Semester-III

Course No.	Courses	Credit		
		T	P	Total
A)	**Core Course**			
AGRO234	Crop Production Technology-I (Kharif crops)	1	1	2
AGRO 235	Rainfed Agriculture and Watershed Management	1	1	2
BIOCHM 231	Fundamentals of plant biochemistry and biotechnology	2	1	3
ENGG 232	Farm Machinery and Power	1	1	2
ENTO 232	Insect Ecology and Integrated pest Management	1	1	2
GPB 232	Fundamentals of Plant Breeding	1	1	2
HORT 232	Production Technology for Vegetables and Spices	1	1	2
PATH 232	Principles of Integrated Disease Management	1	1	2
STAT 231	Statistical Methods	1	1	2
	Subtotal	**10**	**9**	**19**
B)	**Common Courses**			
COMP 231	Agri- Informatics	1	1	2
ESDM 231	Environmental Studies and Disaster Management	2	1	3
	Subtotal	**3**	**2**	**5**
	Total Credits (A+B)	**13**	**11**	**24**

Course :	*AGRO 234*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Crop Production Technology-I (Kharif crops)*				

Syllabus

Theory:Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices **Intercropping, pest and disease management** and yield of *Kharif*crops. Cereals – rice, maize, sorghum, pearl millet and finger millet, **Small millets*** pulses-pigeonpea, mungbean, urdbean, **Cowpea, kidney bean and horse gram***; oilseeds- groundnut, soybean, **Sesame** and **Niger***; fibre crops- cotton & Jute; forage crops- sorghum, cowpea, cluster bean, napier, **pearlmillet and maize***, Grasses - **marvel***.

Practicle: 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. **Mechanization in crop cultivation of *kharif*crops.***

(Note : * new inclusion)

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1 - 5	Cereals – Rice, maize, *kharif*, sorghum, pearl millet and minor millet	35
6 -9	Pulses – Pigeon pea, mungbean, urdbean, cowpea, kidney bean and horse gram	20
10 - 12	Oilseeds – Groundnut, sesame, soybean and Niger	20
13-15	Fiber crops – cotton and jute	15
16-18	Forage crops – Sorghum, cowpea, pearl millet and maize: Grasses–Napier and Marvel	10

b) Practical

Experiment	Topic
1	Rice nursery preparation, transplanting of Rice
2	Sowing of soybean, pigeonpea and mungbean. maize, groundnut and cotton,
3	To study the effect of seed size on germination and seedling vigour of kharif season crops,
4	Effect of sowing depth on germination of kharif crops
5	Calculations of plant population, seed rate and fertilizers doses.
6	Identification of weeds in kharif season crops.
7&8	Top dressing and foliar feeding of nutrients
9&10	Study of yield contributing characters and yield calculation of kharif season crop
11	Study of crop varieties and important agronomic experiments at experimental farm
12&13	Study of forage experiments
14	Morphological description of kharif season crops,
15	Harvesting and threshing of cereals, pulses, oil seeds and cash crops.
16	visit to research centres of related of related crop

Suggested Readings:

1. *Modern technique of raising field crops by Chiddasingh*
2. *Agronomy of field crop by S.R. Reddy*
3. *Hand book of Agriculture, ICAR New Delhi*

Course :	*AGRO 235*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Rainfed Agriculture and Watershed Management*				

Syllabus

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.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India	6
2-3	Problems and prospects of rainfed agriculture in India	8
4	Soil and climatic conditions prevalent in rainfed areas	8
5	Soil and water conservation techniques	10
6-7	Drought: types, effect of water deficit on physio- morphological characteristics of the plants	10
8-9	Crop adaptation and mitigation to drought	8
10-11	Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices	10
12	Management of crops in rainfed areas	8
13-14	Contingent crop planning for aberrant weather conditions	10

15	Concept, objective, principles and components of watershed management	8
16	Factors affecting watershed management	8

b) Practical

Experiment	Topic
1	Studies on Agro-climate zones of India
2	Studies on Agro-climate zones of Maharashtra
3-4	studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons
5	Studies on cropping pattern of different rainfed areas in the country
6	Demarcation of rainfed area on map of India
7	Studies on interpretation of meteorological data (rainfall, temperature, humidity etc.)
8-9	Studies on critical growth stages of different crops and irrigation scheduling for survival of crops
10	Studies on drought, its classification and effect on crop growth
11	Study on effective rainfall and its calculations
12-13	Studies on different soil and moisture conservation practices for mitigating moisture stress
14	Studies on watershed, its characteristics and delineation of model watershed
15	Studies on field demonstration on soil and moisture conservation measures
16	Studies on field demonstration on water harvesting studies
17	Visit to rainfed research station/ watershed areas

Suggested Readings:

1) Sustainable Development of Dryland Agriculture in India – R. P Singh
2) Dry Farming Technology in India – P. Rangaswamy
3) Dryland resources and Technology – Vol. 8 L.L Somani, K.W. Kaushal
4) Physiological Aspect of Dryland Farming – U.S Gupta
5) Principles of Agronomy S.R. Reddy
6) Dryland Technology – M.L. Jat, S.R. Bhakar, S.K. Shrma , A. K. Kothri
7) Climate, Weather and Crops in India – D. Lenka

Course :	*GPB 232*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Fundamentals of Plant Breeding*				

Syllabus

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes- Ear to row method, Modified Ear to Row, recurrent selection schemes;Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

Practical

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1.	**Objective andConcept-** of plant breeding**,** **Nature-** Art, science or technology**,** **Definitions** of plant breeding, and **Role of plant breeding-** in crop improvement **Historical development-** significant landmarks made in the history of plant breeding	3
2.	**Historical development-** Contribution of Indian plant breeders	

