V SEMESTER

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

PBG 301 Fundamentals of Plant Breeding (2+1)

THEORY

Unit I: Reproductive systems in plant breeding

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

Unit II: Breeding methods of self pollinated crops

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

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

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

Unit IV: Special breeding methods

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

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

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

PRACTICAL

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

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.
4. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine.
5. Modes of reproduction – sexual – asexual –mechanisms promoting self and cross pollination – 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. EGMS - TGMS,PGMS, Gametocides, Transgenic Male sterility and applications.
9. Apomixis – introduction – classification-applications; Parthenocarpy and its types.
10. Polygenic variation-components of variance - phenotypic, genotypic and environmental variance-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's 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– procedure - types – merits and demerits-achievements- comparison of mass and pureline selection.
14. Breeding methods of self pollinated crops involving artificial hybridization: Creating variability in self pollinated crops - Hybridization and selection – objectives – steps in hybridization - choice of parents – kinds of emasculation – hybridization- transgressive breeding.
15. Handling segregating generations- 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 basis –– procedures for transferring dominant and recessive genes
19. Back cross breeding – merits – demerits – multilines- types- procedure- merits and demerits.
20. Genetic structure of a population in cross pollinated crops – Hardy Weinberg law – gene frequencies in random mating population.
21. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – Grid selection – progeny 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.
24. Heterosis breeding – procedure – development of inbreds- evaluation of inbred lines – top cross method and single cross method- prediction of double cross performance- hybrids – single cross- double cross- three way cross hybrids. achievements – merits and demerits.
25. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits
26. Genetic characters of asexual reproduction – clonal selection – hybridization and clonal selection – merits and demerits – achievements;
27. Polyploidy breeding – classification – induction of polyploidy - achievements – limitations.
28. Wide hybridization-importance-barriers and techniques for overcoming barriers-utilization- Pre-breeding.
29. Mutation breeding: mutation – types – mutagens – breeding procedure – achievements – limitations.
30. Concepts in biotic stress resistance breeding- diseases and pests - gene for gene hypothesis- mechansims of resistance - sources of resistance- multilines-gene pyramiding-gene deployment- Breeding methods.
31. Concepts in abiotic stress resistance breeding- drought- mechansims of drought resistance – basis of drought resistance- morphological and physiological characters- sources of drought resistance- Breeding methods.
32. Procedure for release of new varieties-stages in seed multiplication-steps in nucleus and breeder seed production.
33. Introduction to markers – morphological – biochemical- DNA markers – advantages and disadvantages- marker assisted selection in plant breeding.
34. Participatory plant breeding- Intellectual Property Rights- Patenting- Plant Breeders and Farmers Rights.

Practical schedule

1. Reproduction in plants - Alternation of generation and life cycle.
2. Mode of pollination - Mechanisms enforcing self and cross pollination in crops- Working out extent of natural out crossing.

3. Breeder's kit and its components
4. Basic techniques for selfing and crossing in crop plants.
5. Emasculation and pollination techniques in field crops.
6. Emasculation and pollination techniques in horticultural crops.
7. Handling of segregating populations- Layout of different yield trials-maintenance of records.
8. Study of Cytoplasmic genic male sterility system in Rice
9. Study of Genic male sterility system in Redgram
10. Mutagenesis study using physical and chemical mutagens
11. Germplasmcollection and conservation.
12. Experimental designs used in plant breeding-RBD analysis
13. Calculation of mean, range, PCV, GCV, heritability, genetic advance
14. Estimation of heterosis and prediction performance of double cross hybrids
15. Screening techniquesfor biotic stresses in rice
16. Screening techniques for abiotic stresses in rice
17. **Final Practical examination**

References

Singh, B. D. 2005. Plant breeding - Principles and Methods. Kalyani Publishers, New Delhi.

Phundhan Singh. 2001. Essentials of Plant Breeding, 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

6. Breeding: Biotechnological and Conventional Approaches. Narosa Publishing House (India)

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

R. K. Singh and B. D. Choudhary. Biometrical methods in quantitative Genetics. Kalyani Publishers, Ludhiana

E- References

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/

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

Theory

Unit 1: Agricultural Marketing – Nature and Scope

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets**;** nature and determinants of demand and supply of farm products. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities. Approaches to the study of marketing - Market functionaries and Market forces. Marketing of agricultural versus manufactured goods.

