2$ probe. Inoculation of a bacterial / yeast strain in fermentor for batch production of an enzyme / biomass/ ; estimation of kinetic parameters of product formation, biomass production and substrate utilization. Laboratory centrifugation for separation of biomass from fermentation broth.Filtration and microfiltration for solid-liquid separation. Extraction of crude enzyme from microbial biomass and enzyme assay. Production of microbial secondary metabolites and product recovery. Mechanical cell disruption by homogenization: determination of product release kinetics. Sonication of microbial cell suspensions and determination of product release kinetics.Salting out of proteins by precipitation with ammonium sulphate. Precipitation of proteins with acids or bases: determination of isoelectric point. Batch adsorption of an acid on activated charcoal.Solvent extraction and aqueous two-phase extraction of proteins. Gel-filtration chromatography of a protein - salt mixture.Ion-exchange chromatography of a positively charged protein.Gas chromatography for quantitative estimation of volatiles- ethanol.SDS-PAGE of proteins and determination of molecular weight.

**Lecture Schedule**

1. Role and importance of bio separations in biotechnological processes. Problems and requirements of bioproduct purification
2. Cost- cutting strategies. Characteristics of biological mixtures. Classification of bio products

3. Biological activity, Analysis of purity. Process economics. Capital and operating cost analysis
4. Centrifugation and filtration-Cell disruption methods
5. Enrichment Operations: precipitation methods(with salts; organic solvents and polymers)
6. Extractive separations; aqueous two-phase extraction; supercritical extraction and adsorption methods
7. Membrane based separation theory - types of membranes; types of membrane processes – dialysis, ultrafiltration, microfiltration and reverse osmosis
8. Physico-chemical basis of bio-separation processes. Removal of particulate matter, biomass and insolubles: flocculation; sedimentation
9. **Mid semester evaluation**
10. Adsorption – Isotherm,batch, continuous and scale-up of adsorption
11. Extraction: solvent separation, equipment and modes of extraction.Aqueous two-phase extraction process, supercritical fluid extraction.
12. Precipitation of proteins: methods and scale-up. Chromatography - principles, instruments and practice
13. Paper; TLC, adsorption, gel filtration; reverse phase, ion-exchange, hydrophobic interaction, bioaffinity ; pseudo affinity chromatographic techniques
14. GC, HPLC, FPLC HPTLC, parafusion chromatography and membrane based chromatographic techniques and sample preparation. and electrophoretic separation
15. Products polishing. Crystallization and drying. Purification of antibiotics
16. Purification of amino acids,organic acids, enzymes and proteins
17. Monoclonal antibodies; human growth hormones – Insulin etc

**Practical Schedule**

1. Kinetics of a bacterium / yeast in batch culture: calculation of doubling time, specific growth rate, and plotting of growth curve.
2. Preparation of fermentor and accessories for batch cultivation of microbes: calibration of pH probe, medium preparation, sterilization, and calibration of $dO_2$ probe.
3. Inoculation of a bacterial / yeast strain in fermentor for batch production of an enzyme / biomass: estimation of kinetic parameters of product formation, biomass production and substrate utilization.

4. Laboratory centrifugation for separation of biomass from fermentation broths. Filtration and microfiltration for solid-liquid separation.
5. Extraction of crude enzyme and assay of enzyme
6. Production of secondary metabolites from microbes and recovery
7. Mechanical cell disruption by homogenization: determination of product release kinetics.
8. Sonication of microbial cell suspensions and determination of product release kinetics.
9. Salting out of proteins by precipitation with ammonium sulphate.
10. Precipitation of proteins with acids or bases: determination of isoelectric point.
11. Batch adsorption of an acid on activated charcoal.
12. Solvent extraction and aqueous two-phase extraction of proteins.
13. Gel-filtration chromatography of a protein-salt mixture.
14. Ion-exchange chromatography of a positively charged protein.
15. Gas chromatography for quantitative estimation of volatiles: ethanol.
16. SDS-PAGE of proteins and determination of molecular weight
17. **Final Practical Examination**

**Text Books**


1. Sivasankar B., 2010. Bioseparations: Principles and Techniques, PHI, New Delhi .
2. Stanbury, P.F., Whitaker, A. and Hall, S.J. 2016. Principles of Fermentation Technology, BH Elsevier Publications, Third Edition.


**Reference Books**


1. Harrison, R.G. Todd, P., Rudge, S.R. andPetrides, D.P., 2003. Bioseparation Science and Engineering, Oxford University Press.
2. Costa,C.A. and CabralJ.S. 1991. Chromatographic and Membrane Processes in Biotechnology, Publisher: Kluwer Academic Publishers, The Nether lands.
3. Harrison et al. 2006. Bioseparation Science and Engineering. Oxford Univ. Press.
4. Nooralabettu Krishna Prasad, 2010. Downstream Process Technology: A New Horizon in Biotechnology, PHI, New Delhi.
5. Jenkins, R.O. 1992. Product Recovery in Bioprocess Technology, Biotechnology by Open Learning Series, Butterworth- Heinemann, London, Second Edition.

## 17 AGM 312 MICROBIAL ENZYMES (1+1)

**Aim:** Main aim of the course is to impart knowledge on microbial sources of enzymes and their utility in different industries.

**Objectives**: Student will learn about the microbial enzymes, their characteristics, techniques of microbial enzyme production and use in different industries.

### Unit I: Introduction

Introduction and Scope, General distinctive features and industrial applications. Enzymes: Historical perspectives, Nomenclature and classification of enzymes. Isozymes, biological roles, activation energy, chemical nature of enzymes, characteristics of enzymes, 3'D' structure of enzymes, active site, factors affecting enzyme activity, modifiers of enzyme activity, enzyme activators, enzyme inhibitors and allosteric enzymes.

### Unit II: Enzyme kinetics

Kinetics of single substrate reactions, Estimation of *Michaelis - Menten* parameters, multi substrate reactions, mechanisms and kinetics, turnover number, types of inhibition, kinetic models: substrate and product inhibition, allosteric regulation of enzymes, *Monod ChangeuxWyman* model, pH and temperature effect on enzymes and deactivation kinetics. Vitamins and their co-enzymes: structure and functions with suitable examples. Metallo enzymes and metal ions as co-factors and enzyme activators.

### Unit III: Extraction and purification of microbial enzymes

Importance of enzyme purification, different sources of enzymes.Extracellular and intracellular enzymes. Physical and chemical methods used for cell disintegration. Enzyme fractionation by precipitation - using temperature, salt, solvent, pH, *etc*., Liquid-liquid extraction -ultra filtration, ionic exchange, gel chromatography, affinity chromatography and other special purification methods. Enzyme crystallization techniques.Criteria of purity of enzymes.

### Unit IV: Industrial applications of enzyme and enzyme engineering

Industrial applications: Microbial enzymes in textile, leather, wood industries and detergents. Enzymes in clinical diagnostics.Enzyme sensors for clinical processes and environmental analyses.Enzymes as therapeutic agents. Enzyme engineering: Chemical modification and site-

directed mutagenesis to study the structure-function relationship of industrially important enzymes. Cloning- strain improvement.

**Unit V: Enzyme formulation**

Physical and Chemical techniques for enzyme immobilization – adsorption - matrix entrapment encapsulation - cross-linking - covalent binding - examples; advantages and disadvantages of different immobilization techniques. Freeze drying and spray drying of immobilized enzymes.

**Practical**

Amylase production using *Bacillus amyloliquefaciens*and its assay.Protease production by using *Bacillus* isolate and its quantification. Production of cellulase by solid state fermentation (SSF) of rice straw through lignocellulolytic fungi: (a) Estimation of filter paper lyase activity (b) Estimation of carboxy methyl cellulase activity. Production and estimation of xylanase from rice straw through submerged fermentation.Immobilization of microbial cells for enzyme production. Protease production from *Bacillus subtilis* using soybean meal.Purification of fungal α - amylase or bacterial protease by fractionation, chromatographic techniques and electrophoretic separation. Studies on enzyme kinetics of alpha amylase / protease- optimization of parameters *viz*., substrate, enzyme concentration, reaction temperature, reaction pH, $K_m$, $V_{max}$ and metal ions as activators and inhibitors. Enzyme extraction- concentration- ultrafiltration- chromatography- microencapsulation.

**Theory schedule**

1. Introduction and scope, general distinctive features and industrial applications.
2. Enzymes: historical perspectives, nomenclature and classification .
3. Isozymes, biological roles, activation energy, chemical nature of enzymes.
4. Characteristics of enzymes, 3'D' structure of enzymes, active site, factors affecting enzyme activity.
5. Modifiers of enzyme activity, enzyme activators, enzyme inhibitors; allosteric enzymes.
6. Kinetics of single substrate reactions, estimation of *Michaelis - Menten* parameters, multi substrate reactions, mechanisms and kinetics; turnover number.
7. Types of inhibition; Kinetic models: substrate and product inhibition; Allosteric regulation of enzymes.

8. *Monod Changeux Wyman* model, pH and temperature effect on enzymes and deactivation kinetics.

**9. Mid Semester Examination**

10. Vitamins and their co-enzymes: structure and functions with suitable examples. Metallo enzymes and metal ions as co-factors and enzyme activators.
11. Importance of enzyme purification, different sources of enzymes. Extracellular and intracellular enzymes.
12. Physical and chemical methods used for cell disintegration. Enzyme fractionation by precipitation - using temperature, salt, solvent, pH, *etc*., liquid-liquid extraction.
13. Ionic exchange, gel chromatography, affinity chromatography and other special purification methods. Enzyme crystallization techniques. Criteria of purity of enzymes.
14. Industrial applications: Microbial enzymes in textile, leather, wood industries and detergents. Enzymes in clinical diagnostics. Enzyme sensors for clinical processes and environmental analyses. Enzymes as therapeutic agents.
15. Enzyme engineering: Chemical modification and site-directed mutagenesis to study the structure-function relationship of industrially important enzymes. Cloning- strain improvement.
16. Physical and Chemical techniques for enzyme immobilization – adsorption - matrix entrapment encapsulation - cross-linking - covalent binding - examples;
17. Advantages and disadvantages of different Immobilization techniques - overview of applications of immobilized enzyme systems

**Practical schedule**

1. & 2. Amylase production using*Bacillus amyloliquefaciens*in submerged and solid state fermentationand its assay.
3. & 4. Protease production using*Bacillus* isolate and its quantification.
5. Production of cellulase by solid state fermentation (SSF) of rice straw through lignocellulolytic fungi - Estimation of filter paper lyase activity.
6. Production of cellulase by SSF of rice straw through lignocellulolytic fungi- Estimation of carboxy methyl cellulase activity.
7. Production and estimation of xylanase from rice straw through submerged fermentation.
8. Immobilization of microbial cells for enzyme production.
9. Protease production from *Bacillus subtilis*using soybean meal.

10. -12. Purification of fungal alpha-amylase or bacterial protease by fractionation, chromatographic techniques and electrophoretic separation.

13-14. Studies on enzyme kinetics of alpha amylase / protease - optimization of parameters *viz*., substrate, enzyme concentration, reaction temperature, reaction pH, $K_m$, $V_{max}$ and metal ions as activators and inhibitors.

15-16. Enzyme extraction- concentration-ultrafiltration-chromatography-microencapsulation

17. **Final Practical Examination**

**Text Books**


1. Alexander N. Glazer, Hiroshi Nikaido. 2007. Microbial Biotechnology, Second Edition, ISBN 9780521842105, Cambridge University Press.

2. Trevor Palmer and Philip L. Bonner, 2004. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, East- West Press.


**Reference Books**


1. Shuler, M.L. and F. Kargi, 2002. Bioprocess Engineering : Basic Concepts, Second Edition, Pearson.
2. Blanch, H.W and D.S. Clark, 1997. Biochemical Engineering, Marcel & Dekker, Inc.,.
3. Bailey, J.E and D.F. Ollis, 1986. Biochemical Engineering Fundamentals, Second Edition, McGraw-Hill.
4. Nicholas C. Price and Lewis Stevens, 1982. Fundamentals of Enzymology, Oxford University Press.
5. Alan Wiseman, 1999. Handbook of Enzyme Biotechnology, Third Edition, Ellis Harwood Publications.


**E-Book**


1. James Lee, M., Biochemical Engineering, PHI, USA, e-Book Version 2.1, 2002.

## 17 AGM 313 MICROBIAL QUALITY AND SAFETY OF FOODS (1+1)

**Aim:**This course aims in imparting knowledge on microbial quality and safety of foods.

**Objectives :**At the end of the course the student will be able to learn the techniques of microbial quality assessment and food safety standards**.**

**Unit I Introduction**

Food safety risks and assessment– characteristic features of spoilage - significance of spoilage of different groups of foods - cereal and cereal products, vegetables and fruits, meat, poultry, sea foods, milk and milk products, packed and canned foods.

**Unit IIFood borne infections and intoxications**

Food borne pathogens- food infections and intoxications of food borne diseases – bacteria, fungal, protozoa and viral.Investigation and management of food borne diseases.

**Unit III Techniques for detection of pathogens and toxins**

Advanced laboratory techniques for food-borne pathogens: principle, working and application of GC-MS, HPLC, LC/MS, inductively coupled Plasma Mass Spectroscopy, TOF and PCR-real time PCR.DGGE.Metagenomics, proteomics and immunological methods

**Unit IV Food standards**

Food standards – HACCP concepts, principles – EU, FDA and WHO standards - CODEX – Food Law & regulations - HACCP principles & applications – GM foods – SSOP – GMP & GAP – Food traceability- Food Audit - functions, duties and responsibilities of food safety regulators.

**Practical**

Food sampling procedures – Preparation & plan - Examination of microorganisms of by aerobic plate count -Assessing *Bacillus cereus,* coliforms, *Campylobacter, Salmonella* and *Staphylococcus* in various food samples. Microbiological examination of canned foods. Rapid detection of pathogens and toxins in foods– HACCP of fruits and vegetables - visit to food processing industry.

**Lecture Schedule**

1. Food Safety Risks - biological, chemical, physical risks; risk assessment.
2. Physical and chemical changes during food spoilage.