Lecture	Topic	Weightage (%)
	Major achievements- Semi-dwarf wheat and rice, nobalisation of sugarcane, hybrid millets, hybrid cotton, etc. **Future prospects-** Crop improvement through plant breeding for current situations like climate change, improving nutritional status of crop plant, multiple resistance, improving yield per unit area, etc. by using tissue culture, genetic engineering and molecular techniques **Genetics in relation to plant breeding-** Awareness of science of genetics for deciding appropriate breeding approaches for developing plants with desired combination of traits	
3	**Self incompatibility-** Definition, classification, heteromorphic SI, its features, distyly, tristyly, homomorphic SI, its types i.e. gametophytic SI and sporophytic SI, its features, mechanism of SI, utilization of Self incompatibility in plant breeding	6
4	**Male sterility-** Definition, Classification/types, Genetic MS, Thermosensitive Genetic MS, Photosensitive Genetic MS, Transgenic MS, Cytoplasmic MS, Cytoplasmic Genetic MS, Chemical Hybridizing Agents	
5	**Male sterility-** maintenance of MS, diversification of MS and Restorer **Genetic consequences-** genetic consequences of MS **Cultivar options-** development of hybrid by using MS	
6	**Domestication-** Definition, concept, changes under domestication **Acclimatization-** Definition, concept, factors affecting acclimatization	5
7	**Introduction-** Definition, purpose, types i.e. primary and secondary introduction, advantages and disadvantages, Gene pool concept **Centre of origin / diversity-** Definition, concept, list of main and sub centres of origin and crop diversity found, types of centres of diversity i.e. primary, secondary and micro-centres of diversity	
8	**Components of genetic variation-**, Classification, definition and features of additive, dominance and epistatic variance, gene action	4
9	**Heritability-** Definition, types-narrow and broad sense heritability **Genetic advance-** Definition, factors affecting genetic gain under selection	
10	**Genetic basis and breeding methods in self - pollinated crops:** Definition of plant breeding method, factors affecting choice of plant breeding method, general and special methods of breeding, list of plant breeding methods for self pollinated crops **Pure line selection-** Definition, detailed procedure of development of pure line	5
11	**Pure line selection-** uses of pure line, merits, demerits, achievements **Mass selection-** Definition, genetic basis, main features, positive and negative selection, detailed procedure of development of variety by mass selection, its merits, demerits, achievements	
12	**Hybridization techniques-** Definition, aim and objectives, types of hybridization, steps and procedure of hybridization programme **Handling of segregating population through Pedigree method-** definition of pedigree, pedigree record, application of pedigree method	8
13	**Handling of segregating population through Pedigree method-** detailed procedure of pedigree method, its merits, demerits,	

Lecture	Topic	Weightage (%)
	achievements **Handling of segregating population through shuttle breeding method-** concept of shuttle breeding, detailed procedure of shuttle breeding method, its comparison with pedigree method	
14	**Handling of segregating population through Bulk method-** Concept of bulk method, short term, long term, its application, procedure of bulk method, its merits, demerits, achievements	
15	**Handling of segregating population through Single seed descent method-** concept of SSD method, its application, detailed procedure of SSD method, its merits, demerits, achievements **Back cross method**- Definition of backcross, its objective, requirements and applications of backcross method, procedure for transfer of dominant gene	6
16	**Back cross method-** procedure for transfer of recessive gene, merits, demerits, achievements of backcross method **Multiline concept-** concept, procedure for development of multiline, its merits, demerits, achievements	
17	**Concepts of population genetics-** Definition and concept of population genetics, random mating population, gene and genotypic frequency **Hardy-Weinberg law-** Law, its validity, factors affecting gene frequency	2
18	**Genetic basis-** Genetic basis of breeding cross pollinated crops **Methods of breeding cross pollinated crops**- list of plant breeding methods for cross pollinated crops **Modes of selection-** Progeny selection, ear-to-row method, modified ear-to-row method	6
19	**Modes of selection-** Recurrent selection, its types and its procedure	
20	**Heterosis-** Definition, heterosis and hybrid vigour, effects and estimation of heterosis, genetic basis/theories of heterosis, fixation of heterosis, effects of heterosis **Inbreeding depression-** Definition, types and effects of inbreeding depression	8
21	**Development of inbred lines-** Selfing heterozygous population, DHLs, evaluation of inbred lines **Hybrids-** Definition of hybrid variety, main features of hybrids, production of hybrid seeds, merits and demerits of hybrid breeding	
22	**Composite and synthetic varieties-** Definition, steps for development of composites and synthetics, procedure of developing composites and synthetics, its merits, demerits and achievements	5
23	**Breeding methods in asexually propagated crops:** List of breeding methods for asexually propagated crops. **Clonal selection-** Definition, features of asexually propagated crops, procedure of clonal selection, its merits and demerits **Hybridization and Clonal Selection-**steps and procedure of hybridization in clonal crops	6
24	**Wide hybridization-** Definition, types, main features, interspecific and intergeneric hybridization, its examples, incompatibility barriers for wide hybridization, techniques for overcoming incompatibility barriers, achievements **Pre-breeding-** Definition; concept of pre-breeding, primary, secondary and tertiary gene pool and its utilization	5

Lecture	Topic	Weightage (%)
25	**Polyploidy in relation to plant breeding-** Definition of haploid, monoploid, diploid, polyploid, genome, heteroploidy, annuploidy, euploidy, types of annuploidy its application in crop improvement, types of polyploidy (natural occurring and artificial) and its role in crop improvement, effects of polyploidy, its application in crop improvement and limitation	5
26	**Mutation breeding method and its uses –** Definition of mutation breeding, conditions in which mutation is rewarding, procedure of mutation breeding for seed and vegetatively propagated crops, applications, its merits, demerits and achievements	6
27	**Breeding for important biotic & abiotic stresses :** Definition of stress, biotic and abiotic stress **Biotic stresses-** Types/nature of disease resistance, types of genetic resistance i.e. vertical, horizontal, cytoplasmic and systemic acquired resistance, gene-for-gene concept,	12
28	**Biotic stresses-** mechanism and sources of disease resistance, methods of breeding for disease resistance, achievements Mechanism of insect resistance i.e. antibiosis, antixenosis, tolerance, basis of insect resistance i.e. morphological, physiological, biochemical; genetics of insect resistance, sources of insect resistance, methods of breeding for insect resistance, screening techniques, advantages and disadvantages of resistance breeding	
29	**Abiotic stresses-** Types of abiotic stresses, definition of drought resistance, mechanism of drought resistance, basis of drought resistance i.e. morphological traits and physiological factors, sources of drought resistance, methods of breeding and measures of drought resistance	
30	**Abiotic stresses-** Temperature stress-heat, chilling, freezing; nature and effects of heat stress, mechanism of heat tolerance, selection criteria Cold tolerance- Definition, features, selection criteria Salinity tolerance- Effects of salinity, mechanism of salinity resistance, Breeding approaches for salinity resistance	
31	**Biotechnological tools-DNA markers :** Meaning and short description of RFLP, AFLP, RAPD, CAPS, SSR, SNP, HA, **Marker assisted selection-** Definition and background, pre-requisite of MAS, various types of breeding population used for MAS i.e. NILs, BSA, ILs, main features and procedure of MAS, its merits, demerits and achievements	4
32	**Participatory plant breeding-** what is PPB, its objectives, activities of PPB, impact of PPB **Intellectual Property Rights-** Definition of IPR, types of IPR Patenting- Definition of patent, short description **Plant Breeders and Farmer's Rights-** Definitions and main features	4
Total		100