Unit 2: Marketing Functions, Pricing and Promotion strategies

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

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

Unit 3: Marketing Efficiency and Marketing Institutions

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration over space, time and form: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Modern marketing systems versus traditional agricultural marketing systems; Role of Government in agricultural marketing - Public sector institutions - CWC, SWC, FCI and DMI – their objectives and functions; cooperative marketing in India; Market Intelligence -Legal measures for improving agricultural marketing: APMC Act. New EXIM policy of India – Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.

Unit 4: Trade in Agricultural Products

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

Unit 5: Agricultural Prices and Risk Analysis

Agricultural Prices and Policy: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP

(SMP) and SAP – Price Parity - Procurement of food grains and buffer stock - Risk in marketing: Meaning and Importance - Types of risk in marketing: Speculation and Hedging and Forward and Futures trading; an overview of futures trading; – Role of Contract Farming in risk mitigation.

Theory Schedule

1. Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing.
2. Market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets.
3. Demand and supply of agri-commodities: meaning, nature and determinants of demand and supply of farm products.
4. Approaches to the study of marketing: Market functionaries and Market forces.
5. Marketing of agricultural versus manufactured goods. Producer surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri- commodities.
6. Marketing process and functions: Marketing process - concentration, dispersion and equalization.
7. Exchange functions – buying and selling; physical functions – storage, transport and processing.
8. Facilitating functions – packaging, branding, grading, quality control and labeling (AGMARK).
9. Standardization, Finance, Storage and Warehousing, Processing, Value Addition and Risk Taking.
10. Market Structure, Conduct and Performance paradigm (SCP) – Market Structure: Meaning, Components, Dynamics of Conduct and Performance.
11. Market structure and Price determination under perfect and imperfect competition.
12. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC.
13. Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing.
14. Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits.
15. 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.
16. Integration over space, time and form: Meaning, definition and types of market integration.
17. **Mid-Semester Examination**
18. 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.
19. Role of Government in agricultural marketing - Modern marketing systems versus traditional agricultural marketing systems.
20. Public sector institutions- CWC, SWC, FCI, and DMI – their objectives and functions.
21. Co-operative marketing in India.

22. Market Intelligence - Legal measures for improving agricultural marketing: APMC Act. New EXIM policy of India.
23. Advantages of AEZs, ITPO, Export Promotion Councils, APEDA, MPEDA, and Commodity Boards.
24. International Trade: Concept of International Trade and its need - Free trade, Autarky and it needs.
25. Theories of Trade: Absolute and comparative advantage;
26. Present status and prospects of Agricultural exports / imports from India and their share.
27. Barriers to Trade: Tariff and non tariff barriers - Trade policy instruments.
28. Terms of Trade - Role of institutions like UNCTAD and GATT - WTO in promoting trade in agricultural products - Free Trade Agreements.
29. AoA and its implications on Indian agriculture: Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies - IPR.
30. Agricultural Prices: Meaning and functions of price; administered prices; need for agricultural price policy; Objectives of Price Policy and Price Stabilization – Role of CACP – Concept of MSP, FRP (SMP) and SAP.
31. Price Parity - Procurement of food grains and buffer stock.
32. Risk in marketing: Meaning and Importance - Types of risk in marketing.
33. Speculation and Hedging and Forward and Futures trading: an overview of futures trading.
34. Role of Contract Farming in risk mitigation.

Practical Schedule

1. Preparation of farm survey schedule
2. Visit to a farm to collect information on marketing practices of agricultural commodities and marketing problems.
3. Plotting and study of demand and supply curves and calculation of elasticities.
4. Computation of marketable and marketed surplus of important commodities.
5. Visit to a local market / weekly *shandy* / farmers' market to study various marketing functions performed by different agencies.
6. Study of relationship between market arrivals and prices of some selected commodities.
7. Identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins; price spread estimation for major agricultural and allied agricultural products to assess their marketing efficiency; and presentation of report in the class.
8. Visit to market committee and regulated market to study their organization and functioning.
9. Visit to co-operative marketing society to study its organization and functioning.
10. Visit to market institutions – SWC / CWC to study their organization and functioning.
11. Visit to AGMARK Laboratory / Grading institutions.
12. Farm input marketing: Visit to Farm input dealer to study marketing of farm inputs.
13. Visit to Commodity Boards / AEZ / Export oriented units.
14. Time Series Analysis of prices–TCSI Study of price behaviour over time for some selected commodities.
15. Construction of Index Numbers and their uses.
16. Application of principles of comparative advantage of international trade.
17. **Practical Examination.**