3. Significance of microbial spoilage of different groups of foods - cereals, vegetables and fruits, packed and canned foods.
4. Significance of microbial spoilage of different groups of foods-meat, poultry, sea foods, milk and milk products.
5. Food borne pathogens – food infection – intoxication - bacterial food borne diseases – viral and protozoa.
6. Mycotoxicoses in foods – occurrence and economic significance and food control measures.
7. Analytical techniques and their working principles for the detection of toxin in foods – GC-MS, HPLC and HPTLC.
8. Analytical techniques and their working principles for the detection of toxin in foods - LC/MS, ICP – MS and TOF.
9. **Mid Semester Examination**
10. Molecular Detection of Food borne Pathogens - PCR, real time PCR, DGGE, metagenomics, proteomics and immunological methods
11. Food standards – India, EU, FDA and WHO Standards of Food Safety
12. Food laws & Regulations - CODEX
13. HACCP concepts, principles and applications
14. GM foods and current guidelines for production and labeling
15. Food Safety – Standard Sanitation Operating Procedures; GMP, GAP for food safety
16. Food traceability– significance - Food safety Audit
17. Functions, duties and responsibilities of food safety regulators

**Practical schedule**

1. Different sampling plan in food and preparation for various foods
2. Determination of aerobic plate counts in food
3. Enumeration of yeasts and molds in food
4. Detection and confirmation of *Bacillus cereus* in food
5. Microbiological hazard analysis in processed fruit product
6. Microbiological hazard analysis in water - water quality control
7. Microbiological hazard analysis in fresh vegetables – *Campylobacter* and *Salmonella*
8. Microbiological hazard analysis in beverages - Detection of coliforms
9. Microbiological techniques for cereal based food analysis

10. Microbiological hazard analysis in meat products - *Staphylococcus aureus*
11. Rapid detection of toxin producing *Escherichia coli* (STEC) in food products –PCR method
12. Detection of aflatoxin in groundnut and maize kernels
13. Hazard Analysis and Critical Control Point (HACCP) of Fruits / vegetables
14. Hazard Analysis and Critical Control Point (HACCP) of processed foods
15. Visit to Food Processing industry
16. Microbiological examination of canned foods
17. **Final Practical Examination**

**Text Books**


1. Adams, M.R. and Moss, M.O.1995. Food Microbiology. The Royal Society of Chemistry, Cambridge.
2. Frazier, W.C. and Westhoff, D.C.1988. Food Microbiology. TATA McGraw Hill Publishing Company Ltd., New Delhi.


**Reference Books**


1. Jay, J.M.1987. Modern Food Microbiology. CBS Publishers and distributors, New Delhi.
2. Banwart, G.J.1989. Basic Food Microbiology. Chapman & Hall New York.
3. Board, R.C.1983. A Modern Introduction to Food Microbiology. Blackwell Scientific Publications, Oxford.
4. Robinson, R.K.1990. Dairy Microbiology Elsevier Applied Science, London.
5. Hobbs, B.C. and Roberts, D.1993. Food Poisoning and Food Hygiene. Edward Arnold.
6. Lund B.M., Baird Parker A.C., and Gould G.W. 2000. The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
7. Gould G.W. 1995. New Methods of Food Preservation. Blackie Academic and Professional, London.

## 17 AGM 314 PLANT-MICROBE INTERACTIONS (1+1)

**Aim:** To allow students to explore various ways in which microbes interact with plants, and the outcomes of that interplay. The focus is on examination of the physiological, biochemical and genetic basis of these interactions, using comparisons to other prokaryotic and eukaryotic model systems.

**Objectives**: At the end of this course students will be able to:

- recognize and distinguish between the different types of plant-microbe interactions
- explain the physiological and biochemical processes underlying major symbiotic and pathogenic relationships
- analyse the design and content of current research studies published in this area of study
- draw connections between the biology of plant-microbe relationships, the impacts of those relationships on plant growth

**Unit I Introduction**

Introduction to plant - microbe interactions; types of interaction -positive and negative.Plants as microbial habitat.Spermosphere, phyllosphere and endophyticmicroorganisms.Bacterial secretion systems, gene regulation and quorum sensing in bacterial - plant interactions.Role of plant-microbial interactions in soil health and plant growth promotion. Signalling - effect of microbial signalling on plant productivity and plant signalling on microbial diversity and activity in the soil.

**Unit II Plant- microbe interaction -I**

Beneficial bacteria – *Arthrobacter, Azospirillum, Azoarcus Bacillus, Burkholderia, Frankia, ,Gluconacetobacter, Herbaspirillum,Paenibacillus, Pseudomonas, Rhizobium, Streptomyces* and*Xanthomonas* - host interactions and plant growth promotion. *Agrobacterium* induced tumorigenesis and rhizogenesis. Azolla - *Anabaena* symbiosis.

**Unit III Plant– microbe interaction -II**

Mutualistic fungal symbionts.Ectomycorrhizal and endomycorrhizal fungi. Infection processes. Interactions with host plants and other soil microbes. Infection processes- fungi and toxins. Induced resistance.Secondary product responses and fungal virulence.Lichens, algal and bacterial interaction.

**Unit IV Applications – Agriculture and industires**

Plant growth promoting bacteria-types and mechanism of plant growth promotion.Biocontrol agents- types and mechanism of action.Induced resistance: Protein defenseresponses and systemic responses.Phytoremediation**.**Industrial application and medicinal applications – antiviral, anti-cancerous, immunosuppressive and antioxidants.

**Unit V Techniques to study plant–microbe interactions**

Techniques to study plant- microbe interactions - Phytortron, Rhizotron and Confocal Laser Scanning Microscope.

**Practical**

Collection and assay of root exudates. Characterization of root exudates. Studying the effect of root exudates on selected bacterial population. Isolation of ecto and endorhizosphere microorganisms.Isolation ofspermospheremicorganisms from germinating seeds. Isolation and purification of endophytic and phyllosphere microorganisms from rice. Visit to plantations and collection of ectomycorrhizal fruiting bodies, orchidaceous and ericoid mycorrhizal root samples and lichens. Examination of endomycorrhizal infection in orchids and ericaceous plants. Examination of lichens associated with trees. Collection and examination of *Anabaena azollae* associated with Azolla. Testing rhizogenesis by *A. rhizogenes*in laboratory conditions.

**Lecture Schedule**

1. Introduction to plant - microbe interactions; types of interaction - positive and negative. Plants as microbial habitat.
2. Role of microbial diversity in soil health and plant growth promotion.
3. Signalling – effect of microbial signalling on plant productivity.
4. Effect of plant signalling on microbial diversity and activity in the soil.
5. Spermosphere andphyllospheremicroroganisms; endophytic microorganisms.
6. Bacterial secretion systems, gene regulation and quorum sensing in bacterial - plant interaction

7.&8. Beneficial bacteria – *Arthrobacter, Azospirillum, Azoarcus, Bacillus, Burkholderia, Frankia, Gluconacetobacter, Herbaspirillum,Paenibacillus, Pseudomonas, Rhizobium, Streptomyces* and*Xanthomonas* - host interactions and plant growth promotion

9. **Mid Semester Examination**
10. *Agrobacterium* induced tumour formation and root proliferation*;* exploitation of tumorigenesis and rhizogenesis. Mutualistic fungal symbionts

11. Ectomycorrhizal and endomycorrhizal fungi. Infection processes. Interactions with host plants and other soil microbes
12. Infection processes - fungi and toxins. Secondary product and fungal virulence
13. Azolla - *Anabaena* symbiosis. Association of lichens with trees
14. Plant growth promoting bacteria- types and mechanism of plant growth promotion
15. Biocontrol agents- types and mechanism of action
16. Induce Resistance-Induced Systemic Resistance (ISR) and Systemic Acquired Resistance (SAR)
17. Protein defense responses and systemic responses

**Practical Schedule**

1. Collection of root exudates
2. Assay of root exudates – growth regulator/sugars
3. Studying the effect of root exudates on selected bacterial population – well diffusion assay
4. Isolation and purification of ectorhizophere – rhizosphere and rhizoplane microorganisms
5. Isolation and purification of endophytic microorganisms from rice
6. Isolation and purification of phyllosphere microorganisms from rice
7. Isolation and purification of *Rhizobium*
8. Isolation and purification of *Frankia*from*Casuarinaequisetifolia*
9. Visit to plantations and collection of ectomycorrhizal fruiting bodies, lichens, orchid and ericaceous mycorrhizae infected root samples
10. Examination of ectomycorrhizal fruiting bodies and isolation of ectomycorrhizal fungi
11. Examination of lichens associated with trees; orchidaceous and ericoid mycorrhizae fungal infection in plants
12. Examination of AM fungal infection in plants
13. Collection and examination of AM spores from soil
14. Testing *Agrobacterium tumefaciens* induced tumour formation in dicotyledonous plants in laboratory conditions
15. Testing *A. rhizogenes* induced root proliferation in laboratory conditions
16. Collection and examination of endosymbiont associated with Azolla
17. **Final Practical Examination**

**Text Books**

1. Kamal B., Normand B. and Fouad D. 2009.Plant-microbe interactions.
2. Chrispeels M.J. and D.E. Sadava. 2003. Plants, Genes, and Crop Biotechnology.

Jones & Bartlett Publishers, Boston.

**Reference Books**

1. Susan I. 1992. Fungal-Plant Interactions, Chapman Hall,
2. George A. 2005. Plant Pathology, Academic Press, Fifth Edition.

**E books**

1. Nautiyal C.S. and Patrice, D. 2008. Molecular mechanism of Plant and Microbe Coexistence, Springer-Verlag Berlin Heidelberg
2. Lugtenberg, B. 2015. Principles of Plant-Microbe Interactions. Microbes for Sustainable Agriculture, Springer International Publishing Switzerland

## 17 AGM 315 QUALITY CONTROL OF BIOINOCULANTS (1+1)

**Aim**: This course aims in imparting knowledge on techniques of quality control of bioinoculants especially nitrogen fixers, nutrient solubilizers and mobilizers and plant growth promotors

### Objectives

At the end of the course, the student will be able to learn the techniques of quality control of microbial inoculants.

### UNIT I

Overview of bioinoculant production and quality control.Nitrogen fixers-types.P solubilizers and mobilizers.Potassium releasing bacteria.Microbial transformation of micronutrients zinc, sulphur, iron *etc*. PPFM – PGPR. Mass production methods.Introduction to quality control standards.FCO standards.

### UNIT II

Quality control of *Rhizobium* inoculants-Purity checking of mother culture-morphological, biochemical and cultural characteristics of *Rhizobium*-Cross inoculation groups-recent classification-methods for testing nodulation-Estimation of nitrogen fixation – direct & indirect methods - Carrier based and liquid inoculants - FCO standards-scope for new formulations-quality control at different stages of production.

### UNIT III

Quality control of *Azospirillum* and *Azotobacter* inoculants-purity checking of mother culture-morphological,biochemical and cultural characteristics-different species-Nitrogen fixation-ARA and microkjeldhal method-Quality control at different stages of production-Quality control of PSB- Purity checking of mother culture-Morphological,biochemical and cultural characteristics-Quantitative and qualitative assay for P solubilization-FCO standards.

### UNIT IV

Endophytic nitrogen fixation in sugarcane-*Gluconacetobacterdiazotrophicus*- Potash releasing bacteria-Characteristics-Mechanism of K release – PPFM - PGPR and bioinculants for micronutrients-Quality control of Mycorrhizae-Ecto and Endo mycorrhiza-AMF-Morphological and cultural characteristics-root infection test and spore count-IP by MPN technique-mechanism of P mobilization-Hairy root organ culture.

**UNIT V**

Cyanobacterialbiofertilizers-types-nitrogen fixing cyanobacteria-Heterocysts-role of akinetes in survival-soil based composite culture-new formulations-quality testing-population by MPN technique-*Azolla-Anabaena* symbiosis-spore inoculum production-rapid methods for quality control of biofertilizers-molecular and immunological methods. Quality of biocontrol agents-*Pseudomonas* and *Trichoderma*.

**Practical**

Quality control of *Rhizobium*- *Azospirillum*- *Azotobacter*- morphological and biochemical characterization-Nodulation by Roll paper towel technique-$N_2$ fixation by ARA- sampling methods-population estimation in broth and inoculants by SPC/MPN methods- P solubilzing bacteria- Available P estimation in Pikosviskya's broth - Organic acid production by titrable acidity-Acid and alkaline phosphatase activity - Quantitative estimation- enumeration of population in hydroxy appetite medium- AM fungi- spore count by wet sieving method- root infection studies by staining with tryphan blue-IP estimation by MPN- hairy root culture Potassium releasing bacteria-quantification of K release-population estimation- PPFM, PGPR, SOB, Zn solubilizing bacteria-qualitative and quantitative assays-Cyanobacteria- Composite culture-enumeration of population by haemocytometer count and MPN technique-*Azolla*-determination ofheterocyst frequency-sporocarps-spore inoculum production- rapid methods for quality control- Molecular methods –immunological methods.

**Lecture schedule**

1. Overview of bioinoculant production and quality control
2. Nitrogen fixing microbes-symbiotic , associative symbiotic, nonsymbiotic and endophytic nitrogen fixation-Mechanism of nitrogen fixation
3. Phosphate solubilizing and mobilizing microbes-Mechanism of action
4. Potash releasing bacteria -PPFM-PGPR- Zinc solubilizers- Sulphur oxidizers-mechanism
5. Mass production methods of bacterial, fungal and algal biofertilizers
6. Introduction to quality control standards-BIS-FCO standards - Sampling methods
7. Purity checking of *Rhizobium* mother culture-Morphological, biochemical and cultural characteristics-cross inoculation groups-recent classification
8. *In vitro* methods for testing nodulation- Roll paper towel technique-MPN counts, growth pouches/tubular pots -$N_2$ fixation-direct & indirect methods –N estimation by

Microkjeldahl method,$^{15}N$ technique & ARA-principles & methods-enumeration of population at different stages of production

9. **Mid Semester Examination**

10. Criteria for selection of carrier material-FCO standards (2011) for carrier based and liquid Inoculants-scope for new formulations

11. Purity checking of *Azospirillum* and *Azotobacter* mother culture- morphological, biochemical and cultural characteristics-different species

12.Phosphobacteria-organisms involved-purity checking of mother culture- morphological, biochemical and cultural characteristics-quantification-available P estimation in broth-organic acid production-acid and alkaline phosphatase

13. FCO standards for *Azospirillum, Azotobacter* and phosphobacteria-quality control of inoculants at different stagesof production- Rapid methods for quality control-molecular and immunological methods. Quality of biocontrol agents-*Pseudomonas* and *Trichoderma*.

14. Potassium releasing bacteria- organisms involved-morphological, biochemical and cultural Characteristics-mechanism and quantification of K release

15. Endophytic nitrogen fixation-*Glucanoacetobacterdiazotrophicus*-PPFM, PGPR-bioinoculants for micronutrients *viz*., sulphur, zinc and iron

16. Ecto and Endo mycorrhizae-AM fungi-morphological and cultural characteristics-mechanism of P mobilization-quality control-root infection-spore count and IP by MPN

17. Nitrogen fixing cyanobacteria-heterocysts-role of akinetes in survival-soil based composite culture-quality checking by MPN technique-*Azolla*-Anabaena symbiosis-heterocyst frequency-sporocarps-spore inoculum production-storage and shelf life

**Practical schedule**

1. Sampling methods and study of different inoculants-carrier based and liquid inoculants
2. Morphological, cultural and biochemical characterization of *Rhizobium*
3. Purity checking of *Rhizobium* strains-Leonard Jar, germination paper roll and tubular pot methods-MPN counts
4. Morphological, cultural and biochemical characterization of *Azospirillum*
5. Morphological, cultural and biochemical characterization of *Azotobacter*
6. Estimation of $N_2$ fixation- Acetylene Reduction Assay of nodules/cultures
7. Estimation of $N_2$ fixation in broth under *in vitro* conditions-Microkjeldahl method

8. Quantitative and qualitative assay for phosphobacteria-Available P estimation in Pikosviskya's broth by Olsen's method and organic acid production by titrable acidity
9. Assay of acid and alkaline phosphatase activity of phosphobacterial cultures
10. Enumeration of population of *Rhizobium* at different stages of production with Congo red YEMA by SPC method
11. Enumeration of population of *Azospirillum* different stages of production with N free bromothymol blue (Nfb) semi solid medium by MPN method
12. Enumeration of population of *Azotobacter* at different stages of production with Waksman No.77 medium by SPC method
13. Enumeration of population of phosphobacteria at different stages of production with Sperber'shydroxy appetite medium by SPC method
14. Quality control of AM fungi-Spore count by wet sieving, root infection by Tryphan blue staining and Infective propagules by MPN
15. Potassium releasing bacteria- quantification of K release
16. Cyanobacterial inoculants-microscopic examination, determination of heterocyst frequency& population estimation by haemocytometer count and MPN method
17. **Final Practical Examination**

**Text books**


1. Maheshwari, D. K. and R.C.Dubey, 2008. Potential Microorganisms for Sustainable Agriculture - A techno-Commercial Perspective. I.K.International Publishing House Pvt.Ltd., New Delhi and Bangalore
2. Rai, M.K. 2006. Hand book of microbial biofertilizers. CRC press.