Practical

Experiment	Topic
1	Plant Breeder's kit
2	Study of germplasm of various crops
3	Study of floral structure of self pollinated crops
4	Study of floral structure of cross pollinated crops
5	Emasculation and hybridization techniques in self pollinated crops : Green gram, Black gram, Rice, Wheat, Groundnut, Soybean,
6	Emasculation and hybridization techniques in self pollinated crops : Sesame, Chickpea, Okra, Tomato, Brinjal, Chilli,
7	Emasculation and hybridization techniques in cross pollinated crops : Maize, Bajra, Sunflower, Papaya, Sugarcane,
8	Emasculation and hybridization techniques in often cross pollinated crops : Cotton, Sorghum, Pigeonpea,
9	Consequences of inbreeding on genetic structure of resulting populations
10	Study of male sterility system
11	Handing of segregation populations
12	Methods of calculating mean, range, variance, standard deviation, heritability
13	Designs used in plant breeding experiment
14	Analysis of Rondomized Block Design
15	To work out the mode of pollination in a given crop and extent of natural out crossing
16	Prediction of performance of double cross hybrids

Suggested Readings:

Sr. No	Title of Book	Authors	Publisher
1.	Plant Breeding Principles and Methods	B. D. Singh	KalyaniPublication New Delhi.
2.	Essentials of Plant Breeding	Phundansingh	Kalyani Publication New Delhi
3.	Principles and Practices Plant Breeding	J. R. Sharma	McGraw Hill Publishing company Limited , New Delhi.
4.	Plant Breeding Theory and Practices	V. L. Chopra	Oxford and IBH. Publishing Company , New Delhi.
5.	Introduction to Plant Breeding	R. C. Choudhary	Oxford and IBH. Publishing Company , New Delhi.
6.	Elementary Principles of Plant Breeding	R. C. Choudhary	Oxford and IBH. Publishing Company , New Delhi.

Course :	*ENTO 232*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Insect Ecology and Integrated Pest Management*				

Syllabus

Theory

Part I: Insect Ecology: Definition, scope, environment and its components. Effect of abiotic factors – temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance. Concepts of balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.

Part II: Pest surveillance, it's types and pest forecasting. Categories of pests. Natural and applied pest control. IPM – Introduction, Importance, Scope, Concepts, Principles, Tools and Limitations of IPM. Host plant resistance, cultural, mechanical, physical and legislative methods of pest control. Biological- parasitoids, predators and transgenic plant pathogens such as bacterial, fungi and viruses. Chemical control– importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Examples of important insecticide groups - botanical insecticides – Neem based products. Cyclodienes, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazines, Thioureaderivaties, Pyridine azomethines, Pyrrolesetc, Nematicides, Rodenticides, Acaricides and Fumigants. Insecticides Act 1968-important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Recent methods of pest control. Repellants, antifeedants, hormones, attractants, gamma radiation and genetic control.

Practical:

Visit to meteorological observatory / automatic weather reporting station. Terrestrial and pond ecosystems of insects. Behaviour of insects and orientation (repellency, stimulation, deterancy). Distribution patterns of insects, sampling techniques for the estimation of insect population and damage. Pest surveillance through light traps, pheromone traps and field incidence. Practicable IPM practices- Mechanical and physical methods, Cultural and biological methods. Chemical control – Insecticides and their formulations. Pesticide appliances, insecticide application techniques, calibration of plant protection appliances, Calculation of doses/concentrations of insecticides. Compatibility of pesticides and Phytotoxicity of insecticides IPM case studies–Cotton, Sugarcane, Mango/ Citrus/Pomegranate. Identification of common phytophagous mites and their morphological characters Identification of rodents, bird pests, their damage and management. Vermiculture – visit to vermiculture unit,Biopesticides used in IPM with mass multiplication of NPV and Entomopathogenic fungi.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Definition of Insect Ecology, Scope, Environment and its components.	25
2	Effect of abiotic factors – temperature and moisture, humidity, rainfall, light, atmospheric pressure and air currents.	
3	Effect of biotic factors – food competition, natural and environmental resistance	
4	Concepts of balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.	
5	Pest surveillance and it's types and pest forecasting. Categories of pests.	10
6 & 7	Natural and Applied pest control. IPM – Introduction, Importance, Scope, Concepts, Principles, tools and limitations of IPM.	30
8	Host plant resistance and cultural methods of pest control	
9	Mechanical, Physical and Legislative methods of pest control.	
10	Biological- parasitoids, predators and transgenic plant pathogens such as bacterial, fungi and viruses.	
11 & 12	Chemical control – importance, hazards and limitations. Classification of insecticides, toxicity and formulations	25
13 & 14	Examples of important insecticide groups - Botanical insecticides – Neem based products. Cyclodienes, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazines, Thioureaderivaties, Pyridine azomethines, Pyrrolesetc, Nematicides, Rodenticides, Acaricides and Fumigants. Insecticides Act 1968-important provisions.	
15 & 16	Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes.	
17 & 18	Recent methods of pest control. Repellants, Antifeedants, hormones, attractants, gamma radiation and genetic control.	10
	Total	**100**

b) Practical

Experiment	Topic
1.	Visit to meteorological observatory / automatic weather reporting station
2.	Study of terrestrial and pond ecosystems of insects.
3.	Studies on behaviour of insects and orientation (repellency, stimulation, deterancy).
4.	Study of distribution patterns of insects, sampling techniques for the estimation of insect population and damage.
5.	Pest surveillance through light traps, pheromone traps and field incidence.
6.	Practicable IPM practices- Mechanical and Physical methods
7.	Practicable IPM practices – Cultural and Biological methods
8.	Chemical control – Insecticides and their formulations
9.	Pesticide appliances, insecticide application techniques, calibration of plant protection appliances
10.	Calculation of doses/concentrations of insecticides
11.	Compatibility of pesticides and phytotoxicity of insecticides
12.	IPM case studies -Cotton
13.	IPM case studies – Sugarcane
14.	IPM case studies – Mango/ Citrus/Pomegranate
15.	Identification of common phytophagous mites and their morphological characters
16.	Identification of rodents and bird pests and their damage
17.	Vermiculture – visit to vermiculture unit
18.	Biopesticides used in IPM with mass multiplication of NPV and Entomopathogenic fungi.