References

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.
5. Sivarama Prasad A. 1999. Agricultural Marketing in India. Mittal Publications, New Delhi.
6. Kohls R. L. and N. Uhl. Joseph. 1980. Marketing of Agricultural Products. Collier Macmillan. New York.

AGM 301 Agricultural Microbiology (1+1)

Theory

Unit I Introduction

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

Unit II Biogeochemical cycling of nutrients

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

Unit III Microbial degradation and bioremediation

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

Unit IV Microbiomes and plant growth

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

Unit V Microbes in human welfare

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

Practical

Enumeration of soil microbial population - quantitative and qualitative methods. Organic matter decomposition - CO_2 evolution and BOD. Isolation of symbiotic nitrogen fixing bacteria, free living, associative and endophytic nitrogen fixing bacteria. Isolation of phosphobacteria and sulfur oxidizing bacteria. Isolation of zinc and silicate solubilizing/ potassium releasing bacteria. Isolation of plant growth promoting rhizobacteria(*Pseudomonas* sp) and phyllosphere (PPFM) microbes. Examination of AM fungal infection in plants and recovery of AM spores from soil. Examination of Blue Green Algae (BGA) from soil and azolla. Mass production of bacterial bioinoculants, blue green algae, azolla and AM fungi. Visit to biopesticides, silage production and compost yard.

Theory schedule

1. Introduction and historical developments in soil microbiology. Contributions of BeijerinckHellriegel, Wilfarth, Frank, Winogradsky, Fleming, Waksman, Doberiener and Mosse
2. Soil microorganisms and their role in soil fertility and crop production
3. Assessment of microbial diversity. Factors influencing the activities of soil microorganisms. Role of soil enzymes in nutrient transformation

4. Carbon cycle. Role of soil microorganisms in the decomposition of organic matter in oxygenic and anoxygenic environments; humus formation.
5. Nitrogen cycle – microbiology and biochemistry of mineralization, ammonification, nitrification and denitrification
6. Biological nitrogen fixation – free living, associative, endophytic, epiphytic and symbiotic diazotrophic microorganisms. Nodulation in *Rhizobium*- legume and *Frankia* – actinorhizal symbioses
7. Biochemistry and molecular biology of nitrogen fixation in different types of diazotrophs
8. Phosphorus cycle and microbial transformation of phosphorus – mineralization, phosphate solubilization and translocation
9. **Mid Semester Examination**
10. Sulphur cycle - sulphur oxidizers; microbial transformation of K, Zn and Si.
11. Role of microbes in reclamation of problem soils. Microbes in solid waste management
12. Biodegradation of agricultural residues and chemicals- processes involved in remediation
13. Importance of soil and plant microbiomes– rhizosphere, spermosphere, phyllosphere, epiphytic and endophytes. Plant growth promoting microbes-types and mechanism of action.
14. Soil microorganisms and their interactions – positive and negative interactions. An overview of industrially important microorganisms and products.
15. Silage production. Bioinoculants – types; biofertilisers - bacterial, fungal (AMF) and algalbiofertilisers. Biopesticides – types and mechanism of action
16. Mass production and quality control of bacterial and fungal bioinoculants. BIS standards– methods of application of bioinoculants.
17. Biofuel production – methane, hydrogen, 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 and bulk soil microorganisms and determination of R:S ratio
3. Studying organic matter decomposition by measurement of CO_2 evolution
4. Isolation of *Rhizobium* from root nodulesand*Azotobacter*from soil
5. Isolation of *Azospirilum*byMPN technique
6. Isolation of *Gluconoacetobacter* from sugarcane phllosphere/rhizosphere and PPFM fromphyllosphere
7. Isolation of phosphobacteria, potassium releasing and zinc solubilizing bacteria from soil
8. Isolation of PGPR (*Pseudomonas*sp) and sulphur oxidizing bacteria from soil
9. Examination of AM infection in roots and recovery of spores from soil
10. Mass production of bacterial bioinoculants and AM fungi
11. Examination ofblue green algae from soil and azolla
12. Mass multiplication of blue green algae and azolla
13. Methods of application of different bioinoculants
14. Antibiosis in soil – Crowded plate technique
15. Visit to biopesticides production unit
16. Visit to silage production and compost yard
17. **Practical Examination**