**Reference Books**


1. Bagyaraj, D.J. and A. Manjunath. 1990. Mycorrhizal symbiosis and plant growth, Univ. of Agricultural Sciences, Bangalore, India.
2. Kannaiyan S. 2002. Biotechnology of Biofertilisers. Kluwer Academic publishers &Narosa Publishing House.
3. Motsara M.R., Bhattacharya P., and Srivastava B. 1995. In: Biofertilizer Technology, Marketing and Uses -A Source Book cum Glossary. Fertilizer Development and Consultancy Organization, New Delhi.
4. Somasegaran, P. and H.J.hoben.1985. Methods in Legume-*Rhizobium* Technology, NifTAL Project and MIRCEN, University of Hawaii, Paia, USA

5. SubbaRao, N. S. 1993. Biofertilizers in Agriculture and Forestry. Oxford and IBH Publishing Co. Ltd., New Delhi.

**e-books/ materials**

1. Biofertilizers and Organic Fertilizers in Fertilizer (Control) Order, 1985
2. FNCA biofertilizer project group, 2006. Biofertilizer Manual, Japan Atomic Industrial Forum, MEXT, Tokyo, Japan.

## 17 SAC 311 DESIGNER FERTILIZER PRODUCTION (1+1)

**Aim**

This course is aimed to impart knowledge on the production, characterization, evaluation and economics of various designer fertilizers. Further, it also provides guidelines for establishing a designer fertilizer production unit.

**Theory- Syllabus**

**UNIT I**

Designer Fertilizers - Definitions - Concepts - Historical development - Scope and Need - Scenario of Multi nutrient deficiencies in soils and plants.

**UNIT II**

Designer Fertilizers – Classification- Production and Characterisation - Speciality / Customized fertilizer mixtures - Fortified fertilizers - Pelleted fertilizers - Multi nutrient liquid formulations.

**UNIT III**

Foliar Formulations - Leaf nutrient analysis -Value added fertilizers- enriched with organics/chelates- methods and guidelines for preparing designer Fertilizers- Filler materials- Industries and approved formulations.

**UNIT IV**

Quality of Designer fertilizers- Compatibility of fertilizer materials - issues in storability, hygroscopicity, clogging, etc. - Toxicity - Advantages and Disadvantages - Key Challenges - Crop response to designer fertilizers - Agricultural, Horticultural, high value crops- yield and quality - Soil health - Nutrient use efficiencies

**UNIT V**

Feasibility of using designer fertilizers for drip fertigation- Poly houses - roof gardening- Quality Standards- Specifications - Guidelines for Patenting, Licensing and Registration of newer products

**Lecture Schedule**

1. Designer Fertilizers - Definitions - Concepts -Historical development
2. Scope and need for Designer Fertilizes –Multi nutrient deficiencies in soils and plants - Critical limits - current scenario of multi nutrient disorders
3. Classification-Types- Speciality / Customised, Fortified and Pelleted fertilizers, Multi-nutrient liquid formulations
4. Speciality / Customised Fertilisers- Definitions- Production-characteristics- sources - suitability for crops -Merits and Demerits
5. Fortified fertilizers-Definitions- Production-characteristics-sources-suitability for crops-Merits and Demerits
6. Pelleted fertilizers - Definitions- Production- characteristics- sources- suitability for crops -Merits and Demerits
7. Multi nutrient liquid formulations - Definitions- Production- characteristics- sources - suitability for crops -Merits and Demerits
8. Foliar Formulations - Leaf nutrient analysis - organic and synthetic chelates
9. Mid semester examination
10. Value added fertilizers- enriched with organics/chelates
11. Methods and guidelines for preparing designer Fertilizers - Filler materials
12. Industries and Approved formulations and mixtures - Advantages and Disadvantages - Key Challenges
13. Quality of designer fertilizers - Compatibility of fertilizer materials - issues in storability, hygroscopicity, clogging, etc - Toxicity
14. Crop response to designer fertilizers - Agricultural and Horticultural crops- Yield and Quality- Soil health and Nutrient use efficiencies
15. Feasibility of using designer fertilsiers for drip fertigation - Poly houses - roof gardening
16. Quality Standards-Specifications for designer fertilisers
17. Guidelines for Patenting, Licensing and Registration of newer products

**Practical Syllabus**

Preparation of Designer Fertilizer Mixtures for major agricultural, Horticultural and High value crops- Preparation of multi nutrient liquid formulations for drip fertigation, poly houses, roof gardening - Preparation of pelletised fertilizer mixtures for high value crops and roof gardening-

Preparation of fortified fertilizer mixtures for major agricultural and horticultural crops- Preparation of value added fertilsiers - Assessing the storability of the formulations and mixtures -Machineries in designer fertilizer production - Computation of cost effectiveness of the designer fertilizers - Visit to Designer Fertilizer manufacturing Unit- Protocols for establishing a Designer Fertilizer Production Unit - Procedures for Licensing, registration and Patenting.

**Practical schedule**

1. Preparation of Designer Fertilizer Mixtures for major agricultural crops: Rice/ Pulse
2. Preparation of Designer Fertilizer Mixtures for major horticultural crops : Banana/ Tapioca
3. Preparation of Designer Fertilizer Mixtures for high value crops : Turmeric/Cotton
4. Preparation of multi nutrient liquid formulations for drip fertigation : Sugarcane/Turmeric
5. Preparation of multi nutrient liquid formulations for poly houses: Tomato/ Cucumber/Capsicum
6. Preparation of pelletised fertilizer mixtures for high value crops : Maize/ Turmeric/Cotton
7. Preparation of pelletised fertilizer mixtures for roof gardening : Chillies/ Brinjal/ Greens
8. Preparation of fortified fertilizer mixtures for major agricultural crops: Maize, Groundnut
9. Preparation of fortified fertilizer mixtures for major horticultural crops: Onion, Bhendi
10. Preparation of value added fertilizers
11. Assessing the storability of the mixtures and formulations
12. Machineries in designer fertilizer production
13. Computation of cost effectiveness of the designer fertilizers
14. Visit to Designer Fertilizer manufacturing Unit
15. Protocols for establishing a Designer Fertilizer Production Unit - Guidelines and budget
16. Procedures for Licensing, registration and Patenting
17. Final practical examination

**Outcome**

- Acquiring technical knowhow and skills on preparing various designer fertilizer mixtures and formulations to establish a designer fertilizer production unit as an entrepreneur

**References**

1. Hagin, J. and B. Tucker (2012). Fertilization of Dry land and Irrigated Soils, Springer Science & Business Media, 06-Dec-2012 - Technology & Engineering, 190 pages

2. John Havlin, Samuel L. Tisdale, James D. Beaton, Werner L. Nelson (2013) Soil Fertility and Fertilizers: An Introduction to Nutrient Management, Pearson, 2013 - Technology & Engineering - 516 pages

3. Hari Lal Singh Tandon (2012) Fertilizer Management: Balance-efficiency-profitability Fertilizer Development and Consultation Organization, Arid regions agriculture - 187 pages

4. Anac,D. and P.Martin Pravel (1999).Improved crop quality by nutrient management , Kluwer Academic Publications, London Springer Science & Business Media, 30-Sep,1999 - Science - 310 pages

5. Gustafson,A.F. (2013) Handbook of Fertilizers - Their Sources, Make-Up, Effects, And Use,Read Books Ltd, 16-Apr-2013 - Technology & Engineering - 170 pages

6. Kolay,A.K.(2007) Manures and Fertilizers Atlantic Publishers & Dist, Fertilizers - 173 pages

7. UN Industrial Development Organization(1998), Fertilizer Manual, Int'l Fertilizer Development Center, Springer Science & Business Media, 31-Mar-1998 - Nature - 616 pages

8. Casper, **M. S. (1973).**Liquid fertilizers, Noyes Data Corp., 1973 - Technology & Engineering - 268 pages

## 17 SAC 313 Soilless Crop Production (1+1)

**Aim :** To introduce the techniques of growing plants without soil or minimal soil and outline the field of application of soilless cultivation systems in commercial greenhouse production. The course will provide a sufficient background on the physical and chemical properties of substrates and necessary knowledge on the chemistry of nutrient solutions to the students and enable them to calculate nutrient solutions of any desirable composition. Further, provide advanced knowledge on automated methods of nutrient and water cycling in various soilless cultivation systems.

**Unit I**

Protected agriculture overview and scope - Introduction to soilless cultivation of plants - History of solution culture - Present status of hydroponics - Nutrient requirements - Absorption of nutrients by the roots and interaction between the roots and the soil solution - Nutrient ratios - Effects of pH, EC and nutrient ratios on plant growth, yield and quality

**Unit II**

Containers - Grow bag / container media – formulations - their properties - Systems with aggregates as substrate - bag culture, container culture, trough culture, thin layer systems, other alternative systems - effect of volume and shape of container. Hydroponic systems - Systems involving solely water as a substrate - deep water culture, floating hydroponics, Nutrient Film Technique, plant plane hydroponics, aeroponics.

**Unit III**

Container media - Description of substrates -sand, gravel, rockwool, expanded minerals, pumice, zeolite, pyroclastic materials, peat, coir, tree bark, sawdust, wood fibres, etc. - Physical properties – impact of physical properties on irrigation management. Chemical properties - Container media analyses - Total and available nutrients - Microbiology and phytosanitation in container media

**Unit IV**

Composition of nutrient solution: Calculation of nutrient solutions for open systems/ closed systems: concept of drainage solution plus fresh water - Management of nutrient solution - Nutrient solution recycling - Irrigation control - characteristics of irrigation systems : capacity,

uniformity - Delivery Systems : overhead systems, drip irrigation, sub-irrigation. Irrigation scheduling : preset schedule, sensor-based schedule, transpiration-based schedule

**Unit V**

Equipments in Soilless culture - Automated delivery of nutrient solution - sensor based monitoring - moisture, nutrient, temperature and humidity sensors - Integrated system development for electronic control of equipments for irrigation and nutrient solution recycling. Nutrient solution disinfection - heating, UV-irradiation, chemical treatments by means of ozone, hydrogen peroxide, chlorine, iodine, etc. - membrane filtration - slow sand filtration

**Lectures**

1. Importance and scope of protected agriculture; Factors affecting crop growth under protected cultivation – temperature, light intensity, $CO_2$ and humidity
2. Introduction to soilless cultivation of plants; Various systems of soil-less crop production - bag culture, container culture, trough culture, thin layer systems, other alternative systems..
3. History of solution culture and Present methods of hydroponics - deep water culture, floating hydroponics, Nutrient Film Technique, plant plane hydroponics, aeroponics. - Basic needs and suitable crops for hydroponics.
4. Calculation of nutrient solution – mixing of nutrients, concentration and method, dose and time of application; Management of nutrient solution.
5. Fertilization - Nutrient requirements by crops, absorption of nutrients, nutrient ratios and its effect on crop growth and yield; Sensor based nutrient management.
6. Containers – kinds of substrates - sand, gravel, rockwool, expanded minerals, pumice, zeolite, pyroclastic materials, peat, coir, tree bark, sawdust, wood fibres, etc. – resources and methods of preparation.
7. Physical properties of substrates - air to water ratios, bulk density, particle size distribution, porosity, water release curves, hydraulic conductivity
8. Chemical properties of substrates - pH, electrical conductivity, ion sorption, ion exchange, concentration and composition of ions, cation exchange capacity.
9. Mid semester examination
10. Standardization of soil-less media and solution culture
11. Irrigation systems – Drip irrigation, sub-irrigation, matric suction irrigation and irrigation management.

12. Automated irrigation system – sensor based, transpiration based schedule
13. Equipments used in soil-less cultivation – various sensors used
14. Sterilization of substrate in grow bag media and disinfection of nutrient solution in hydroponics.
15. Day to day maintenance of soil-less system of crop production.
16. Suitability of crops for growing under green house cultivation; specific technology for raising vegetable crops under protected cultivation.
17. Economics and Business opportunities in soil-less system of crop production.

**Practical**

Propagation of plants for culture by hydroponics - testing seeds or cutting using media for adaptation to soilless culture - Growing crops in solution culture observation on growth and maturity phases - Growing crops in water culture and identification of plant nutrient deficiencies / nutritional stresses - Control of acidity of solutions by regulation of pH of nutrient solutions or by control of the sources of N - Formulation of nutrient solutions - Factors governing stability of Nutrient solutions - solubility of salts, purity of constituents, buffering of acidity, quality of water - Regulation of salinity in nutrient solutions – record of change in concentration of soluble salts in nutrient solutions - Culture of plants by nutrient film technique – growing plants using thin layers of water which flow by roots in a designed chamber -Evaluation of solid media in solution culture – growth of plants in solid media - sand, gravel, sawdust, perlite, etc.- Visit to commercial hydroponics greenhouse

**Schedule**

1. Preparation of soilless media using different substrates for grow bag method and sowing crop.
2. Preparation of solution culture for hydroponics and sowing crop.
3. Estimation of physical characteristics of grow bag media (cocopeat, vermiculite)
4. Determination of chemical properties like pH, EC, CN ratio of grow bag media.
5. Determination of water soluble and exchangeable nutrients in grow bag media.
6. Evaluation of porosity of medium based on moisture characteristic/ water retention curve.
7. Computation of container capacity, air filled porosity of grow bag media
8. Estimation of moisture constants by pressure plate apparatus and computation of available water and water holding capacity.
9. Preparation of common nutrient solution for hydroponics and drip system.

10. Preparation of fertilizer pellet packs for crops under matric suction irrigation.
11. Nutrient monitoring study using sensors in grow bag media.
12. Nutrient monitoring study using sensors in continuous recycling solution culture.
13. Assembling water lines and measurement of water consumption under drip / matrix suction irrigation.
14. Recording of operations involved in devices – peristaltic pump, filter pump, injectors, solenoid valves
15. Study of circuitry for sensor based nutrient monitoring system with wireless controls.
16. Visit to successful greenhouse cultivation system
17. Practical examination

**Outcome**

As population increases and arable land declines, people will turn to new technologies like soil-less crop production to feed the growing population. Soil-less culture will help to improve the yield and quality of the produce so that we can ensure food security of our country.

**References**

Burt, C., K. O'Connor, and T. Ruehr. 1998. Fertigation. ITRC, California Polytechnic State University, San Luis Obispo, CA.FAO. 1990. Soilless Culture for Horticultural Crop Production.