Marks distribution for practical examination

1. *Collection-6*
2. *Spotting -15*
3. *Problem / written – 15*
4. *Vivavoce -04*
5. *Practical manual -5*
6. *General performance-5*

Suggested Readings:

1) *Metcalf, R.L. and Luckman W.H. 1982. Introduction to Insect Pest Management. Wiley Inter Science publishing, New York.*

2) *G.S. Dhaliwal and Ramesh Arora 2001. Integrated Pest Manageemnt. Concepts and Approaches. Kalyani publishers, New Delhi.*

3) *Larry P. Pedigo. 1991. Entomology and Pest Management. Larry P. Pedigo. 1991. Mac Millan publishing company, New York.*

4) Yazdani G. S. and Agarwal M.L. 1979. Elements of Insect Ecology. Naroji publishing house, New Delhi.

5) Hufakar C.V. Ecological Entomology

6) Clark L.R., Gier P.W., Rughas R.D. and Marris R.F. The Ecology and Insect Population.

7) *Odum E.P. Fundamentals of Insect Ecology*

8) *Gupta S. K. Plant Mites of India, 1995*

Course :	*HORT 232*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Production Technology for Vegetables and Spices*				

Syllabus

Theory

Importance of vegetables & spices in human nutrition and national economy, brief about origin, area, production, improved varieties and cultivation practices such as time of sowing, sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, storage, physiological disorders, disease and pest control and seed production of important vegetable and spices.

Practical

Identification of vegetables & spices crops and their seeds. Nursery raising. Direct seed sowing and transplanting.Study of morphological characters of different vegetables &spices.Fertilizersapplications.Raising of nursery of vegetables & spices. Vegetables & spices seed extraction. Harvesting & preparation for market.Economics of vegetables and spices cultivation.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of vegetables & spices in human nutrition and national economy	10
	Brief about origin, area, production, improved varieties and cultivation practices such as time of sowing, sowing,transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, storage, physiological disorders, disease and pest control of following crops	
2	Solanaceous vegetables	10
3	Cucurbits	10
4	Legume vegetables	05
5	Okra	10
6	Onion and Garlic	10

7	Leafy vegetables	05
8	Perennial vegetables, under exploited and wild vegetables	20
9	Black pepper	
10	Nutmeg	
11	Cinnamon	
12	Clove & Cardamom	
13	Turmeric & Ginger	10
14	Minor spices – Kokum, Curry leaf, Tirphal	
15	Multistoried cropping	05
16	Seed production of important vegetables and spices	05
	Total	**100**

b) Practical

Experiment	Topic
1	Identification of vegetables crops and their seeds (Solanaceous, Cucurbits, Okra)
2	Identification of vegetables crops and their seeds (Leguminous, leafy, Other)
3	Identification of spices crops and their seeds (Tree Spices)
4	Identification of spices crops and their seeds (Seed Spices and condiments)
5	Nursery raising
6	Direct seed sowing and transplanting
7	Study of morphological characters of different vegetables
8	Study of morphological characters of different spices
9	Fertilizers applications
10	Propagation and raising of nursery of vegetables
11	Propagation and raising of nursery of spices
12	Vegetables & spices seed extraction
13	Harvesting & preparation for market of vegetables
14	Harvesting & preparation for market of spices
15	Economics of vegetables cultivation
16	Economics of spices cultivation

Suggested Readings:

Book	Title of Book	Authors
1	Vegetables	B. Choudhary
2	Vegetable Crops	T. K. Bose, M. G. Som and T. Kabir
3	Vegetable, Tuber and Spices	S.Thamburaj
4	Production technology of vegetable crops	S. P. Singh
5	Vegetables – Production Technology Astral International	Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M.
6	Major Spices of India	J.S.Pruthi
7	Minor Spices and Condiments	J.S.Pruthi
8	Introduction to spices and plantation crops	N.Kumar and others
9	Spice Crops Vol.I and Vol. II	Parthasarathi and Others

Course :	*ENGG 232*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Farm Machinery and Power*				

Syllabus

Theory

Status of Farm Power in India, Sources of Farm Power , Scope of Mechanization, I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines , Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor, Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Practical

Study of different components of I.C. engine. To study air cleaning and cooling system of engine, Familiarization with clutch, transmission, differential and final drive of a tractor, Familiarization with lubrication and fuel supply system of engine, Familiarization with operation of power tiller, Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow . Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters Familiarization with different inter-cultivation equipment, Familiarization with harvesting and threshing machinery.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Sources of farm power in ..Human, Animal, Mechanical, electrical, solar, Wind Power, Scope of Mechanization.	6
2-3	Principle of operation of I.C. engine- I.C. engine working principles Two and Four stroke engine, Engine terminology and examples	13
4-5	I.C. Engine systems -Fuel supply system, cooling system, Air cleaner, lubrication of tractor.	12
6-7	Tractor -Tractor types and their selection, fixed and operating cost of tractor power and attached implements with examples	13
8	Tillage - Tillage, objectives of tillage, classification & types of tillage, Tillage implements	7

Lecture	Topic	Weightage (%)
9	Primary tillage implements - M. B. plough and Disc plough, Rotavator, with examples	6
10	Secondary tillage implements - Harrows, cultivators & examples	6
11-12	Implements for inter-culturing operations - Hand tools, Improved hoes, Wheel hoe, Multipurpose hoe, Tractor drawn intercultural equipments	12
13	Seed drills - Sowing methods, seed drill, components of seed drill, seed metering mechanism (Fluted roller and plate type only) , types of furrow openers, calibration of seed drill, examples	7
14	Study of planter -Planter, Functions, seed metering devices, type of planters, solved examples	6
15	Plant protection equipments- Classification, types of spraying and types of dusting machines.	6
16	Harvesting and threshing equipments-Definition of harvesting and threshing, harvesting /threshing methods implements , mower and combine harvester-thresher, solved examples	6
	Total	**100**

b) Practical

Experiment	Topic
1.	Study of components of internal combustion (I. C.) engine
2.	Study of two stroke cycle engine
3.	Study of four stroke cycle engine
4.	Study of Fuel supply systems for S. I. engines
5.	Study of Fuel supply systems for C. I. engines
6.	Study of Air Cleaning and Cooling systems of an engine
7.	Study of Lubrication system
8.	Study of clutch, Gear box and differential unit of the tractor
9.	Study of primary tillage implements: mould board plough and disc plough
10.	Study of secondary tillage implements- harrows and cultivators.
11.	Study of inter-culturing tools and implements- manual and animal drawn.
12 &13	Study of seed-cum-fertilizer drill and calibration of seed drill.
14.	Study of sprayers and dusters
15.	Study of harvesting and threshing machinery
16.	Study of power tiller- important parts and attachments