Text Books

1. Alexander, M. 1977. Soil Microbiology. John Wiley and Sons. New York
2. Paul , E . A. 2014. Soil Microbiology, Ecology and Biochemistry. 4th Ed. , Academic Press, USA
3. e book: Waksman, S. A 1952. Soil Microbiology John Wiley & Sons, Inc.

4. e book:Paul , E . A. 2007. Soil Microbiology, Ecology and Biochemistry. 3rd Ed. , Academic Press, USA.

Reference :

1. Rangaswamy,G. andBagyaraj, 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.

E- Reference

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

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

Theory

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

Unit-I Diseases of cereals and Millets

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

Unit- II Diseases of Pulses and Oilseeds

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

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

Unit- IV Diseases of Fruits and vegetables crops

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

Unit- V Diseases of Plantation crops

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

Practical

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

Theory

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

1. Diseases of rice
2. Diseases of maize and sorghum
3. Diseases of pearl millet, finger millet and small millets,
4. Diseases of pigeonpea, urdbean, mungbean, soybean and cowpea
5. Diseases of groundnut , sesame and castor
6. Diseases of tobacco, jute and mulberry
7. Diseases of banana
8. Diseases of guava , papaya and pomegranate
9. Mid semester examination
10. Diseases of tomato
11. Diseases of brinjal and okra
12. Diseases of crucifers
13. Diseases of sweet potato and beans
14. Diseases of coconut and arecanut
15. Diseases of tea
16. Diseases of coffee
17. Diseases of rubber and cocoa

Practical

Study of symptoms and host-parasite relationship of:

1. Diseases of rice
2. Diseases of maize and sorghum
3. Diseases of pearl millet, finger millet and small millets,
4. Diseases of pigeonpea, urdbean, mungbean, soybean and cowpea

5. Diseases of groundnut , sesame and castor
6. Diseases of tobacco, jute and mulberry
7. Diseases of banana
8. Diseases of guava, papaya and pomegranate
9. Diseases of crucifers
10. Field visit/ exposure visit to hilly fruits , vegetables and plantation crops
11. Diseases of tomato, brinjal and okra
12. Diseases of sweet potato and beans
13. Diseases of coconut and arecanut
14. Diseases of tea
15. Diseases of coffee
16. Diseases of rubber and cocoa
17. Final 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.

E- Books

1. Agrios, G.N. 2008. Plant Pathology, Academic Press, New York.
2. Rangaswami, G. 2005. Diseases of Crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.

Thakur, B.R. 2006. Diseases of field crops and their management

ARM 301 Entrepreneurship Development and Business Management (1+1)

Theory

Unit I – Entrepreneur and Entrepreneurial Process

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

Unit II – EntrepreneurshipOpportunities

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

Unit III – ManagerialFunctions – Planning and Organizing

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

Unit IV – ManagerialFunctions – Staffing, Directing and Control

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

Unit V – Functional Areas of Management

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

Practical

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

Lecture Schedule

1. Concept of Entrepreneurship and Types of Entrepreneurship
2. Characteristics of Entrepreneurs and Entrepreneurial Skills
3. Entrepreneurial process -– Importance of Entrepreneurship
4. Innovation - principles of innovation - Sources of innovative opportunities
5. Business environment – Micro and Macro environment
6. MSME Classification and Opportunities for rural enterpreneurship - KVIC classification, Startup and Business incubators
7. Agribusiness – Importance, Opportunities and Challenges
8. Management Functions – Planning – Types of Plans and Steps in Planning
9. **MID SEMESTER EXAMINATION**