Jones, J. Benton. 1983. A Guide for the Hydroponic and Soilless Culture Grower. Timber Press.
Jones, J. Benton. 2005. Hydroponics: A Practical Guide for the Soilless Grower. 2nd ed. CRC Press. Boca Raton.

Kipp, J.A., G. Wever and C. de Kreij. 2000. International Substrate Manual. Elsevier, the Netherlands.

Marschner, H. 1995. Mineral Nutrition of Higher Plants (2nd ed.). Academic Press, London.
Mengel, K. and Kirkby, E.A. 2001. Principles of Plant Nutrition (5th ed). Kluwer Academic Publishers, Dordrecht.

Raviv, M and Lieth, J.H. (eds.) 2008. Soilless Culture, Theory and Practice. Elsevier, London.
Schwartz, M. 1995. Soilless Culture Management. Springer-Verlag, Berlin.
Proceedings of the World Congress on Soilless Culture: Agriculture in the coming millennium. Editors, A. Bar-Tal, Z. Plau. 2001.

## 17 SAC 314 Instrumental Methods of Analysis (1+1)

**Objective**

To familiarize students with the design, operational principles and practical applications of modern instruments used for the quantitative analysis of soil, plant water, manure and fertilizer samples

**Unit I**

Principles of instrumentation- classification of instrumental methods – selection of instruments - Principles involved in digestion methods – dry ashing and wet digestion – open vs closed digestion - Block digester , microwave digester and IR digestion systems - components - operation - special consideration

**Unit II**

Automated methods – Principle and applications - Total N analyser, CN analyser

**Unit III**

Optical methods – spectrophotometry – visible, ultraviolet and infrared spectrometry - Principle - Instrumentation – sample handling and measurement - method development and validation - accuracy

**Unit IV**

Emission and absorption Spectroscopy - principles and applications - flame photometry, atomic absorption spectrophotometry, inductively coupled plasma emission spectrometry - instrumentation - features and operation of components - sample handling - errors - fault finding - trouble shooting

**Unit V**

Chromatography techniques – classification - paper chromatography, TLC - Gas chromatography- HPLC , GC – MS - principles - Instrumentation - sample preparation and handling - errors – trouble shooting

**THEORY SCHEDULE**

1.Basic principles in instrumental method of analysis
2.Principle and practice of digestion methods
3.Principle and practice of N analyser and CN analyser

4.Spectrophotometry : Types, Principle and instrumentation
5.Spectrophotometry: Sample handling and measurement, method development and validation and checking for accuracy
6.Emission spectroscopy (Flame Photometer) : Instrumentation, interferences, trouble shooting and maintenance
7.Absorption spectroscopy (Atomic Absorption Spectrophotometer) : Principle, instrumentation, features and operation of components
8. Absorption spectroscopy (Atomic Absorption Spectrophotometer ) : Sample handling and measurement, errors due to molecular and ionic species, matrix effect and other interferences, trouble shooting and maintenance
9. Mid semester examination
10. Absorption spectroscopy (Inductively Coupled Plasma Emission Spectrometer) : Concepts and instrumentation
11. Absorption spectroscopy (Inductively Coupled Plasma Emission Spectrometer) : Preparation of samples and standards, interferences, trouble shooting and maintenance
12. Principle and practice of paper chromatography, Thin layer chromatography
13. Gas chromatography : Principle, Types and instrumentation
14. Gas chromatography : Operation ,sample handling, maintenance and trouble shooting and applications
15. High Performance Liquid Chromatography : Principle, Instrumentation and operation
16. High Performance Liquid Chromatography : Sample preparation , method development, maintenance and troubleshooting
17. GC – MS : Principle , instrumentation, Sample preparation , method development, maintenance and troubleshooting

**PRACTICAL**

Collection and processing of samples - Digestion of samples – block digester and microwave digester methods - N analyser – Specrophotometry - UV –Vis Spectrophotometer -- Emission spectroscopy - Flame photometer – Absorption spectroscopy – Atomic Absorption Spectrophotometer (AAS) and Inductively Coupled Plasma Emission Spectrometer (ICP) – Chromatography - Gas Chromatography and High Performance Liquid Chromatography- Procedures for establishing a analytical laboratory

**PRACTICAL SCHEDULE**

1. Collection and processing of samples (Soil, plant, water, manure and fertilizer)
2. Digestion of samples by block digester/microwave digester and sample preparation for different analysis
3. N anlyser : Calibration , sample estimation and results interpretation

4. UV -Vis spectrophotometer : Getting acquainted with parts of UV -Vis spectrophotometer and preparation of standards
5. UV -Vis spectrophotometer : Calibration, sample estimation (P/S/B) and results interpretation
6. Flame photometer : Getting acquainted with components of flame photometer and preparation of standards, calibration, sample estimation (P/S/B) and results interpretation
7. Getting acquainted with components of AAS and standards (micronutrients and heavy metal) preparation
8. Calibration and sample estimation for micronutrients and heavy metals by AAS
9. Getting acquainted with components of ICP
10. Calibration , sample estimation for elements by ICP and results interpretation
11. Analyte extraction from sample and separation for GC
12. Calibration , sample introduction and interpretation of results in GC
13. Analyte extraction from sample and separation for HPLC
14. Calibration, sample introduction and interpretation of results in HPLC
15. Visit to a analytical laboratory (Government/Private)
16. Procedures for establishing a analytical laboratory – Guidelines and budget
17. Practical examination

**Outcome** : At the end of the course the student will be able to handle sophisticated instruments. The knowledge earned will help in establishing a analytical laboratory for analyzing soil/plant/water/fertilizer/manure samples.

**References**

Chatwal, G. and Anand. 2005. *Instrumental Methods of Chemical Analysis*. Academic Press.

Muralidhar aRao, D., A.V.N Swamy and D. Dharaneeswara Reddy.2013. *Instrumental Methods of Analysis*. CBS Publishers & Distributors Pvt.Ltd., New Delhi.

Skoog, A., Holler, F and Nieman, A. 2007. *Principles of Instrumental Analysis* (6th Ed.). Thomson Brooks/Cole publishing. ISBN: 9780030020780.

Willard M, Merritt LL & Dean JA.1989. *Instrumental Methods of Analysis*. (7th Ed). Wadsworth Publishing Compnay, Boston, USA. ISBN :9780534001423.

**e resources**

http://blogs.rediff.com/ticconcvibi1985/2013/05/12/download-ebook-modern-hplc-for-practicing-scientists-free/

http://cdn.intechopen.com/pdfs-wm/26275.pdf

http://faculty.ksu.edu.sa/Dr.almajed/Books/practical%20HPLC.pdf

http://web.uni-plovdiv.bg/plamenpenchev/mag/books/spectroscopy/PRIMER.PDF

## 17 SAC 312 Rejuvenation of Deteriorated Lands (1+1)

**Objective** To impart knowledge related to various factors and processes of land deterioration and their rejuvenization techniques.

**Theory syllabus**

**Unit I**

Type, factors and processes of soil / land deterioration and its impact on soil productivity, including soil fauna, bio deterioration and environment. Land rejuvenization and conservation / management techniques; afforestation and sylviculture and soil carbon restoration.

**Unit II**

Causes, reclamation and management of soil physical deterioration - surface and sub surface hard pans, shallow, slowly permeable and highly permeable and fluffy paddy soils; soil erosion, ravine and sand dune, coastal and seasonally inundated soils and mined land.

**Unit III**

Causes, reclamation and management of salt-affected soils – saline, sodic and saline sodic soils; acid and acid sulphate soils; laterite soils.

**Unit IV**

Extent, diagnosis and mapping of land deterioration by conventional and modern RS-GIS tools. Monitoring land deterioration by fast assessment and modern tools.

**Unit V**

Land use policy, incentives and participatory approach for reversing land deterioration; global issues for twenty first century.

**Practical syllabus**

Determination of gypsum requirement in sodic soils, lime requirement in acid soils and soil erodibility indices – field reclamation of saline, saline-sodic, sodic and acid soils. . Characterization of soil physical constraints - surface and sub surface hard pans, shallow, slowly permeable soils, and fluffy paddy soils - characterization of mined out and ravine lands, laterite, sand dune, coastal and seasonally inundated soils.

**Theory-Lecture schedule**

1. Type, factors and processes of soil / land deterioration.
2. Soil / land deterioration impact on soil productivity, including soil fauna, bio deterioration and environment.
3. Land rejuvenization and conservation techniques; Land configuration techniques; Surface / vertical mulching.
4. Afforestation and sylviculture methods; Soil carbon restoration – use of industrial C- rich by products.
5. Causes, reclamation and management of soil physical deterioration - surface and sub surface hard pans, shallow, slowly permeable and highly permeable and fluffy paddy soils.
6. Causes, management of soil erosion.
7. Causes, reclamation and management of mined and ravine lands.
8. Causes, reclamation and management of sand dunes, coastal and seasonally inundated soils.
9. Mid semester examination
10. Causes, reclamation and management of saline and saline sodic soils
11. Causes, reclamation and management of sodic soils
12. Causes, reclamation and management of acid and acid sulphate soils.
13. Causes, reclamation and management of laterite soils.
14. Extent, diagnosis and mapping of land deterioration by conventional and modern RS-GIS tools.
15. Monitoring land deterioration by fast assessment and modern tools.
16. Land use policy, incentives and participatory approach for reversing land deterioration.
17. Global issues for twenty first century.

**Practical schedule**

1. Practicing field reclamation of saline soils and assessing its impact and cost benefit.
2. Practicing field reclamation of saline-sodic soils and assessing its impact and cost benefit.
3. Practicing field reclamation of sodic soils by gypsum application and assessing its impact and cost benefit.
4. Practicing field reclamation of sodic soils by press mud application and assessing its impact and cost benefit.
5. Practicing field reclamation of sodic soils by spent wash application and assessing its impact and cost benefit.
6. Practicing field reclamation of acid soils and assessing its impact and cost benefit.

7. Practicing management of surface and sub surface hard pans and assessing its impact and cost benefit.
8. Practicing management of slowly permeable and highly permeable and fluffy paddy soils and assessing its impact and cost benefit.

9 to 13. Field visit and characterization of eroded, ravine and mined out lands, sand dune, coastal, seasonally inundated and laterite soils and assessing its management impact and cost benefit.

14. Field visit to agro forestry and sylviculture farms and assessing its impact on soil conservation.
15. Assessing the suitability of industrial byproducts for eco friendly recycling through soil conservation and rejuvenization.
16. Diagnosis and mapping of land degradation using RS and GIS tools.
17. Final Practical examination.

**Outcome:**

Students will gain knowledge to manage deteriorated lands by suitable ameliorative measures

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Greenland DJ and Szabolcs I. 1994. Soil Resilience and Sustainable Land Use. CABI.

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Sehgal J & Abrol IP. 1994. *Soil Degradation in India - Status and Impact*. Oxford & IBH.

## 17 SAC 315 Crop and Pesticide Chemistry (1+1)

**Aim**

To impart knowledge on the chemistry and nutritional significance of various field and horticultural crops so as to include them in the breeding and biofortification programmes towards nutritional security. This course will also impart knowledge on different pesticides, their nature and mode of action and their fate in soil so as to monitor their effect on the environment

**Unit-I**

Chemistry of Agricultural Crops: Chemical constituents of plants - Proximate and ultimate constituents - Chemical composition and nutritional quality of cereals, pulses and forage crops. Chemical composition and nutritional quality of oilseeds and sugarcane. Post harvest changes in Sugarcane.

**Unit-II**

Chemistry of Horticultural Crops, alkaloids and Essential oils: Chemical composition and nutritional quality of fruits, vegetables, spices, condiments, tuber crops and beverages. Post harvest changes in fruits. Chemistry of medicinal and aromatic plants.

**Unit-III**

Pesticides and its Formulations: Pesticides - Definition - Classification-Trends in pesticide use. Pesticide formulations -dusts, wettable powders, emulsifiable concentrate, granules. Insecticides - classification-. Characteristics, Mode of action and use of Organophosphates - Carbamates - Pyrethroids , Botanicals, Insect Growth Regulators and Newer insecticides.

**Unit-IV**

Fungicides and Herbicides : Fungicides - classification of fungicides -properties, mode of action of inorganic, organic and systemic fungicides - Rhodenticides- Zinc phosphide - Aluminium phosphide - Bromodiolone Herbicides - classification - properties - mode of action of inorganic and organic herbicides like phenoxy compounds, substituted ureas, amides, thiocarbamates, triazines, pyridines, imidazolines and sulphonyl ureas.

**Unit-V**

Pesticides and Environment : Insecticide Act and Insecticide Rules - Fate of pesticides in soil- Impact of pesticides on environment

**Practical**

Estimation of moisture, ash, crude protein, P, K and crude fibre in plant samples - Determination of reducing and non-reducing sugars in jaggery — Oil content in Groundnut- Estimation of total solids, ascorbic acid, titratable acidity in fruits- Phenols/ Mucilages in Vegetables - HCN content in Tapioca/ Sorghum - Analysis of pesticides - Physical tests - Bulk density, wettability, suspensibility, Emulsion stability -. Estimation of pesticide residues in soil, water , vegetables, fruits and pesticidal calculations. Visit to Pesticide Testing Laboratory.