Suggested Readings

1) *Principles of Agricultural Engineering Vol. 1. Reprint Edition: 2012. by T. P. Ojha, A. M. Michael, Jain Brothers, New Delhi*
2) *Elements of Agricultural Engineering by JagadishwarSahay. Forth Edition, 2010 Standard Distributor and Publishers, New Delhi*
3) *Agricultural Engineering by O P Singhal (2011) Aman Publishing House, Meerut*
4) *Elements of Farm Mechaneries by A C Srivastava, Oxford and IBH Publishing Co Pvt Ltd, New Delhi*
5) *Farm Tractor -Repair and Maintenance by S.C. Jain and C.R. Rai.*
6) *Principles of Farm Machineies by R A Kepner, R Bainer, E C Barger (2000) CBS Publishers and Distributors, Delhi*
7) *Farm Engines and Tractors by H E Gulvin (2001) McGraw Hill, New York*
8) *Servicing and Maintenance of Farm Tractors (2005) E J Johnson and A HHollenburg, McGraw Hill, New York*
9) *Tractor Implement System by Alcock and Ralph (1986) Athe AVI Publishing Co. Inc Springer, New York*

Course :	*PATH 232*		***Credit:***	*2(1+1)*	***Semester-II***
Course title:	*Principles of Integrated Disease Management*				

Syllabus

Theory

IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of diseases and pest risk analysis.Methods of detection and diagnosis of diseases.Measurment of lossess causes due to diseases. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment.Introduction to conventional pesticides for the disease management.Survey surveillance and forecasting of plant diseases. Development and validation of IPM module.Implementation and impact of IPM (IPM module for diseases. Safety issues in pesticide uses. Political, social and legal implication of IPM.Case histories of important IPM programmes.

Practical

Methods of diagnosis and detection of various plant diseases, Methods of plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents,Mass multiplication of *Trichoderma, Pseudomona*s, NPV etc. identification of diseases and their management. Crop (agro-ecosystem) dynamics of selected diseases.Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by diseases . Awareness campaign at farmers' fields.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	IPM: Introduction, history, importance, concepts.	8
2	Principles and tools of IPM	8
3	Economic importance of diseases	6
4	Pest risk analysis	6
5	Methods of detection and diagnosis of diseases	6
6	Measurement of losses causes due to diseases	6
7	Methods of control: Host plant resistance, cultural, mechanical, physical,	6
8	Legislative, biological and chemical control	6
9	Ecological management of crop environment	6
10	Introduction to conventional pesticides for the disease management	6
11	Survey surveillance and forecasting of plant diseases	6
12	Development and validation of IPM module	6
13	Implementation and impact of IPM (IPM module for diseases)	6
14	Safety issues in pesticide uses	6
15	Political, social and legal implication of IPM	6
16	Case histories of important IPM programmes	6
	Total	**100**

b) Practical

Experiment	Topic
1	Methods of diagnosis various plant diseases,
2,3	Methods of detection of various plant diseases
4,5	Methods of plant disease measurement
6	Assessment of crop yield losses
7	calculations based on economics of IPM
8	Identification of biocontrol agents
9	Mass multiplication of *Trichoderma*,
10	Mass multiplication of *Pseudomona*s,
11	Mass multiplication ofNPV
12	Identification of diseases and their management
13	Crop (agro-ecosystem) dynamics of selected diseases
14	Plan & assess preventive strategies (IPM module) and decision making
15	Crop monitoring attacked by diseases
16	Awareness campaign at farmers fields.

Suggested Readings

1) Singh RS. 2013. *Introduction to Principles of Plant Pathology.* Oxford and IBH Co., New Delhi.

2) Pathak, V. N. Essentials of plant pathology. Prakash Pub., Jaipur

3) Agrios, G. N. Plant Pathology. 5th edition, Published by a division of Reed Elsvier India Pvt., Ltd., New Delhi (2005)

4) Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur

5) Stakman EC & Harrar JG. 1957. *Principles of Plant Pathology*. Ronald Press, USA.

6) *Tarr SAJ*. 1964. *The Principles of Plant Pathology*. McMillan, London.

7) *Vander Plank, JE.* 1975. *Principles of Plant Infection.* Acad. Press

8) Verma JP, Varma A & Kumar D. (Eds). 1995. Detection of Plant Pathogens and theirManagement. Angkor Publ., New Delhi

9) Mehrotra RS & Aggarwal A. 2003. *Plant Pathology*. 2nd Ed. Oxford & IBH,

10) Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press

11) Fox RTV. 1993. Principles of Diagnostic Techniques in Plant Pathology. CABINene YL & Thapliyal PN. 1993. Fungicides in Plant Disease Control. Oxford & IBH, NewDelhi.

12) Palti J. 1981. *Cultural Practices and Infectious Crop Diseases*. Springer- Verlag, New York.

13) Vyas SC. 1993 *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw

14) Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.

15) Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in

16) Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

Course :	*STAT 231*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Statistical Methods*				

Syllabus

Theory

Definitions of Statistics and its applications in Agriculture, limitations, types of **d**ata, classifications and frequency distribution, Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)

Arithmetic mean, median, mode, GM, HM, weighted average, quartile, deciles, percentiles, Characteristics of ideal measure, merits and demerits of various measures (grouped and ungrouped data), Range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped and ungrouped Data), Concept of measures of Skewness and Kurtosis.

Definitions of population, sample, parameter, statistic, need of sampling, sampling versus complete enumeration and introduction to simple random, stratified and multistage sampling methods. Simple random sampling with and without replacement.Use of random number tables for selection of simple random sample.

Random experiment, events (simple, compound, equally likely, complementary, independent) Definitions of probability (mathematical, statistical, axiomatic), addition and multiplication theorem (without proof). Simple problems based on probability, Random variable, discrete and continuous random variable, probability mass and density function, definition and properties of Binomial, Poisson and Normal distributions.