10. Organizing – Principles and Departmentation
11. Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection
12. Directing – Principles, Techniques and Supervision
13. Controlling – Process and Types
14. Functional Areas of Management – Operations Management – Meaning and Scope
15. Supply Chain Management – Importance, Drivers and flows and Total Quality Management – Meaning and Principles
16. Marketing Management – Market Segmentation and Marketing Mix
17. Financial Management –Meaning, Objectives and Scope

Practicals schedule

1. Assessment of entrepreneurial traits
2. Identification of new business opportunities
3. Exercise on SWOC Analysis of Agribusiness sectorin India
4. Market survey for understanding customer needs
5. Starting new business - Visit to firms / discussion with entrepreneurs
6. Documenting Procedure for Establishing Agribusiness Firms
7. Government programs and institutions for entrepreneurship development
8. Financing new agribusiness ventures - Visit to banks / discussion
9. Exercise on Demand Forecasting for Agricultural Inputs/Products
10. Preparation of Advertisement and Sales Promotion Measures for Agribusiness
11. Exercise on Inventory Management – EOQ Model and ABC Analysis
12. Exercise on discounted measures of capital budgeting
13. Calculation of Break Even Point and its Business Implication
14. Business Plan Preparation
15. Understanding balance sheet and income statement
16. Financial Perfromance Analysis - Ratio Analysis
17. **PRACTICAL EXAMINATION**

References

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

E- References

1. www. ediindia. org/
2. iie. nic. in/

3. msme. gov. in/
4. niesbudtraining. org
5. www. nimsme. org/
6. www. nsic. co. in/
7. https://www. nabard. org/

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

Practical Schedule:

- Rice *(Transplanted rice or Direct sown rice):*

Transplanted 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:

Transplanted rice:

1&2. Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu.

3&4. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery.

5&6. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management.

7 & 8. Study and Practice of main field preparation and puddling operations.

9&10. Practicing of field preparatory operations - sectioning of field bunds and plastering, leveling and basal application of fertilizers.

11 &12. Practicing transplanting techniques in lowland rice.

13 &14. Estimation of plant population and acquiring skill in gap filling and thinning.

15 &16. Study of weeds and weed management in rice.

17 &18. Study and practice of green manuring and bio-fertilizer application in rice.

19 & 20. Acquiring skill in nutrient management and practicing top dressing techniques.

21 & 22. Study of water management practices for lowland rice.

23 & 24. Observation of insect pests and diseases and their management.

25 & 26. Recording growth and other related characters of rice.

27 & 28. Estimation of yield and yield parameters in rice.

29 & 30. Harvesting, threshing and

31 & 32. Cleaning, drying and calculating the yield of produce

33 Working out cost of cultivation and economics.

34 **Practical Examination**.

References:

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

Chidda Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd. , New Delhi.

Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.

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

Reddy,S. R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.

ICAR 2015. Hand book of Agriculture. Indian Council of Agricuture, New Delhi.

E-References:

1. WWw. irri. org
2. www. crri. nic. in
3. www. drrindia. org

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

Theory

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Practical

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

Theory schedule

1. Scope and importance of postharvest technology of fruits and vegetables
2. Factors responsible for post harvest losses.
3. Preharvest factors affecting postharvest life of fruits and vegetables
4. Physiological and biochemical changes during maturity and ripening
5. Respiration and ripening and the factors affecting the ripening of fruits and vegetables
6. Role of ethylene in ripening of fruits and vegetables

07. Preharvest operations to extend shelf life of fruits and vegetable crops

08. Postharvest handling of the produce (washing, fungicide treatment, precooling, grading, sorting waxing and nano coating)

9. **Mid -semester examination**

10. Importance of packaging, types of packaging and packaging materials.

11. Methods of storage of fruits and vegetables *viz.* , Zero energy cool chamber, cold storage, controlled atmosphere, modified atmosphere and hypobaric storage and management of cold chain for export of high value fruits and vegetables

12. Principles and methods of preservation of fruits and vegetables
13. Preservation and value addition of fruits viz. , jam, jelly, marmalade, preserve and candy
14. Concepts and standards in fermented and non fermented beverages from fruits and vegetables
15. Drying, dehydration and osmotic dehydration of fruits and vegetables- concepts and methods
16. Canning of fruits and vegetables- concepts-processing of canned products-spoilage and prevention
17. Packaging of products and standards in value addition of fruits and vegetables viz. , GMP, HACCP, FSSAI, Codex alimentrarius and ISO certification.