**Lecture Schedule**

1. Chemical composition and nutritional quality of cereals and pulses - Rice, wheat, maize, minor millets, Red gram, blackgram, and soybean. Starch synthesis and protein synthesis
2. Chemical composition and nutritional quality of oil seed crops - Groundnut, sesame, sunflower, castor, coconut and palm.
3. Chemical composition and nutritional quality of sugarcane -Sucrose synthesis - Post harvest changes in sugarcane. Nutritional quality of forage crops.
4. Chemical composition and nutritional quality of fruits - Mango, banana, papaya, grapes, guava, apple and pomegranate. Chemistry of post harvest changes in fruits.
5. Chemical composition and nutritional quality of vegetables- Tomato, bhendi, brinjal, moringa, greens, cauliflower, radish and peas.
6. Chemical composition of spices and condiments (Turmeric, chillies, pepper, ginger, onion, garlic and Beverages (tea and coffee).Tuber crops- Potato & Tapioca
7. Alkaloids in medicinal plants (Cinchona, Gloriosa, Coleus and Aloevera )
8. Pesticides - Definition - Classification-Trends in pesticide use
9. Mid semester Examination
10. Pesticide formulations - dusts - wettable powders, flowables, sprays –Emulsion concentrates – water soluble liquids - granules, fumigants and aerosols - characteristics and uses.
11. Insecticides classification -Characteristics, Mode of action and use of Organophosphates(Chlorpyriphos, Phorate, Dimethoate, Quinalphos and Profenophos)

12. Characteristics, Mode of action and use of Carbamates (Carbaryl, carbofuran, carbosulfan, aldicarb) and synthetic pyrethroids (Deltamethrin, Fenvalerate, Cypermethrin and Lambdacyclothrin )
13. Characteristics, Mode of action and use of Botanicals (nicotine and neem), Insect Growth Regulators (Novaluron, Buprobasin and GABA inhibitors) and *and newer insecticides (Neonicotinoids - Imidachloprid, Thiachloprid, Acetamiprid, Flupendiamide, Fipronil, Emamectin, Thiomethoxam, Indoxacarb, Chlorantraniliprole)*
14. Fungicides - Classification – Inorganics (sulfur) and Organic fungicides (Chlorobenzene and Chlorothalanil) - Characteristics, mode of action and use
15. Characteristics, mode of action and use of Systemic fungicides (Benomyl, Carbendazim, Metalaxyl, Quinones, Diclones, Dicarboximides –vincozolin).
16. Herbicides - Classification of herbicides - Characteristics, Mode of action and use of 2, 4-D, Sulfonyl ureas - Metsulfuron, Pyrosulfuron, Imidazoline, Alachlor, Butachlor, Oxyfluorfen, Fulchloralin, Pendimethalin, Atrazine, Paraquat and Glyphosate. Bisperipac sodium.
17. Fate of pesticides in soil-Impact of pesticides on the environment , Highlights of Insecticide Act -1968 and Insecticide Rules -1971

**Practical schedule**

1. Sampling, processing and storage of plant materials for chemical analysis -Estimation of moisture and ash content
2. Preparation of tri acid extracts of plant samples -Estimation of P and K in triple acid extract
3. Estimation of crude protein
4. Estimation of crude fibre
5. Estimation of reducing and non-reducing sugars in jaggery
6. Estimation of oil content in groundnut
7. Estimation of total solids, ascorbic acid and titrable acidity in fruit samples
8. Estimation of phenols in vegetables / Mucilages in Bhendi
9. Determination of HCN content in Tapioca/ forage sorghum
10. Determination of bulk density in dust formulation, wettability and suspensibility test in wettable powder formulations
11. Estimation of emulsion stability in EC formulation
12. Estimation of pesticide residues in soil using GC/HPLC
13. Estimation of pesticide residues in Water / Soft drinks using GC/HPLC

14. Estimation of pesticide residues in Vegetables using GC/HPLC
15. Estimation of pesticide residues in Fruits using GC/HPLC & Pesticide requirement calculations
16. Visit to Pesticide Testing Laboratory
17. Practical Examination

**Text books**


1. Konard Mengel *et al.,* 2006. Principles of Plant Nutrition. 5th Edition, Springer International.
2. Vasanthi ,D, T.Chitdeshwari, M.R.Latha, C.Sudhalakshmi and A.Vadivel,2014. Text book on Crop and Pesticide Chemistry Pp.310
3. Dhakshinamoorthy, M. 2000. An Introduction to Plant Biochemistry and Chemistry of Crops, Suri Associates, Coimbatore Pp.192
4. Handa, S, K,2004. Principles of Pesticides Chemistry, Agrobios (INDIA), Jodhpur.
5. Roy,N.K, 2002. Chemistry of Pesticides.CBSPublishers &Distributors, New Delhi.


**References**


1. Brijesh Tiwari and Narpinder Singh. 2012. Pulse Chemistry and Technology. Scientific Publishers, Jodhpur, India.
2. Hand book of Agriculture, 2009. Published by Indian Council of Agricultural Research, New Delhi 110 012.Pp.1583
3. Paul H.Moore and Frederik C.Botha. 2014. Sugarcane : Physiology, Biochemistry and Functional Biology (World Agriculture Series). Amazon Publishers, India.
4. Petra Marschner. 2012. Marschner's mineral nutrition of higher plants.3rd Edition. ISBN: 978-0-12-384905-2.Elsevier publications.
5. Yash P. Kalra, 1998, Handbook of Reference Methods for Plant Analysis, Taylor & Francis Group, LLC, New york, London
6. Dodia, D.A., I.S.Patel and G.M.Patel. 2010. Botanical Pesticides for Pest Management. Amazon Publishers, India.
7. Gupta,A.2006. Pesticide Residue in Food commodities. Agrobios Publishers, Jodhpur.
8. Hassall, K.A. 2013. The Chemistry of pesticides, their metabolism, mode of action and uses in crop production. Scientific Publishers, Jodhpur, India.

9. Koul, 0., G.S.Dhaliwal, S.Khohar and R.Singh. 2014. Biopesticides in Sustainabie Agriculture. Progress and Potential. Amazon Publishers, India.
10. Mac Bean, C. 2013. The Pesticide Manual: A World Compendium. Amazon Publishers, India.
11. Sree Ramulu, U.S. 1979. Chemistry of Insecticides and Fungicides - Oxford and IBM Publishing Co, New Delhi.

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6. www.aiou.edu.pk/FoodSite/Research%20Papers/48.pdf
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10. www.studiauniversitatis.ro/v15/pdf/20-2010/20.../SU20-2-10Caunii.pdf
11. www.fao.org/docrep/t0073e/t0073e01 .htm
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14. www.uvm.edu/extension/cropsoil/wp-content/uploads/turner_refining.pdf
15. journals.cambridge.org/article_S0021859600040156
16. www.intechopen.com/.../pesticides-in-the-modern-world-trends-in-pestic...
17. cibrc.nic.in/insecticides_rules.htm
18. www.agcsa.com.au/static/atm_articles/html/3_3c.html
19. www.agf.gov.bc.ca > Agriculture > Pesticide Wise

**Out come:**

The students of undergraduate will gain knowledge on chemical composition and nutritional quality of various agricultural and horticultural crops. Proper understanding of chemistry of pesticides will be inculcated among the students. The students will acquire the skills on quality monitoring of crops and pesticides through practices.

**17 PBG 311 Plant Genetic Resources : Collection, Conservation and Utilisation (1+1)**

**Aim:**

To inculcate the knowledge and to expose the students for experiencing on the current status and trends of the science, practices and policies of plant genetic resources with respect to collection, conservation and beneficial use for food and agriculture

**Syllabus for theory**

**Unit I Concepts in agrobiodiversity**

Origin and history of agriculture; conservation and agricultural development; the central role of agrobiodiversity: trends and challenges; centers of crop plant origin and diversity; Crop Wild Relatives and their role in crop domestication; dynamics of domestication; concept of gene pool; agrobiodiversity regions of India- geographical distribution of crops of Indian origin

**Unit II: Planning and execution of collection missions**

Importance and need for collection missions; planning and execution of collection missions ; Logistics for collection; GIS- Information on collection sites; Passport data and its importance in collection missions; use of flora and herbaria for planning collections; National and international policies and procedures to be adopted in collection missions

**Unit III : Concepts in PGR conservation**

*In situ* and *ex situ* conservation: concept of biosphere reserves, gene sanctuaries, on-farm conservation, seed genebanks, field genebanks, botanical gardens, herbal gardens, *in vitro* repositories and cryo-genebanks; short-, medium- and long-term conservation, concept of base, active and working collections

**Unit IV: International and national policies**

International framework and PGR networks; International treaties and policies in relation to agrobiodiversity conservation and sustainable use; CBD , UPOV ; National policies and legal frame work; Organisations; Biodiversity authority; PPV and FR authority; National Biodiversity Authority, IP issues with respect to ITKs and communities safe guarding biodiversity

**Syllabus for practical**

Concepts and methods for computing biodiversity; Alpha and beta models; Calculation of species richness and endemism. Field visits to biosphere reserves – *in situ* methods of conservation.Visit to Field gene banks and understanding the modalities of conservation. Visit to Ramiah Gene Bank to understand the concepts of medium and long term storage in seed gene banks – Seed acquisition, processing, packing, barcoding, viability monitoring, registration and documentation. Visit to clonal gene banks. Biotechnology in conservation - *In vitro* methods of conservation. Exposure to cryoconservation methods. Concepts of PGR documentation and related web resources. Crop genetic diversity - Concepts of core and mini core collections. Molecular methods in PGR documentation and fingerprinting. Planning a Pre breeding programme with adapted and unadapted germplasm. Crop wild relatives - designing a Pre breeding programme with Crop Wild relatives. PGR- Global and National policies. Learning the institutional policies and modalities in exchange and utilization of PGR at TNAU

**Lecture schedule:**

1. Origin and history of agriculture; conservation and agricultural development-the central role of agrobiodiversity – Methods to estimate biodiversity- trends and challenges
2. Crop diversity - centers of crop plant origin and diversity , Concepts of gene pools
3. Biodiversity hotspots - Global – Indian- Regions of agobiodiversity
4. Crop wild relatives – domestication of crops
5. Dynamics of crop domestication with special reference to Rice, Wheat, Maize and Tomato
6. Germplasm exploration and collection – Eco-Geographical issues to be considered in planning explorations- – use of GIS and GPS principles during explorations
7. Planning the logistics and execution of collection missions- Global collection missions and achievements
8. Sampling strategies to be adopted in collections – Data recording and handling including passport data, collection of herbaria of samples etc during collection missions
9. Mid semester examination

10. Historical issues related to PGR conservation, scientific basis of PGR conservation – Types :*In situ* and *ex situ* conservation:
11. *In Situ* Conservation methods : concept of biosphere reserves, gene sanctuaries,and on-farm conservation
12. *Ex Situ* conservation methods : Field gene banks and seed gene banks
13. *Ex Situ* conservation methods : Cryo conservation, *in vitro* conservation, DNA banks, conservation of microspores and mega spores
14. Concept of base, active and working collections, core collections and reference sets
15. International framework and PGR networks; International treaties and policies in relation to agrobiodiversity conservation and sustainable use; CBD and UPOV convention
16. National polices: National Biodiversity Authority, PPV & FR authority, IP issues with respect to ITKs and communities safe guarding biodiversity
17. Utilization of Plant Genetic Resources – Pre-breeding concepts for use of adapted and un-adapted germplasm in crop improvement programmes

**Final theory Examination**

**Practical schedule:**

1. Concepts and methods for computing biodiversity; Alpha and beta models;
2. Calculation of species richness and endemism
3. Field visits to biosphere reserves – *in situ* methods of conservation
4. Visit to Field gene banks and understanding the modalities of conservation
5. Visit to Ramiah Gene Bank to understand the concepts of medium and long term storage in seed gene banks – Seed acquisition, processing, packing, barcoding
6. Visit to Ramiah Gene Bank to understand the concepts of medium and long term storage in seed gene banks – viability monitoring, registration and documentation
7. Visit to clonal gene banks
8. Biotechnology in conservation - *In vitro* methods of conservation
9. Exposure to cryoconservation methods
10. Concepts of PGR documentation and related web resources
11. Crop genetic diversity - Concepts of core and mini core collections
12. Molecular methods in PGR documentation and fingerprinting
13. Planning a Pre breeding programme with adapted and unadapted germplasm

14. Crop wild relatives - designing a Pre breeding programme with Crop Wild relatives
15. PGR- Global and National policies
16. Learning the institutional policies and modalities in exchange and utilization of PGR at TNAU
17. Practical Examination

**1. Reference Text Books ( one or two only):**

1. Engels J.M. and Visser, L. **(**eds.). 2003. A guide to effective management of germplasm collections. IPGRI Handbook for Genebanks No.6. IPGRI, Rome, Italy.

2. Guarino, L., Rao, V.R. and Reid, R. **(**eds.). 1995. Collecting plant genetic diversity. CAB International, Wallingford, UK.

**2. E references:**

1. Food and Agriculture Organization **(**FAO) Commission on Biodiversity for Food and Agriculture; www.fao.org/biodiversity

2. http://www.bioversityinternational.org/uploads/tx_news/Molecular_markers_for_gene bank_management_1082.pdf

## 17 SST 311 Seed entrepreneurship skill development and management 2 (1+1)

**Objective**

To update the knowledge and skills of students about the seed entrepreneurship, establishment and management of seed enterprise.

**Unit I**

Current status of National and Global Seed Industry and future perspectives Seed plan - Supply chain management - Significance of Seed Replacement Rate (SRR) Formal and informal seed sector - Seed trade - Role of International agencies in cross border trading (UPOV, OECD, ISTA, IPPC, AOSA, AOSCA) Varietal registration - Seed legislation and regulatory frame works (Seeds Act and Rules, Seed Control Order 1983 and amendments - PPV&FRA 2001).

**Unit II**

Seed promotional policies and programmes – NPSD 1988 - National seed policy 2002- Seeds Bill 2004 - EXIM policy - Domestic and International organizations involved in seed business - NSC, SSC,NSAI - International Seed Federation (ISF) - Asia Pacific Seed Association (APSA) - National seed quality regulatory system - Seed Certification Agencies - Notification - Seed Testing Laboratories - Central and Referral laboratories - Uniformity in quality regulation - International Seed quality regulatory system - OECD varietal certification - International Seed analysis certificate - ISTA membership and accreditation system.

**Unit III**

Seed Export and Import - procedures and guidelines - Germplasm exchange rules and directions - Plant Quarantine system and Sanitary and Phyto Sanitary (SPS) issues and measures for export and import of seeds - NBPGR, FAO - Human resource skill development - Financial requirements and their significance in successful seed company management - Seed company - Corporate affairs – components - Registration and establishment - Grant and issue of license - Seed preference assessment - Seed Rolling Plan - OPVs and hybrids - Role of Seed multiplication Ratio (SMR) - Varietal Replacement Rate (VRR).

**Unit IV**

Post harvest handling and machineries - Principles of seed drying, cleaning and upgradation - their significance in seed shelf life preservation - Risk coverage of carry over seeds - factors affecting seed storage - infrastructure facilities - ambient and advanced storage structures - Pre and post seed quality control - management checks and balances - their significance in seed trade - Linkages with various organizations for effective seed trade and business management - Farmers centric and market driven strategies for sustaining seed business and achieving seed security - Seed pricing - pricing policies of public and private agencies - strategies - methods and factors affecting prices.

**Lecture schedule**

1. Current status of National and Global Seed Industry and future perspectives
2. Seed plan - Supply chain management - Significance of Seed Replacement Rate (SRR) - Formal and informal seed sector
3. Seed trade - Role of International agencies in cross border trading (UPOV,OECD, ISTA IPPC, AOSA, AOSCA)
4. Varietal registration - Seed legislation and regulatory frame works (Seeds Act and Rules, Seed Control Order 1983 and amendments - PPV&FRA 2001 )
5. Seed promotional policies and programmes – NPSD 1988 - National seed policy 2002- Seeds Bill 2004 - EXIM policy
6. Domestic and International organizations involved in seed business – NSC, SSC,NSAI- International Seed Federation (ISF) - Asia Pacific Seed Association(APSA)
7. National seed quality regulatory system- Seed Certification Agencies- Notification - Seed Testing Laboratories - Central and Referral laboratories - Uniformity in quality regulation.
8. **Mid semester examination**
9. International Seed quality regulatory system - OECD varietal certification - International Seed analysis certificate - ISTA membership and accreditation system
10. Seed Export and Import - procedures and guidelines - Germplasm exchange rules and directions - Plant Quarantine system and Sanitary and Phyto Sanitary (SPS) issues and measures for export and import of seeds - NBPGR, FAO etc

11. Human Resource skill development - Financial requirements and their significance in successful seed company management
12. Seed company - Corporate affairs - components- Registration and establishment - Grant and issue of license
13. Seed preference assessment - Seed Rolling Plan - OPVs and hybrids - Role of Seed multiplication Ratio (SMR) - Varietal Replacement Rate (VRR )
14. Post harvest handling and machineries - Principles of seed drying, cleaning and upgradation - their significance in seed shelf life preservation
15. Risk coverage of carry over seeds - factors affecting seed storage - infrastructure facilities - ambient and advanced storage structures
16. Pre and post seed quality control - management checks and balances - their significance in seed trade - Linkages with various organizations for effective seed trade and business management
17. Farmers centric and market driven strategies for sustaining seed business and achieving seed security - Seed pricing - pricing policies of public and private agencies - strategies - methods and factors affecting prices

**Practical schedule**

1. Basic components in establishment of seed company and organizational setup - staffing pattern - Registration procedures - Company - seed producer
2. Visit to public and private sector seed companies
3. Preparation of seed rolling plan
4. Visit to seed production plots - Study on field inspection procedures
5. Lay out and designing of seed processing unit and infrastructure
6. Lay out and designing of large and small scale seed storage facilities
7. Layout and establishment of seed quality control laboratory
8. Financial assistance for seed company establishment - Central Sector Seed Schemes - NABARD - Financing organizations
9. Preparation of projects for financial assistance for establishment of seed company - Micro, small and medium enterprises etc.,
10. Project preparation on establishment of seed processing units and seed storage infrastructures for financial assistance
11. Visit to seed dealer and retail outlets

12. Value addition techniques for seed preservation, marketing and minimizing post harvest quality losses
13. Management of legal issues related to seeds - stop sale order, punitive action, punishment and appeal - appellate authority
14. Visit to Seed Testing laboratories - Notified and ISTA accredited
15. Preparation of company status report and analysis of critical issues on sustaining seed business
16. Downgrading of seeds - Upgradation and improvement of seed standards of "sales returned seeds" for placing in market
17. **Final practical examination**

**Out come**

The students will gain knowledge about the National and International seed trade and seed quality regulation system.