Null and alternate hypothesis, types of errors, degrees of freedom, level of significance, critical region, steps in testing of hypothesis, one sample, two sample and paired 't' test. F test for equality of variance, Large sample tests for one sample mean, two sample means 'Z' tests, Chi-square test of goodness of fit, Chi-square test of independence of attributes in 2 X2 contingency table

Definition of correlation, types, scatter diagram. Karl Pearson's coefficient of correlation and its test of significance. Spearman's rank correlation coefficient, Linear regression equations, definition & properties of regression coefficient, constant, fitting of regression lines, its test of significance, comparison of regression and correlation coefficients

Introduction to analysis of variance, Assumptions of ANOVA, analysis of one way classification and two way classification

Practical

Graphical presentation: Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)

Computations of arithmetic mean, mode, median, GM and HM, quartiles, deciles&percentiles(Ungrouped data), Computations of arithmetic mean, mode, median, quartiles, deciles& percentiles (grouped data).

Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (ungrouped Data), Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped data).

Selection of random sample using simple random sampling.

Computations of Karl Pearson's coefficient of correlation with its test of significance, Spearman's rank correlation, Fitting of simple linear regression equation with test of significance of regression coefficient.

Problems on One sample, two Sample and paired t-test, Chi-Square test of Goodness of Fit. Chi-square test of independence of Attributes for 2 X 2 contingency table.

Analysis of Variance one way and two way classification.

Teaching Schedule:

a) Theory

Lecture	Topic	Weightage (%)
1	**Introduction**: Definitions of Statistics and its applications in Agriculture, limitations, types of **d**ata, classifications and frequency distribution	05
2	**Graphical presentation:** Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)	04
3	**Measures of central tendency**: Arithmetic mean, median, mode, GM, HM, weighted average, quartile, decilies, percentiles, Characteristics of ideal measure, merits and demerits of various measures (grouped and ungrouped data)	06
4	**Measures of Dispersion:** Range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped and ungrouped Data).	06

Lecture	Topic	Weightage (%)
5	Concept of measures of Skewness and Kurtosis.	05
6	**Sampling:** Definitions of population, sample, parameter, statistic, need of sampling, sampling versus complete enumeration and introduction to simple random, stratified and multistage sampling methods. Simple random sampling with and without replacement. Use of random number tables for selection of simple random sample.	08
7&8	**Probability:** Random experiment, events (simple, compound, equally likely, complementary, independent) Definitions of probability (mathematical, statistical, axiomatic), addition and multiplication theorem (without proof). Simple problems based on probability.	08
9&10	**Probability distributions:** Random variable, discrete and continuous random variable, probability mass and density function, definition and properties of Binomial, Poisson and Normal distributions.	08
11 &12	**Test of Significance:** Null and alternate hypothesis, types of errors, degrees of freedom, level of significance, critical region, steps in testing of hypothesis, one sample, two sample and paired 't' test. F test for equality of variance	10
13	Large sample tests for one sample mean, two sample means 'Z' tests.	05
14	Chi-square test of goodness of fit, Chi-square test of independence of attributes in 2□□2 contingency table	05
15	**Correlation:** Definition of correlation, types, scatter diagram. Karl Pearson's coefficient of correlation and its test of significance. Spearman's rank correlation coefficient.	10
16	**Regression**: Linear regression equations, definition & properties of regression coefficient, constant, fitting of regression lines, its test of significance, comparison of regression and correlation coefficients.	10
17	**Analysis of Variance:** Introduction to analysis of variance, Assumptions of ANOVA, analysis of one way classification and two way classification.	10
	Total	**100**

b) Practical

Exercise	Topic
1	**Graphical presentation:** Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)
2	**Measures of central tendency**: Computations of arithmetic mean, mode, median, GM and HM, quartiles, deciles& percentiles(Ungrouped data).
3	Computations of arithmetic mean, mode, median, quartiles, deciles& percentiles (grouped data).

4	**Measures of Dispersion:** Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (ungrouped Data).
5	Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped data).
6	Selection of random sample using simple random sampling.
7	**Correlation:** Computations of Karl Pearsons coefficient of correlation with its test of significance
8	Spearman's rank correlation
9&10	**Regression**: Fitting of simple linear regression equation with test of significance of regression coefficient.
11	**Test of Significance:** Problems on One sample, two Sample and paired t-test.
12	F test for equality of variance
13 &14	Chi-Square test of Goodness of Fit. Chi-square test of independence of Attributes for 2□□2 contingency table.
15&16	**Analysis of Variance:** Analysis of Variance one way and two way classification.

Suggested Readings:

1) *Statistical methods for Agricultural workers by Panse V.G. Sukhatme P.V.*
2) *Mathematical statistics by Gupta and Kapoor.*
3) *Statistical Methods by Snedocor and Cochran.*
4) *A Text book of Agriculture Statistics by R. Rangaswami*
5) *Statistics for Agriculture Sciences by NageshwarRao G.*
6) *Experimental Designs by Cochran G.W. and Cox G.W.*
7) *Design and Analysis of Experiment by Das M.N. and Giri N.C.*
8) *Statistical procedures for Agricultural Research by Gomez K.A. and Gomez A.A.*
9) *Applied statistics by Gupta and Kapoor*

Course :	*BIOCHEM 231*		***Credit:***	*3(2+1)*	***Semester-III***
Course title:	*Fundamentals of Plant Biochemistry and Biotechnology*				

Syllabus

Theory

Importance of Biochemistry.Plant cell structure and function of cell orgenells.Properties of Water and significance of weak interactions and biomolecules.Bioenergetics and significance of redox reactions. Carbohydrate: Structure, classification, properties and functions. Lipid: Structures and properties of fatty acids. Structure, classification, properties and functions. Amino acids and Proteins: Structure, classification, properties and functions. Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action and enzyme kinetics and inhibition. Enzyme regulation. Nucleic acids: Importance and classification; Structure of Nucleotides, DNA structure and forms of RNA and function.Mitochondrial electron transport and oxidative phosphorylation. Metabolism of carbohydrates, lipids and nucleic acids.Biochemistry of nitrate assimilation and photosynthesis. Introduction to recombinant DNA technology: PCR techniques and its applications.