Practical Schedule

1. Preharvest operations to improve post harvest shelf life of fruits and vegetable crops
2. Assessment of maturity indices and harvest criteria for fruits and vegetable crops
3. Methods of packaging in fruits and vegetables
4. Identification and causes of chilling and freezing injury in vegetables and fruits
5. Estimations of ethylene evolution in fruit crops
6. Identification of postharvest diseases and disorders of fruits and vegetable crops
7. Postharvest machineries for fruits and vegetables crops
8. Postharvest handling of the produce (washing, fungicide treatment, grading, sorting, precooling, waxing and nano coating).
9. Preparation of jam/Jelly and quality evaluation of products
10. Preparation of RTS, nectar, squash and quality evaluation of products
11. Processing of dried and dehydrated fruits and vegetables
12. Preparation of fruit bar and candy and quality evaluation of products
13. Preparation of tomato products
14. Processing of canned fruits and vegetables

15 Quality evaluation of products –physio-chemical and sensory evaluation. .

16. Visit to processing unit/ industry and cold storage / packaging unit
17. **Practical examination**

Reference

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

E-References

- www. fao. org/inpho
- www. postharvest. ucdavis. edu
- www. postharvest. ifas. ufl. edu
- www. postharvest. com. au
- www. ams. usda. gov

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

Theory

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

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

Unit-III: History of soil fertility and plant nutrition. Criteria of essentiality. Role, deficiency and toxicity symptoms of essential plant nutrients. Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients.

Unit-IV :Soil fertility evaluation-Soil testing, Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, and rapid plant tissue tests. Indicator plants.

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

Practical

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

Lecture Schedule

1. Organic manures-Importance, Definition, classification, properties and sources- Fortified organics.
2. Methods of preparation of bulky and concentrated manures - Composting techniques- Aerobic and anaerobic (Bangalore & Coimbatore method) enriched FYM and vermicompost.
3. Composting of organic waste-Sugarcane trash and coir waste. Green manuring and green leaf
4. Soil carbon sequestration and carbon trading.
5. Fertilizers- Definition, classification of N, P and K fertilizers.
6. N fertilizers- Urea, ammonium sulphate, ammonium nitrate, CAN, properties and their reactions in
7. P fertilizers- Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate, triple super phosphate, properties and their reactions in soil.
8. K fertilizers- MOP and SOP- properties and reactions in soil.
9. Secondary nutrient fertilizers and micronutrient fertilizers.
10. Complex fertilizers- definition, manufacture of ammonium phosphate, nitro phosphate and N,P,K complexes.
11. Mixed fertilizers-definition, preparation and compatibility.
12. Customized/designer fertilizers, water soluble, liquid fertilizers and Nano fertilizers.
13. Micro nutrient mixtures and chelated micronutrients. Soil amendments
14. Fertilizer Storage and Fertilizer Control Order
15. History of soil fertility, productivity plant nutrition and criteria of essentiality. Functions, deficiency and toxicity symptoms of N, P and K.
16. Functions, deficiency and toxicity symptoms of Secondary, micronutrient and beneficial elements

17. **Mid semester Examination**
18. Mechanisms of nutrient transport to plants
19. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil
20. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorous in soil
21. Sources, forms, mobility, transformation, fixation, losses and availability of potassium in soil
22. Sources, forms, mobility, transformation, fixation, losses and availability of calcium, magnesium and sulphur in soil
23. Sources, forms, mobility, transformation, fixation, losses and availability of micronutrients in soil
24. 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.
25. Techniques/ methods of soil fertility evaluation: Crop logging, critical level, DRIS, Isotopic nutrient availability techniques.
26. Fertilizer application: Soil and foliar application.
27. Fertigation - Definition - Types of fertigation and scheduling.
28. Fertilizer application- specific methods - Seed coating, pelletization, seedling dipping - Nutriseed pack
29. Nutrient management concepts – 4 R concept-Agronomic approach, Inductive(STCR), SSNM and RTNM
30. Nutrient management concepts -Deductive, INM, IPNS. Tools - DSSIFER and VDK
31. Nitrogen use efficiency - Slow release N fertilizers - Significance and enhancement techniques
32. Nutrient use efficiency of P, K and micronutrients and their enhancement techniques
33. Nutrient management for dry land and rainfed agriculture.
34. Long term effect of fertilization on soil health-PME and LTFE.