**References**


1. Dadheech, P.K. 1996. Seed Programming. Management system and concepts. Lok Sahitna Kendra. Jodhpur.
2. Gurudev Gingh and Asokan, S.R., 1997. Management of seed activity. Oxford and IBH Publishing Co., New Delhi.
3. Ramalingam, C. K.Sivasubramaniam and A. Vijayakumar. 1997. A Guide to seed legislation. Rassi Computers, Madurai
4. Trivedi, R.K. and M. Gunasekaran. 2013. Indian Minimum Seed Certification Standards. Dept. of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, New Delhi.
5. Compendium of Seed Legislation. 2013. Dept. of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, New Delhi

**Online references**

1. www.fao.org
2. www.seednet.gov.in
3. www.agricoop.nic.in

## 17 NEM 351 Commercial Production of Nematode Antagonistic bio-agents 2 (1+1)

**Aim:** The course is aimed to inculcate entrepreneurial skill to students and expose them to different aspects in commercial production of biocontrol agents, marketing and economics. The course will also provide hands on training to students in mass culturing and marketing of nematode antagonistic fungal organisms.

### SYLLABUS

**THEORY:**

**Unit 1**

Concepts and definition of biocontrol agents **–** Economic yield loss caused by plant parasitic nematodes in agricultural and horticultural crops – Ecofriendly management of plant parasitic nematodes - Types of bioagents – Fungal antagonistic organisms – Applications – Dosage - Commercial formulations available in India – Merits and demerits.

**Unit 2:**

*Paecilomyces lilacinus – Pochonia chlamydosporia* - Morphological identification of colony – Conidiaspore and Chalmydospores identification –- Isolation from eggs - Mode of action – Host range - virulence – effect of biotic and abiotic factors on growth – compatibility with chemical inputs.

**Unit 3:**

Sterilization – Types and Preparation of sterilizing agents – Equipments used – Principle of autoclave – Principle of Laminar Air Flow Chamber – Fermentor – Laboratory up-keep – Haemocytomenter – Assessment of spore load – colony forming unitis.

**Unit 4:**

Preparation different culture media – Maintenance of pure culture - Mother culture – Subculturing – Mass culturing techniques – solid and liquid formulations - Commercial Formulations – Carrier materials – Packing – Quality control and shelf life.

**Unit 5:**

Market demand analysis - Economics – Establishment of pilot plant – Infrastructure - Budget preparation – Marketing and cost-benefit analysis – risk
analysis – Environmental impact test with vertebrate and invertebrate organisms.

**LECTURE SCHEDULE**

1. Introduction - Economic yield loss caused by plant parasitic nematodes in agricultural and horticultural crops. Concepts and definition of biocontrol agents.
2. Types of bioagents – Fungal antagonistic organisms – Applications – Dosage - Commercial formulations available in India – Merits and demerits
3. *Purpureocillium lilacinum (=Paecilomyces lilacinus)* – Morphological identification of colony, phialids and conidia spore
4. *Pochonia chlamydosporia* - Morphological identification of colony. Conidia spore and Chalmydospores identification
5. Isolation of *P. lilacinum* and *P. chlamydosporia* from nematode eggs and mode of action.
6. Host range of *P. lilacinum* and *P. chlamydosporia* - virulence and effect of biotic and abiotic factors on growth – compatibility with chemical inputs

7. Sterilization – Types and Preparation of sterilizing agents – Equipments used for production of bioagents.
8. Principle of Autoclave, Laminar Air Flow Chamber and Fermentor
9. Laboratory up-keep – Preparation of cleaning solutions – preparation of stock solutions
10. Haemocytomenter – Assessment of spore load – colony forming units.
11. Preparation of different culture media – Maintenance of pure culture - Mother culture – Subculturing
12. Mass culturing techniques – solid and liquid formulations – Shelf life
13. Commercial Formulations – Carrier materials – Packing – Quality control and shelf life.
14. Market demand analysis – Economics
15. Establishment of pilot plant – Infrastructure requirement – cost analysis
16. Budget preparation – Marketing and cost-benefit analysis – risk analysis
17. Environmental impact test with vertebrate and invertebrate organisms

**PRACTICAL:**

Plant parasitic nematodes eggs isolation – Eggs parasitization tests with *Paecilomyces lilacinus* and *Pochonia chlamydosporia* – Fungal specific media preparation – Pure culture - Preparation of common culture media – subculturing of *Paecilomyces lilacinus* - subculturing of *Pochonia chlamydosporia* – Preparation of broth – Inoculation – Incubation in mechanical shaker – *In vitro* bioefficacy test on root knot nematode - Fermentation process – Haemocytometer – Assessing spore load in broth – Preparation of commercial formulation – Quality control test - Packing – Analyzing market potential and demand – Conducting environmental impacts test with termites, saprophytes, honeybees, earthwarm etc., - Visit to commercial production unit ( HRS, Ooty).

1. Isolation of eggs of plant parasitic nematodes.
2. Eggs parasitization tests with *Purpureocillium lilacinum*
3. Eggs parasitization tests with *Pochonia chlamydosporia*
4. Fungal specific media preparation – Pure culture - Preparation of common culture media
5. Subculturing of *P. lilacinum* and *Pochonia chlamydosporia*
6. Preparation of broth – Inoculation – Incubation in mechanical shaker
7. *In vitro* bioefficacy test on root knot nematode with *Purpureocillium lilacinum*
8. *In vitro* bioefficacy test on root knot nematode with *Pochonia chlamydosporia*
9. Fermentation process
10. Haemocytometer – Assessing spore load in broth
11. Preparation of commercial formulation
12. Quality control test Packing
13. Analyzing market potential and demand
14. Conducting environmental impacts test with termites, saprophytes,
15. Conducting environmental impacts test with honeybees, earthworm
16. Visit to commercial production unit ( HRS, Ooty).

17. Practical Examination

## 17 EXP 401 & 17 EXP 402
## Experiential Learning Programme (ELP)/ Hands On Training (HOT)
## (0+20)

This program will be undertaken by the students during the eighth semester for a total duration of 24 weeks with a weightage of **0+20** credit hours. The students will register for any of two modules, listed in page No.9, of **0+10** credit hours each.

### Aim

Experiential Learning helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This embraces the earning while learning concept. Experiential Learning is a major step forward for high quality professional competence, practical work experience in real life situation to graduates, production oriented courses, production to consumption project working, facilitates producing job providers rather than job seekers and inculcates entrepreneurial orientation.

### Experiential Learning (EL)

#### a) Concept

The word 'experiential' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, and bring in innovation or some other transfer of skills or knowledge. Experiential learning is a business curriculum-related endeavour which is interactive.

EL is for building (or reinforcing) skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities move participants to explore and discover their own potential. Both activities and facilitation play a critical role in enhancing team performance

**b) Objectives**

EL provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work.

The main objectives of EL are:

1. To promote professional skills and knowledge through meaningful hands on experience.
2. To build confidence and to work in project mode.
3. To acquire enterprise management capabilities

**c) Duration**

The experiential learning programme will be offered for 168 days (one semester) period in the final year preferably $8^{th}$ semester. As the programme is enterprise oriented, students and faculty are expected to attend the activities of the enterprise even on institutional holidays with total commitment, and without any time limit or restriction of working hours for ELP.

## LIST OF EXPERIENTIAL COURSES

| S. No | Course code | Titles of the module | Credits |
|---|---|---|---|
| **1.** | 17 AGM 411 | Bio-inoculant production technology | 0+10 |
| **2.** | 17 HOR 411 | Hybrid Seed Production in Vegetable Crops | 0+10 |
| **3.** | 17 SAC 411 | On Farm Advisory for Soil Health, Water Quality & Plant Nutrition | 0+10 |
| **4.** | 17 AEN 411 | Commercial Beekeeping | 0+10 |
| **5.** | 17 SER 411 | Commercial Cocoon Production | 0+10 |
| **6.** | 17 ABT 411 | Commercial Plant Tissue Culture | 0+10 |
| **7.** | 17 HOR412 | Commercial Nursery Technology of Horticultural Crops | 0+10 |
| **8.** | 17 HOR 413 | Commercial Landscape Gardening | 0+10 |
| **9.** | 17 PAT 411 | Commercial production of Bio-control agents | 0+10 |
| **10.** | 17 PAT 412 | Commercial mushroom production | 0+10 |
| **11.** | 17 AMP 411 | Commercial broiler and layer production | 0+10 |
| **12.** | 17 SST 411 | Commercial seed production | 0+10 |
| **13.** | 17 PBG 411 | Hybrid pearl millet seed production | 0+10 |
| **14.** | 17 PBG 412 | Hybrid rice parental line seed production | 0+10 |
| **15.** | 17 ARM 411 | Managerial skills for Agribusiness | 0+10 |
| **16.** | 17 AGR 411 | Development of Integrated Farming system Model | 0+10 |
| **17.** | 17 HOR 414 | Protected cultivation of Vegetable crops | 0+10 |
| **18.** | 17 ENS 411 | Composting technology | 0+10 |
| **19.** | 17 AGR 412 | Organic Agriculture | 0+10 |

## 17 AGM 411 Bioinoculants Production Technology (0+10)

| Week | Activities |
|---|---|
| 1. | 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 *etc*., |
| 2. | 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 – *Azotobacter*, *Azospirillum*, *Rhizobium* and *Gluconoacetobacter*. |
| 3. | Isolation and purification of nitrogenous biofertilizers – Azolla and Blue Green Algae (BGA). Screening of nitrogen fixers - plant nodulation tests for *Rhizobium*. Use of Gas Chromatography for nitrogenase assay. Nitrogenase activity by ARA (nodule and broth cultures of *Azotobacter*, *Azospirillum* and *Gluconoacetobacter*). |
| 4. | Isolation, purification and characterization of phosphate solubilizing and potassium releasing (silicate solubilizing) bacteria. Selection of efficient strains by testing their ability under *in vitro* conditions. Isolation of AM spores from soil and morphological characterization of AM spores. |
| 5. | 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. |
| 6. | Isolation, purification and characterization of plant growth promoting bacteria - Pink Pigmented Facultative Methylotrophs (PPFM) and screening of PPFM. Development of markers for easy identification-application of real time PCR in strain identification. |
| 7. | Preparation of medium and carrier material for large scale production. Mass production of *Azotobacter*. |
| 8. | Mass production of *Rhizobium.* |
| 9. | Mass production of *Azospirillum.* |

10. Mass production of phosphate solubilizer.
11. Mass production of *Gluconoacetobacter* and potassium releasing bacterium (silicate solubilizing bacterium).
12. Mass production of PPFM.
13. Mass production of AM fungi, Azolla and BGA.

14. BIS standards / Fertilizer Control Order – Specifications and quality control measures for various biofertilizers. Storage and preservation of various microbial cultures – sub culturing, lyophilization *etc*., 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. *Rhizobium, Azospirillum* and *Azotobacter*. Quality control laboratories in India.

15. Application techniques– form, dose, method and time of application of biofertilisers – *Rhizobium, Azospirillum, Azotobacter, Gluconoacetobacter,* 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.

16. Financing - credit facilities – assistance – facility available for establishing biofertilizer production &17 units- licensing required *etc*., Formulation and presentation of a bankable project for production of fixed quantity of various biofertilizers.

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2. Somani L.L., 2011. Biofertilisers: Commercial Production Technology and Quality Control Publishers:
   ATPA. (ISBN-10: 8183211968, ISBN-13: 978-8183211963)
3. NIIR 2012. The Complete Technology Book on Biofertilizer and Organic Farming NIIR Project Consultancy Services, New Delhi. P. 608. (ISBN: 9789381039076)
4. Reeta Khosla 2017. Biofertilizers and Biocontrol Agents for Organic Farming, Publishers: Kojo press. (ISBN-10: 8192756793,ISBN-13: 978-8192756790)

## 17 AGR 411 Development of integrated farming system model (0+10)

**Conceptual understanding of IFS in the course**

1. Farming system: concepts, scope, objectives and advantages
2. Cropping systems for different agro climatic zones of India and Tamil Nadu Crop diversification and intensification in farming system perspective
3. Integrated Farming Systems
4. Enterprises selection in Integrated Farming Systems
5. Integrated Farming System models for wetland ecosystem Management of different enterprises of wetland IFS
6. Integrated farming system models for irrigated dry land ecosystem Management of different enterprises of irrigated dry land IFS
7. Integrated farming system models for dry land ecosystem Management of different enterprises of dry land IFS
8. Interaction between different components of IFS Resource recycling in integrated farming system IFS research methodology and evaluation
9. 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.
10. Preparation of bankable projects in IFS under irrigated dry land ecosystem Preparation of bankable projects in IFS under dryland ecosystem

## 17 ABT 411 Commercial Plant Tissue Culture (0+10)

**Practicals (Weekly Schedule)**

1.**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**

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1. Razdan, M.K. 2003. **Introduction to Plant Tissue Culture**. Enfield: Science Publishers Inc. USA

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3. *Gamborg OL, Phillips GC (2004*) ***Plant cell tissue and organ culture. Fundamental methods.****Narosa Publishing House, New Delhi*

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3. *dbtmicropropagation.nic.in/surveytcp.pdf*
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## 17 AGR 412 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.<br>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.<br>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<br>Preparation of culture media for biofertilizers<br>Isolation of *Rhizobium* from root nodules of leguminous plants<br>Isolation of *Azospirillum* from roots of cereal crops/ grasses<br>Isolation of phosphobacteria from soil<br>Microscopic observation of biofertilizer cultures |
| 5 week | Population assessment of bacterial biofertilizers<br>Method of application of bacterial biofertilizers<br>Mass production of Arbuscular Mycorrhizal Fungi<br>Identification of AM propagules in roots and soil<br>Mass production of *Azolla* and method of application<br>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 *Panchagavya*, Jeevamruth and Effective<br>Microorganisms (EM) -EM to be prepared from mother culture obtained from progressive<br>organic farmers for multiplication<br>Formation of beds and digging of compost pit of required size based on the availability of the<br>farm wastes. Filling the pit and bed for biocompost |
| 8 week | Vermicompost process respectively. Release of earthworms onto the compost bed<br>Monitoring the composting process for moisture and temperature for efficient composting.<br>Sampling of partially decomposed material for determining the nutritive value especially<br>carbon build up |
| 9 week | Harvest of matured composts, quantification and assessment of compost maturity indices<br>and comparing with FAO standards for marketability. Characterization of Panchagavya,<br>Jeevamruth and EM formulations<br>Preparation of enriched biocompost, vermicompost and FYM using *Azospirillum* and<br>*Azotobacter* or Azophos |
| 10 week | Establishment of model pest repellants cafeteria.<br>Preparation and application of herbal leaf extracts in pest management. |
| 11 week | Monitoring of insect pests through traps and lures.<br>Fruit fly trapping survey in horticultural crops. |

| | |
|---|---|
| 12 week | Case study on Agro-Eco System Analysis (AESA).<br>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<br>Diagnosis of disease symptoms and pathogens and cultural methods of disease management<br>Disease assessment and scoring. |
| 14 week | Removal of pathogens like ergot by mechanical methods.<br>Preparation and foliar spraying of Arappu butter milk extract and fliar spraying of pseudomonas butter milk extract<br>Preparation and foliar spraying of garlic vasambu extracts<br>Preparation and foliar spraying of cowdung 20% extract for BLB management |
| 15 week | Organic certification – Importance and scope<br>Procedure for obtaining certification<br>Post harvest management and value addition |
| 16 week | Supply chain management in Organic Farming<br>Exposure visit to Tamil Nadu Organic Certification Directorate and organic outlets |
| 17 week | Preparation of bankable projects<br>Evaluation of individual and group assignments and report submission<br>Visit to Nationalized Banks to learn about funding for projects.<br>**Final Practical Examination** |

## 17 PBG 412 Hybrid rice: Parental line seed production technique (0+10)

**Activities**:

1. 1st 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.