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

Practical

Preparation of solution, pH & buffers, Qualitative tests of carbohydrates and amino acids.Quantitative estimation of soluble sugars and amino acids. Estimation of starch, total carbohydrate and soluble proteins . Determination of crude fat and qualitative tests of fats and oils. Enzyme assay: Alpha amylase , Nitrate reductase, lipase and protease. Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides.Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of Biochemistry	2
2-3	Properties of Water, pH and Buffer	5
4	Biomolecules - Definition, types, structure, properties and its applications	5
5-7	Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides.	8
8-9	Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids.	6
10-12	Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins.	8
13-14	Enzymes: General properties; Classification; Mechanism of action; Michaelis&Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes.	8
15	Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure.	5
16-18	Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain.	8
19-20	Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.	5
21	**Biochemistry of nitrate assimilation**	5

22	Photosynthesis	5
23-24	Introduction to recombinant DNA technology: PCR techniques and its applications.	5
25-26	Organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications;	5
28-29	Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids	8
30	Somaclonal variation and its use in crop improvement	4
31-32	Physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods	4
33	Marker Assisted Breeding in crop improvement	4
	Total	**100**

b) Practical

Experiment	**Topic**
1	Preparation of solution, pH & buffers
2-3	Qualitative tests for carbohydrates and amino acids
4	Estimation of reducing sugars by Nelson-Somogyi method
5	Estimation of starch by Anthrone method
6	Determination of soluble protein by folin-lowry method
7	Estimation of free amino acids by Ninhydrin method
8	Determination of total crude fat/oil by Soxhlet method
9	Qualitative tests for oil
10	Determination of alpha amylase activity from germinating seed
11	Determination of invivo nitrate reductase activity from leaf tissue
12	Paper chromatography/ TLC demonstration for separation of amino acids
13	TLC for separation of sugars
14-15	Isolation of genomic DNA from plant. Purification, Quantification and quality determination
16	Amplification of genomic DNA using different primers and resolution of PCR products on agarose gel

Suggested Readings:

1) Bhatia S. C., 1984, Biochemistry in Agricultural Sciences, Shree Publication House, New Delhi.

2) Purohit S.S. 2009, Biochemistry - Fundamentals and Applications, Agrobios, Jodhpur

3) Singh M. 2011, A Textbook of Biochemistry, Dominant Publishers & Distributors, New Delhi

4) Veerkumari L. 2007, Biochemistry, MIP Publishers, Chennai

5) Jain J. L. etal 2005, Fundamentals of Biochemistry, S. Chand & Company Ltd. , New

Delhi
6) *Rastogi S. C.*. 2003 - *Biochemistry* Tata McGraw-Hill Education, New Delhi.
7) *Rama RaoA. V. S. S.*, 2002 A *Textbook of Biochemistry*. Edition, 9, illustrated. Publisher, Sangam Books Limited, New Delhi.
8) Com EE &Stumpf PK. 2010.Outlines of Biochemistry.5th Ed. John Wiley Publications.
9) Donald Voet and Judith G. Voet. 2011. Biochemisry, 4th Ed. John Wiley and Sons, Inc., NY, USA.
10) Goodwin, TW & Mercer EI. 1983. Introduction to Plant Biochemistry. 2nd Ed. Oxford, New York.Pergaman Press.
11) David L. Nelson and Michael M. Cox.2012. Lehninger Principles of Biochemisry, 6th Ed .Macmillan Learning, NY, USA
12) Jeremy M. Berg, John L. Tymoczko, LubertStryer and Gregory J. Gatto, 2002.Biochemisry, 7th Ed. W.H. Freeman and Company, NY, USA
13) Jayaram. T. 1981. Laboratory manual in biochemistry, Wiley Estern Ltd. New Delhi:
14) Plummer D. 1988. An Introduction to Practical Biochemistry. 3rd ed. Tata McGraw Hill, New Delhi.
15) Practical biochemistry: R. L. Nath. A treatise on Analysis of Food, Fats and Oils: A. R. Sen, N.K. Pramanik and S.K. Roy
16) *Sadasivam* S, *Manickam* A (1996) *Biochemical methods*. 2nd edition, New Age International (p) Ltd. Publisher, New Delhi.

Course :	*EVS 231*		***Credit:***	*3(2+1)*	***Semester-III***
Course title:	*Environmental Studies and Disaster Management*				

Syllabus

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance.Natural Resources: Renewable and non-renewable resources, Natural resources and associatedproblems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timberextraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use andover-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefitsand problems. c) Mineral resources: Use and exploitation, environmental effects of extracting andusing mineral resources, case studies. d) Food resources: World food problems, changes causedby agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, waterlogging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewableenergy sources, use of alternate energy sources. Case studies. f) Land resources: Landas a resource, land degradation, man induced landslides, soil erosion and desertification.

• Roleof an individual in conservation of natural resources.

• Equitable use of resources for sustainablelifestyles.

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 andfunction of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desertecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystemdiversity and biogeographical classification of India. Value of biodiversity: consumptive use,productive use, social, ethical, aesthetic and option values. Biodiversity at global, National andlocal 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 ofIndia. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.Environmental Pollution: definition, cause, effects and control measures of:a. Air pollutionb. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollutiong. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban andindustrial wastes. Role of an individual in prevention of pollution.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urbanproblems 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.Consumerismand waste products.Environment Protection Act.Air (Prevention and Control of Pollution) Act.Water (Prevention and control of Pollution) Act.Wildlife Protection Act.Forest ConservationAct. 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: HumanRights, Value Education, HIV/AIDS. Women and Child Welfare.Role of Information Technologyin 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 waterpollution, 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 disastermanagement framework; financial arrangements; role of NGOs, community –based organizationsand 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 environmentalassets 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.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1.	Environmental studies:- Nature, Definition, scope and importance	3
2	Natural Resources:-Renewable and non-renewable resources, Natural resources and associated problems.	16
3-6	a) Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground	

Lecture	Topic	Weightage (%)
	water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of non-conventional energy sources. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.	
7	Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	
8	Ecosystems: -Concept of an ecosystem, Structure and function.	14
9	Study of Producers, Consumers and Decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids.	
10	Types of Ecosystem Introduction, characteristic features, structure and function of Forest, Grassland, Desert and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
11-12	Biodiversity: - Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India, Value of biodiversity.	
13-14	Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity: Endangered and endemic species of India., Conservation of biodiversity:	12
15-17	Environmental Pollution:- Types of pollution, definition, cause, effects and control measures of Air, Water, Soil, Marine, Noise, Thermal pollutions and Nuclear hazards.	14
18	Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	
19-20	Carbon Credit: Concept, Exchange of carbon credits. Carbon Sequestration, Importance, Meaning and ways.	08
21-22	Environmental ethics: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	
23-24	Environment (Protection) Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.	08
25	Human Population and the Environment: Population growth, variation among nations, population explosion. Environment and human health: Human Rights, Value Education.	04
26-27	Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves.	10
28	Climatic change: global warming, Sea level rise, ozone depletion.	
29-30	Man Made Disasters:- Nuclear disasters, chemical disasters,	08