Practical Schedule

1. Analytical instruments : Principles, calibration and applications – Colorimetry and Spectrophotometry
2. Flame photometry and Atomic absorption spectroscopy
3. Estimation of available N in soil
4. Estimation of available P (Olsen P and Bray P) in soil
5. Estimation of available K in soil
6. Estimation of available sulphur in soil by turbidimetry
7. Estimation of available Ca and Mg in soils.
8. Estimation of DTPA extractable micronutrients in soil
8. Estimation of N content in plant.
9. Estimation of P content in plant.
10. Estimation of K content in plant.
11. Estimation of S content in plant
12. Estimation of N content in manure
13. Estimation of P content in manure
14. Estimation of K content in manure
15. Colloquium on establishment of soil testing laboratories -Fertilizer calculations-Soil test based fertilizer prescription
16. Visit to STL and FTL / Fertilizer manufacturing or mixing unit
17. **Practical Examination**

References

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.

E - references

1. www. fspublishers. org/ijab/past-issues/IJAB Vol_5_No_3/47. pdf
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-

APE 311 PROTECTED CULTIVATION AND SECONDARY AGRICULTURE 1+1

THEORY

Unit I: Introduction to Protected Cultivation and Green houses

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

Unit II Design of Greenhouses

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

Unit III Applications of Greenhouses

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

Unit IV: Engineering Properties of Food Materials

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

Unit V: Drying and Dehydration

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

Unit VI: Material Handling

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

PRACTICAL

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

LECTURE SCHEDULE

1	Introduction to protected cultivation – need, advantages and limitations and present status – protected cultivation for horticultural crops	TB 1: 1-9
2	Green house technology – Definition, History and evolution – Advantages and limitations	TB 1: 77-84
3	Types of greenhouses – based on shape, cost, utility and cladding materials	TB 2: 9-24
4	Plant response to greenhouse environment – Sunlight, Temperature, Relative Humidity, Carbon dioxide enrichment – Soil / media	TB 5:61-62 TB 5:118-124
5	Planning and design of greenhouses – Criteria for site selection – orientation – structural design - Design criteria of green house for cooling and heating purposes	TB 2: 25-46
6	Equipment and components of a Greenhouse – Summer cooling and winter cooling, natural ventilation and forced ventilation	TB 2: 96-102
7	Materials for construction ofgreenhouses – Wood, iron, glass, polyethylene film	TB 3: 16-28
8	Irrigation systems in greenhouses - Rules of watering, hand watering, perimeter watering, overhead sprinklers, boom watering and drip irrigation	TB 4: 61-64 TB 5: 110-116
9	Mid semester examination.	

10	Typical applications of greenhouses – passive solar greenhouse, hot air greenhouse heating system and green house dryng- Cost estimation and economic analysis.	TB 4: 37-38, TB 4: 77-87
11	Physical properties – size- shape- sphericity- density- specific gravity, Aero-hydrodynamic properties – Terminal velocity- drag coefficient	TB 1: 6-11, TB 2: 6-10, TB 3: 2-8
12	Thermal properties- specific heat- thermal conductivity- thermal diffusivity, Application of Engineering properties of cereals, pulses and oilseeds in PHT equipment design and operation	TB 1: 1-6, 15-18, TB 2: 7-9 TB 3: 20-23
13	Moisture measurement, direct method and indirect method of moisture measurments, Drying and dehydration, Drying theory, drying rate curves-constant rate period, CMC- Falling rate period , EMC	TB 1: 107-130 TB 2: 25-49
14	Various drying method, contact type dryers- convective type dryer- radiation dryer	TB 1: 132--161 TB 2: 66-70
15	Commercial grain dryer- deep bed dryer-flat bed dryer- tray dryer-fluidized bed dryer, recirculatory dryer- solar dryer.	TB 1: 143-161 TB 2: 71-90
16	Material handling equipment-introduction, screw conveyor working principle, and selection	TB 1: 289-297 TB 3: 317-332
17	Bucket elevator- head section-Boot section-elevator legs- elevator belts-bucket drive mechanism- Screw conveyor and pneumatic conveyor working principle and selection	TB 1: 297-310 TB 3: 332-347