2. 2nd 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).

3. 3rd week and 4th 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**

Seedlings pest and disease management in nursery

Main field preparation

[redacted]

Transplanting the seedlings in the main field

A x B

[redacted]

| | | |
|---|---|---|
| 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 |

7th week and 8th week

[redacted]

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

9th week and 10th 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)

- $11^{th}$ week and $12^{th}$ 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 exsertion is incomplete in ‘A’ line

Two times of GA3 spray with Knapsack sprayer is needed to make the complete panicle exsertion

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.

13. $13^{th}$ 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.

10. $14^{th}$ 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.

□□15th□week

Monitoring of farmers field for hybrid performance 16th wee

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.

**17 PBG 411 Hybrid pearl millet seed production (0+10)**

Activities :

11. 1st 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.

10. 2nd 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$^{st}$ 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

11. 3rd week

II$^{nd}$ sowing : ICMA 93111 (Female parent A line) After 7 days of male line sowing

Sowing of border Rows : R line - 4 Rows.

- 4th week

Thinning of seedlings in both A and R lines

18 5th week & 6th week

Weeding and irrigation

Top dressing of fertilizer

- 7th week

II[nd] weeding and pest and disease control measures

Monitoring of flowering and rogueing

- 8[th] and 9[th] week
- 10[th] week
- 11[th] week

Thorough rogueing of the A line and harvesting

Threshing in the a separate threshing floor

Seed cleaning

- 12[th] week

Germination test

Seed treatment of hybrid seed

- 13[th] week

Seed packing

- 14[th] week
- 15[th] week
- 16[th] week and 17[th] week

Report preparation and submission

Deliverables

Students can learn the method of genetically pure hybrid seed production techniques in pearl millet.

**17 SAC 411 On Farm Advisory for Soil Health, Water Quality and Plant Nutrition (0+10)**

**Practical Schedule /week**

1. Identification and Selection of farm holdings growing different crops
2. Studying the land features and collection of soil samples
3. Assessment of soil physical and chemical quality indices of collected soil samples
4. Assessment of soil biological quality indices and interpretation (Dept. of Agrl. Microbiology)
5. Interpretation of analytical results of collected soil samples for their quality
6. Identifying soil constraints - Interpretation of results (Soil physics)
7. Problem solving management techniques, Calculation of ameliorants.
8. Assessing the Land suitability for agricultural, horticultural and tree crops (Dept.of RS&GIS)
9. Water sample collection, quality assessment
10. Assessing the land suitability for irrigation
11. Fertilizer prescription calculations for important crops - Nutrient equivalent basis -Soil Test Crop Response based recommendation for targeted yields
12. Deriving the nutrient requirement using DSSIFER soft ware for different crops (STCR)
13. Issue of Soil Health Card and Fertilizer prescription using DSSIFER software
14. Diagnosis of nutrient deficiencies using VDK software and corrective measures
15. Formulating the plan for the selected farm holding for the existing crops
16. Formulating the most viable farm plan for the selected farm holding and Development of Soil Constraint Management Package (SCMP)
17. Recap and Practical examination

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## 17 HOR 411 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

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.

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3. http:sfci.nic.in
4. www.iar.org.in/Directorate1.htm
5. www.apsa.org
6. www.seedassociationofindia.com
7. www.apaseed.com
8. www.apaseed.org

## 17 HOR 411 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<br>techniques (emasculation and pollination) - Identification of physiological disorders and management. |
| 10. | Exposure visit to seed certification department - seed certification procedures - registration and<br>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 -<br>harvesting methods - project preparation - project preparation. |
| 12. | Post harvest verification – fruit grading - extraction of seeds - processing sequence - seed drying<br>- 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<br>test - visit to grow out test field and DNA finger printing laboratory for genetic purity |

## 17 SST 411 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. Eeconomics 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 vent

**Reference**


1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.

2. Bhaskaran, M. A.Bharathi, K.Vanangamudi, N.Natarajan, P.Natesan, R.Jerlin and K.Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.

3. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.

4. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.

5. 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
3. www.apsa.org
4. www.seedassociationofindia.com
5. www.apaseed.com
6. www.apaseed.org

## 17 SST 411 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<br>seeds - processing sequence - seed drying - seed cleaning - grading - pre-storage seed treatment -<br>seed packing - seed storage. |
| 13. | Visit to seed processing unit and seed storage godown and learning sanitation measures - project<br>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 -<br>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. |

## 17 ENS 411 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.

8 John Berry. 2014. How to make compost? A quick and easy guide. Hewel Trading, USA

9 Roland Ulrich. 2014. Creating humus on farm – The controller heat method of composting. Outskirts press

10Augustine Afuilio, 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.cornnell.ed

17 **HOR 412 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, Culcutta, 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

## 17 HOR 413 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

Entrepreneurship skill and buoyancy in handling commercial ventures in the domain of landscape gardening is assured

Student's attitude in leadership quality, managerial skill and professionalism will be enriched

## 17 HOR 414 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**

***17.*** **References**

Prasad, S. and U. Kumar. 2005. Green house management for horticultural crops. 2nd ed. Agrobios.
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

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http://floraculture international.com

http://www.wvu.edu/~agexten/hortcult/greenhou/

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

www.gardenweb.com

www.my-garden-school.com

www.florista.in

www.realsimple.com

**17 PAT 411 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


Course plan: TB: Text Book

| **Units / Practicals** | **Topics to be covered** | **Chapter#** |
|---|---|---|
| 1st week | Establishment of a biocontrol unit, Mass production of *Corcyra cephalonica* and *Maconellicoccus hirsutus* | Chap#1,2,3,6 (TB1 ) |
| 2nd week | Mass production of parasitoids *viz.*,*Trichogramma* sp., *Chelonus blackburnii, Bracon sp* | Chap#7,8,10 (TB1 ) |
| 3rd week | Mass production of parasitoids *viz.*, *Goniozus nephanitis* and *Nesolynx thymus* | Chap#11 (TB1 ) |
| 4th week | Mass production of predators *viz*., *Cryptolaemus montrouzieri* and *Chrysoperla carnea*. | Chap#13,14 (TB1 ) |
| 5th week | Rearing of host insects *viz.*, *Helicoverpa armigera* and *Spodoptera litura* | Chap#4,5 (TB1 ) |
| 6th week | Mass production of nuclear polyhedrosis virus of *Helicoverpa armigera* and *Spodoptera litura* | Chap#15,16 (TB1 ) |
| 7th week | Mass production of entomopathogenic fungi *viz*. *Metarhizium* | Chap#18,19,20 |

| | | |
|---|---|---|
| | *anisopliae, Beauveria bassiana* and *Verticillium lecanii* | (TB1 ) |
| 8th 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:// plant disease.ippc.orst.adv/articles
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**

1. Bio-control agents and their significance in plant disease management
2. Safety procedures for handling of equipments (Autoclave, Laminar Air Flow Chamber, Hot air oven, pH meter)

3. Safety procedures for handling of equipments (Electronic balance, Fermentor, Distillation unit, Spectrophotometer, Microscopes and Spiral Kneader)

4. Good laboratory practices of a bio control lab
5. Sterilization techniques

**10 week**

1. Preparation of PDA and Rose Bengal agar medium
2. Preparation of *Trichoderma* selective medium,
3. Preparation of Kings B medium and Nutrient Agar medium
4. Preparation of Actinomycetes and *Chaetomium* selective medium.

Collection of soil samples and isolation of *Trichoderma, Beauveria* and *Chaetomium*

**11 week**

1. Collection of soil samples and isolation of *Pseudomonas fluorescens* and *Bacillus subtilis* and maintenance of pure cultures of biocontrol agents

2. Morphological and molecular characterization of *Trichoderma*
3. Morphological and molecular characterization of *Pseudomonas fluorescens*
4. Morphological and molecular characterization of *Bacillus subtilis*

**12 week**

1. Keys for the identification of lab contaminants (*Salmonella, Shigella, Vibrio, Aspergillus, Penicillium, Rhizopus* etc.,)
2. Assessing the efficacy of *Trichoderma* under *in vitro* condition.
3. Assessing the efficacy of *Pseudomonas and Bacillus* under *in vitro* condition.

4. Studies on the mode of action of *Trichoderma* against soil-borne, foliar and Post harvest pathogens

5. Studies on mode of action of *Pseudomonas and Bacillus* against soil-borne, foliar and Post harvest pathogens

**13 week**

1. Fermentation systems
2. Different kinds of formulations- solid , liquid oil invert formulation etc.
3. Mass multiplication of *Trichoderma*
4. Mass multiplication of *Trichoderma*

5. Quality analysis of *Trichoderma*

**14 week**

1. Mass multiplication of *Pseudomonas*
2. Mass multiplication of Bacillus

3. Quality analysis of *Pseudomonas and Bacillus*
4. Methods of delivery of bio control agents - *Trichoderma*

5. Methods of delivery of bio control agents - *Pseudomonas and Bacillus*

**15 week**

1. Bioefficacy of *Trichoderma* against plant diseases
2. Bioefficacy of *Pseudomonas and Bacillus* against plant diseases
3. Biocontrol agents in pipeline –*Chaetomium*
4. Biocontrol agents- *Beauveria*

5. Container content compatibility, packaging methods and shelf life studies of bio control agents.

6. Guidelines and requirements to establish a commercial bio control lab

**16 week**

1. Studies on energy requirements to establish a commercial bio control lab

2. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).

3. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).
4. Exposure visit to commercial bio control units

5. 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.)** |
|---|---|---|---|
| **I.Non-Recurring or Capital Investment *** | | | |
| 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 |
| | | **Total** | **7,98,000** |

| **S. No.** | **Particulars** | **Quantity** | **Amount (Rs.)** |
|---|---|---|---|
| **II. Recurring or Working Expenditure** | | | |
| 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 |
| | | **Total** | **18,750.00** |

| **III. Income** | | |
|---|---|---|
| 1. | 500 kgs of product @Rs. 75/- | 37,500.00 |
| 2. | Total Expenditure | 18,750.00 |
| | **Net Profit Rs.** | **18,750.00** |

* **Non-Recurring:** One time investment

**Mass Production of *Pseudomonas fluorescens* talc formulation (1000kg for 30 students)**

| S. No. | Particulars | Quantity | Amount (Rs.) |
|---|---|---|---|
| **I.Non-Recurring or Capital Investment** | | | |
| 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 |
| | | **Total** | **4,98,000** |

| S. No. | Particulars | Quantity | Amount (Rs.) |
|---|---|---|---|
| **II. Recurring or Working Expenditure** | | | |
| 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 |
| | | **Total** | **38,500.00** |

**III. Income**

| | | |
|---|---|---|
| 1. | 1000 kgs of product @Rs. 75/- | 75,000.00 |
| 2. | Total Expenditure | 38,500.00 |
| | **Net Profit Rs.** | **36,500.00** |

* **Non-Recurring:** One time investment

**REFERENCE**


1. Baker, K.F. and Cook, R.J. 1974. Biological control of plant pathogens. W.H. Freeman and Co. San Francisco, U.S.A.
2. Chet, I. 1987. Innovative approaches to plant disease control, John wiley and Sons, New York.
3. Dinakaran, D, G.Arjunan & G.Karthikeyan 2003. Biological control of crop diseases.
4. Papavizas, G.C. 1985. *Trichoderma* and *Gliocladium* : biology, ecology and potential for biocontrol. Annu. Rev. Phytopathol. 23 : 23-54.
5. Maheswari ,D.K and R.C Dubey 2008 .Potential micro organisms for sustainable agriculture. I.K International Publishing House Pvt. Lts , New Delhi
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7. Ahamed S and Narain U 2007 . Eco friendly management of plant diseases. Daya Publishing house , New Delhi
8. Utkhede, R.S. and Gupta, V.K. 1996. Management of soil borne diseases. Kalyani Publishers, New Delhi.

## 17 PAT 412 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.** | **Cholam grain** | **700 Kg** | **30/kg** | **21,000** |
| **3.** | **Calcium carbonate (commercial grade)** | **50** | **25/kg** | **1,250** |
| **4.** | **Non-absorbent cotton (400 g rolls)** | **100** | **80/roll** | **8,000** |

| | | | | |
|---|---|---|---|---|
| | | | | |
| **5.** | **Fungicides & Fumigants** | **--** | **--** | **3,000** |
| **6.** | **Electricity & Fuel** | **--** | **--** | **20,000** |
| **7.** | **Labour @ 2 women per day for 25 days** | **2 nos** | **190/person** | **9,500** |
| **8.** | **Glass wares and chemicals for preparing mother spawn** | **--** | **5,000** | **5,000** |
| **9.** | **Miscellaneous** | **--** | **--** | **2,000** |
| | **Total** | | | 84,150 |
| | **Overall total** | | | 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.) |
|---|---|---|---|---|
| | **Recurring Cost** | | | |
| **1.** | **Paddy straw** | **100 kg** | **5/kg** | **5,000** |
| **2.** | **Spawn** | **-** | **-** | **-** |

| | | | | |
|---|---|---|---|---|
| | | | | |
| **3.** | **Polythene bags for bed & packing** | **2 kg** | **120/kg** | **240** |
| **4.** | **Fungicides, Fumigants & Chemicals** | **--** | **--** | **5000** |
| **5.** | **Labour @ 2 Per day** | **2** | **190 /day** | **3,800** |
| **6.** | **Miscellaneous (gunny bags, rope,racks)** | **--** | | **6000** |
| **II.** | **Non recurring-Oyster Mushroom Shed** | **800 sq.ft.** | **75,000** | **75,000** |
| | | | Total (Rs.) | 95,040 |

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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

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1. www.mushroomcouncil.com/grow /grow.html
2. www.krishiworld.com/html/mushroom.html
3. www.gmushrooms.com /pots.html.
4. www.mushworld.com /home/
5. www.mushroomcouncil.org

## 17 AMP 411 Commercial broiler and layer production (0+10)

**Unit – I - Introduction**

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.

**Unit – II – Housing Management**

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.

**Unit – III – Feeding Management**

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.

**Unit – IV – Flock Health Management**

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.

**Unit – V – Processing and Marketing**

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.

**Practical schedule**

| Week | Topic to be covered |
|---|---|
| 1 | Current status of broiler and layer industry<br>Scope of broiler and layer production in India Commercial strains of broilers and layers<br><br>Location and layout of commercial broiler and layer farm Preparation of poultry house |
| 2 | Equipments used in broiler and layer farm<br><br>Different system of Management<br><br>Deep litter system<br><br>Cage system of management, Raised housing<br><br>Litter management |
| 3 | Preparation of brooder house<br><br>Brooder Management, Grower management and Layer management<br><br>Summer management of broiler and layer<br><br>Winter management of broiler and layer<br><br>Lighting management |
| 4 | Common procedures followed in broiler and layer farm. |

| | |
|---|---|
| | Water – Requirement<br>Quality analysis and its maintenance<br>Feeding Management of broilers and layers<br>Types of feed |
| 5 | Feed ingredients<br>Quality assessment of feed ingredients and feed<br>Additive and supplementation of additives<br>Storage of feed-Feeding Methods<br>Nutrient requirement of different stages of broilers and layers |
| 6 | Various standards for broilers and layers<br>Feed formulation<br>Least cost formulation<br>Preparation of compound feed<br>Components in feed mill |
| 7 | Feed mill operations<br>Hatchery Management<br>Hatchery layout and design<br>Hatcher and Setter<br>Collection and handling of egg |
| 8 | Setting and hatching of eggs and chicks quality assessment<br>Common disease of broilers and layers<br>Control and Prevention<br>Medication and Vaccination in broilers and layers<br>Different vaccination methods |
| 9 | Cold chain for vaccine<br>Vaccination schedule for broilers and layers<br>Postmortem inspection<br>Disposal of waste -dead birds and manure |

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|---|---|
| 10 | Biosecurity measures. |
| 11 | Processing of broilers<br>Slaughtering of broilers and cut up parts of broilers |

| | |
|---|---|
| 12 | Evaluation of egg for its quality Record maintenance |
| | Marketing Channels in broilers and layers |
| 13 | Export of egg and poultry meat |
| | Integration method of broilers |
| | marketing |
| 14 | 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 |
| 15 | Role of NECC and BCC in marketing of poultry and its products |
| 16 | Visit to commercial broiler farm, layer farm, feed plant, hatchery unit and processing plant |
| 17 | Examination |

## 17 AEN 411 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

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1. Atwal, A.S. 2013. Mellifera Bee Keeping and Pollination. *Kalyani Publishers, Ludhiana*. 394 p.

2. Ted Hooper, 1991. Guide to Bees and Honey (Thrid Edition), *BAS printers ltd. Over Wallop, Hampshire* 271 p.

3. Roger A. Morse, 1994. The new complete guide to beekeeping. *The Countryman Press, Woodstock, Vermont*. 207p.

4. Thomas D. Seeley. 1995. The Wisdom of the Hive, Harvard University Press, Cambridge, 295p.

| Sl. No. | Practical classes | Activity | Ref Book |
|---|---|---|---|
| **1.** | 1-10 | Honey bee species, castes, social biology and<br>communication in honey bees | Chapters 3,5,6 and 10 of TB<br>Chapters 2 to 5 of RB 1<br>Chapter 2,10 of RB 4 |
| **2.** | 11-20 | Bee pasturage and preparation of bee floral<br>calendar | Chapter 11 of TB<br>Chapter 12 of RB 1<br>Chapter 10 of RB 2 |
| **3.** | 21-30 | Honey bees for crop pollination and seed<br>production. | Chapter 17 and 18 of TB<br>Chapter 15 of RB 1 |
| **4.** | 31-40 | Stingless bees, little bees, rock bees<br>conservation and honey harvest | Chapter 5 of TB<br>Chapter 2 of RB 1 |
| **5.** | 41-50 | Beehives, beekeeping equipments<br>specification and uses, visit to manufacturing<br>unit | Chapter 9 of TB<br>Chapter 1 of RB 1<br>Chapter 4 of RB 2<br>Chapter 1 of RB 3<br>Chapter 4 of RB 4 |
| **6.** | 51-70 | Hiving feral Indian bee colony, site selection<br>for apiary, visit to migratory bee keeping sites,<br>visit to commercial cerana bee farm | Chapter 8 of TB<br>Chapter 1 and 8 of RB 1<br>Chapter 2 of RB 3 |
| **7.** | 71-80 | Honey extraction, processing, purity testing<br>and value addition, visit to honey processing<br>unit | Chapter 12, 20, 29 of TB<br>Chapter 10 of RB 1<br>Chapter 11 of RB 2<br>Chapter 5 of RB 3 |
| **8.** | 81-100 | Hive inspection, maintenance of hive | Chapter 12 of TB |

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|---|---|---|---|
| | | records,<br>management in nectar flow season, dearth<br>period, management of swarming,<br>absconding and laying workers | <br>Chapter 6, 9 of RB 1<br>Chapter 7 of RB 2<br>Chapter 3 to 7 of RB 3 |
| **9.** | 101-120 | Dividing, uniting bee colonies, artificial<br>feeding, protecting bees from pesticides | Chapter 12, 14, 25 of TB<br>Chapter 9 of RB 1 |
| **10.** | 121-130 | Insect, mite and bird enemies of honeybees,<br>brood and adult diseases | Chapter 21 of TB<br>Chapter 13 of RB 1<br>Chapter 8 of RB 3<br>Chapter 9 of RB 2 |
| **11.** | 131-140 | Mass queen rearing and production of mating<br>nucleus, visit to beekeeping society | Chapter 16, 22 of TB<br>Chapter 10 of RB 1<br>Chapter 8 of RB 2 |
| **12.** | 141-150 | Methods of collection of bees wax, bee pollen,<br>propolis, bee venom, royal jelly - Visit to<br>commercial mellifera bee farm | Chapter 19 of TB<br>Chapter 14 of RB 1 |
| **13.** | 151-170 | Marketing and economics of honey and bee<br>products, preparation of bee keeping projects<br>for bank funding | Chapter 28, 29 of TB<br>Chapter 14 of RB 1 |

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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

## 17 SER 411 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

- Authorized Silkworm Races – crossbreed and bivoltine. Rearing houses – plan and maintenance. Rearing appliances - disinfection.
- 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.
- Chawki Garden – maintenance and management
- Estimation of population of chawki - establishing Chawki Rearing Centres - Record maintenance

  – Transport - Fixation of rate. Visit to Chawki Rearing Centre.
- Late age rearing – tray and shoot rearing methods - leaf selection – feeding - spacing - bed cleaning
- Moulting care - bed disinfectants. Mounting and mountages. Spinning care and Harvesting.
- Calculation of Effective rate of rearing - Transporting and marketing of cocoons- Economics of rearing silkworms.
- Project preparation for establishing Late age rearing centres. Large scale sericulture farming and contract farming.

### Unit III: Silk Reeling

- Physical and commercial properties of cocoons and silk. Cocoon sorting - defective cocoons - cocoon drying - stifling – cooking - brushing - reeling machines - parts and their functions.
- Study of silk reeling - re-reeling - Skein preparation – packing.

- Eri silk spinning – spinning - methods.
- 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<br>requirement. Preparation of nursery - planting material - manure application. |
| 2 | Nursery management – irrigation, weeding, fertilizer application and plant<br>protection. Economics of nursery management. |
| 3 | Main field preparation, manuring - Planting methods - Irrigation – Weeding –<br>Intercropping |
| 4 | Training and pruning the mulberry crop.<br>Chawki rearing garden - Pruning methods – schedule of operations.<br>Visit to Chawki rearing garden. |
| 5 | Late age silkworm rearing - Harvest of leaf and shoot- methods of harvest.<br>Transporting – preservation of leaves and shoots – methods.<br>Visit to Late age silkworm rearing garden - Calculation of brushing capacity. |
| 6. | Farm machinery implements – mulberry pruner, stem cutter and power weeder.<br>Insect pests and diseases of mulberry –natural enemies- IPM.<br>Economics of Mulberry leaf production. Preparation of project proposals. |

| | |
|---|---|
| 7. | Authorized Silkworm Races –crossbreed and bivoltine silkworm rearing.<br>Requisites, inspection and selection of site for rearing house. |
| 8. | Rearing houses – plan and maintenance. Rearing appliances – Disinfection.<br>Agencies involved in egg production - procurement of eggs. Transportation –<br>preservation of eggs – incubation. |
| 9. | Black boxing of eggs. - hatching - estimation of hatching percentage. Brushing of<br>eggs – practicing brushing.<br>Rearing of chawki worms – methods. Leaf selection and feeding for young age silkworms. |
| 10. | Moulting, Bed cleaning and bed disinfectants for chawki worms.<br>Estimation of population of chawki worms. Establishing Chawki Rearing Centres.<br>Record maintenance and logistics at Chawki Rearing Centres. Transport of Chawki<br>worms. Visit to Chawki Rearing Centre. |
| 11. | Late age rearing – tray and shoot rearing methods. Leaf selection and feeding for<br>late age silkworms. Spacing of late age worms and bed cleaning. |
| 12. | Moulting care, application of bed disinfectants and its importance.<br>Mounting of worms and mountages. Spinning care and Harvesting. |
| 13. | Calculation of Effective rate of rearing. Maintenance of rearing records, rearing<br>environment for successful rearing.<br>Transporting and marketing of cocoons. Economics of rearing silkworms and<br>maintenance of rearing records. |
| 14 | Project preparation for establishing Late age rearing centres. Large scale sericulture<br>farming and contract farming.<br>Visit to Chawki Rearing Centre and late age rearing centres. |

| | |
|---|---|
| 15 | 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. |
| 16 | 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. |
| 17 | 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.


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1. www.silkbase.org
2. www.papilo.ab.a.u.tokyo.ac.jp

## 17 ARM 411 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 onAgribusiness – Processing sector
4. Discussion onAgribusiness – Service sector
5. Presentation on identified agribusiness sector – growth and future directions

1. Institutions promoting agribusiness in India
2. Government schemes promoting Agribusiness – Start up India, Make in India
3. Visit to District Industries Centre
4. Visit to MSME
5. 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

1. Functions of management
2. Functional areas of management - Operations
3. Functional areas of management – Human resources
4. Functional areas of management - Marketing
5. 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**

1. Visit to local shandy
2. Visit to Farmers market
3. Visit to Regulated market
4. Market survey –
5. 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**

1. Source of funds
2. Capital Budgeting Techniques
3. Analyzing Financial Statements
4. Analyzing Financial Statements

5. 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**

1. Entrepreneur – Qualities, Types of Entrepreneurship
2. Institutes promoting Entrepreneurship
3. Writing Biography of an agribusiness entrepreneur
4. Writing Biography of an agribusiness entrepreneur
5. Finding Entrepreneurial competency level

**Week 17**

Term paper presentation and
Evaluation Conducting Final
Practical Examination

# Research Integrated Curriculum

The relationship between teacher and learner is completely different in higher education from what it is in school. At the higher level, the teacher is not there for the sake of the student, both have their justification in the service of scholarship. For the students who are the professionals of the future, developing the ability to investigate problems, make judgments on the basis of sound evidences, take decisions on a rational basis and understand what they are doing and why is vital. Research and inquiry is not just for those who choose to pursue an academic career. It is central to professional life in the twenty-first century.

It is observed that the modern world is characterized by heightened levels of complexity and uncertainty. Fluidity, fuzziness, instability, fragility, unpredictability, indeterminacy, turbulence, changeability, contestability: these are some of the terms that mark out the world of the twenty-first century. Teaching and research is correlated when they are co-related. Growing out of the research on teaching- research relations, the following framework has been developed and widely adopted to help individual staff, course teams and whole institutions analyse their curricula and consider ways of strengthening students understanding of and through research. Curricula can be:

**Research – Led: Learning about current research in the discipline**

Here the curriculum focus is to ensure that what students learn clearly reflects current and ongoing research in their discipline. This may include research done by staff teaching them.

**Research – Oriented: Developing research skills and techniques**

Here the focus is on developing student's knowledge of and ability to carry out the research methodologies and methods appropriate to their discipline(s)

**Research – Based: Undertaking research and inquiry**

Here the curriculum focus is on ensuring that as much as possible the student learns in research and or inquiry mode (i.e. the students become producers of knowledge not just consumers). The strongest curricula form of this is in those special undergraduate programmes for selected students, but such research and inquiry may also be mainstreamed for all or many students.

**Research- Tutored: engaging in research discussions**

Here the focus is on students and staff critically discussing ongoing research in the discipline.

All four ways of engaging students with research and inquiry are valid and valuable and curricula can and should contain elements of them.

Moreover, the student participation in research may be classified as,

Level 1: Prescribed Research

Level 2: Bounded Research

Level 3: Scaffolded Research

Level 4: Self actuated Research

Level 5: Open Research

Taking into consideration the above mentioned facts in respect of integrating research into the B.Sc. (Agriculture) curriculum, the following Research Skill Based Courses are introduced in the curriculum.

| Semester | RSB Courses | Credits |
|---|---|---|
| IV | Research Led Seminar | 1 |
| V | Research Methodology | 3 |
| VI | Participation in Bounded Research | 2 |
| VII | Design Project/ Socio Technical Project ( Scaffolded Research) | 4 |

**Blueprint for assessment of student's performance in Research Led Seminar Course**

- **Internal Assessment: 40 Marks**
  - Seminar Report (UG) : 5 X 4 = 20 Marks
  - Seminar Review Presentation : 10 Marks
  - Literature Survey : 10 Marks
- **Semester Examination : 60 Marks**

  (Essay type Questions set by the concerned resource persons)

**Blueprint for assessment of student's performance in Design Project**

- **Continuous Internal Assessment through Reviews: 40 Marks**
  - Review I : 10 Marks
  - Review II : 10 Marks
  - Review III : 20 Marks
- **Evaluation of Socio Technical Practicum Final Report: 40 Marks**
- **Viva- Voce Examination: 20 Marks**
- **Total: 100 Marks**

**Blueprint for assessment of student's performance in Research Methodology Courses**

**Continuous Internal Assessment: 20 Marks**

- Research Tools( Lab) : 10 Marks
- Tutorial: 10 Marks

**Model Paper Writing: 40 Marks**

- Abstract: 5 Marks
- Introduction: 10 Marks
- Discussion: 10 Marks
- Review of Literature: 5 Marks
- Presentation: 10 Marks

**Semester Examination: 40 Marks**

**Total: 100 Marks**