PRACTICAL SCHEDULE

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

TEXT BOOK

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

REFERNCE BOOKS

1. Brennan J.G. Food engineering operations. Second edition. Published by applied science Publisher limited, London.

2. Fellows, P. 2000. Food processing technology Principles and Practice. Second Edition. Published by Woodhead Publishing Limited Abington Hall, Abington Cambridge CB1 6AH, England.
3. Kudra, T. and Mujumdar, A.S. Advanced drying technologies. Marcel Dekker, Inc.

E – BOOKS

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

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

Theory

Unit - I:

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

Unit - II:

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

Unit - III:

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

Unit - IV:

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

Unit - V:

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

Practical:

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

Lecture Schedule:

1. Significance and scope of dry farming in India and history of dryland agriculture.
2. Dry farming and rainfed farming: Definition and Characteristics.
3. Distribution of arid and semi-arid regions in World, India and Tamil Nadu.
4. Major crops of dryland in India and Tamil Nadu.
5. Characteristics of dryland farming and major constraints for crop production.
6. Drought: definition, types and effects of drought on crop production.
7. Drought management strategies and contingent crop planning: mid season correction.
8. Mulching, anti transpirants, in-situ soil moisture conservation techniques and approaches.
9. **Mid-Semester Examination.**
10. Water harvesting, storage and recycling.
11. Integrated dryland technologies and farm mechanization.
12. Watershed: definition, principles, classification and management.
13. Mechanization in dryland farming.
14. Resource management under constraint situations for irrigated and rainfed farming.
15. Cost reduction strategies in crop production - cropping system, integrated farming system and dry farming.

16. Non-monetary inputs and low cost technologies for crop production.
17. Alternate land use systems in dryland - role of institutions – policies.

Practical Schedule:

1. Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
2. Agroclimatic, Agro ecological zones and characteristics.
3. Zonation of dry farming regions of Tamil Nadu, India and World.
4. Characteristics of ACZs of Tamil Nadu and cropping pattern.
5. Cropping and farming systems in dryland.
6. Skill development in Seed hardening technique.
7. Input management and efficiency in dryland.
8. Soil erosion and soil conservation practices.
9. Water harvesting structures and their use.
10. Study of methods to reduce evaporation and transpiration.
11. Study of tools, implements, and machineries for tillage, sowing and after cultivation and assessing their efficiencies.
12. Indices in dry farming - working out LGP and planning for cropping system.
13. Drought management technologies in dryland agriculture.
14. Preparation of contingency crop plan for aberrant rainfall situations.
15. Alternate land use system and their merits.
16. Visit to watershed area to study the impact of various soil and moisture conservation methods.
17. **Practical examination.**

References:

Govindan K. and V. Thirumurugan. 2003. Principles and practice of Dryland Agriculture, Kalyani Publishers, Chennai.

Rengasamy P. 1990. Dry farming Technology in India. Agri publishing Academy, New Delhi.

Reddy, G. S. , Reddy, Y. V. R. , Vittal, K. P. R. , Thyagaraj, C. R. , Ramakrishna, Y. S. and L. L Somani. 2008. Dryland Agriculture. Agrotech Publishing Academy, Udaipur

Jat. , Bharkar. , Sharma and Kothari. 2013. Dryland Technology. Scientific Publishers, Jodhpur

Pradeep, S. 2014. Dryland Agriculture. Discovery Publishing House Pvt. Ltd, NewDelhi

Widtsoe, J. A. 2012. Dry Farming for Sustainable Agriculture. Agrobios (India), Jodhpur

E. References:

www. tnau. ac. in
www. crida. org
www. icrisat. org

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

Theory

Unit I: Pests of Cereals and Millets

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

Unit II: Pests of Pulses and Oilseeds

Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of pulses (redgram, green gram, black gram, bengal gram, cowpea.), groundnut, castor, gingelly, sunflower, safflower, 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

References:

A. Text Books:

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

E- RESOURCES:

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