Lecture	Topic	Weightage (%)
	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.	
31-32	Disaster Management:-Concept, Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. 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; Police and other organizations.	03
	Total	**100**

b) Practical

Exercise	Topic
1	Study of collection, processing and storage of effluent samples.
2	To estimates solids in water samples.
3	To measure the dissolved O_2 content in pond water by Winkler's method.
4	Estimation of respirable and non respirable dust in the air by using portable dust sampler.
5	Determination of sound level by using sound level meter.
6	Study of community structure.
7	Study of pond / River/ hill slopes ecosystem-abiotic and biotic components.
8	Study of grass land and agro-ecosystem and measurement of their productivity.
9	Crop adaptation to different ecosystems. A. Hydrophytes
10	Crop adaptation to different ecosystems. B. Mesophytes
11	Crop adaptation to different ecosystems. C. Xerophytes
12	Crop adaptation to different ecosystems. D. Halophytes
13	Study and Visit of flora and Fauna.
14	Visit to local polluted site - Urban / Rural: observations and remedial control measures.
15	Visit to local polluted site - Industrial: observations and remedial control measures.
16	Collection, identification, herbarium, maintenance and study of plants grown in various ecosystems.

Suggested Readings:

1 Text book of Environmental Studies for undergraduate courses by ErachBharucha University Grants Commission, New Delhi.

2 Ecology and Environment by P.D. Sharma, Rastogi Publication. Meerut.

3 Environmental Sciences by S.S. Purohit, Q.J. Shammi and A.K. Agrawal, Student Edition, Jodhpur.

4 A text book on Ecology and Environmental Science by M.Prasanthrajan and P.P. Mahendran.,Agrotch Publishing Academy, Udaipur-313002.

5 The biodiversity of India, Maplin Publishing Pvt. Ltd., Ahmadabad.

6 Disaster Management by Sarthak Singh. Oxford Book Company.

7 Disaster – Strengthening community Mitigation and Preparedness by Dr. B.K. Khannna and Nina Khanna. New India Publication Agency.

Course :	*COMP 231*		***Credit:***	*2(1+1)*	***Semester-III***
Course title:	*Agri-informatics*				

Syllabus

Theory

Theory: Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and Types, Data Representation, Number systems (Binary, Hexadecimal). Difference between ASCII & UNICODE. Applications of MS-Office for creating , Editing and Formatting of Document, Data presentation, Tabulation and Graph creation, statistical analysis, mathematical expressions, Database-Concepts and Types, creating database, uses of DBMS in agriculture, Internet. And World Wide Web(WWW), Concepts, Components and creation of web, HTML, XML, coding.

e- Agriculture, concepts, design and development. ICT for data collection: Formation of development programmes, monitoring and evaluation; Computer models in agriculture: Statistical, weather analysis and crop simulation models- Concepts, structure, files, limitations and advantages. Application for understanding plant processes, sensitivity, verification, calibration and validation; IT application for computation of water and nutrient requirement of crops; computer controlled devices 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. Communication process, Berlo' s model, feedback and barriers to communication.

Practical

Study of Computer Components, accessories, practice of important DOS Commands, Introduction of different operating systems such as MS-Windows, UNIX/ Linux, Creating, Files & Folders, File Management.Use of MS-WORD and MS Power Point for creating, editing and presenting a scientific document. Handling of tabular data; Animation, Video tools, art tool, graphics, template and designs; MS-EXCEL – Creating a spreadsheet, use of statistical tool, writing expressions, creating graphs, analysis of scientific data a; MS-ACCESS: Creating database, preparing queries and reports , Demonstration of agri information system, Introduction to World Wide Web and its components. Demonstration of Scientific websites and identifying components. 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; Use of Smart phones and other devices in agro-advisory and dissemination of market information;Introduction of Geospatial

technology; Demonstration of generating information important for agriculture; Hands on practice on preparation of Decision Support system

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	IntroductiontoComputers,Definition:Hardware,Software &firmware. Types of software.	
2	DataRepresentation, Numbersystems (Binary,Hexadecimal). Difference between ASCII & UNICODE (Different EncodingSchemes)	
3	Primary,SecondaryMemory,Unitsusedformeasurement ofmemory,Input Outputdevices	
4	OperatingSystems, definition and types	
5	File Management.	
6	Applications used for document creation &Editing,Data presentation usingslides.	
7	Use of Spreadsheets for statistical analysis,evaluatingmathematical&logicalexpressions.	
8	UseofSpreadsheetsforInterpretationandgraphcreation.	
9	Database, concepts and types, uses ofDBMS/RDBMSin Agriculture	
10	Databasedesign, creation,	
11	Database, concepts and types, uses of DBMS/RDBMSin Agriculture	
12	Databasedesign, creation,	
13	Preparation of presentation. Import export operations, using numerical tabular data/text/graph /slides within different applications usingcut-paste.	
14	SmartphoneAppsinAgricultureforfarmadvises, market price, postharvestmanagement etc; Geospatial technology for generating valuable agri-information	
15	Decisionsupportsystems,concepts,components and applicationsinAgriculture,Agriculture ExpertSystem, SoilInformationSystemsetc for supportingFarm decisions.	
16	Communication process, Berlo's model, feedback and barriers to communication.	
	Total	

b) Practical

Exercise	Topic
1	Studyof Computer Components, accessories
2	practiceof important DOSCommands
3	IntroductionofdifferentoperatingsystemssuchasMS-Windows, Unix/ L inux, Creating, Files &Folders,FileManagement.
4	Word-Processing–1
5	WordProcessing–2
6	Presentation
7	Spreadsheet-1
8	Spreadsheet-2
9	Spreadsheet-3
10	DBMS/RDBMSCreating,Updatingdatabase
11	Querying/Retrievingdata,relation
12	Introduction to World Wide Web (WWW).Demonstration ofAgri-information
13	HandsonCropSimulationModels(CSM)suchasDSSAT/Crop-Info/CropSyst/Wofost; Computation of waterandnutrientrequirementsof crop using CSM andIT tools.
14	IntroductionofGeospatialTechnologyforgeneratingvaluable information forAgriculture.
15	Hands on Decision Support System
16	Introduction of programming languages.Preparation ofcontingent crop

Suggested Readings

1) Computer Fundamentals by Pradeep K. Sinha and PritiSinha, III edition, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
2) Computer Fundamentals by P.K. Sinha, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
3) Mastering Office Professional for window 95, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
4) Statistical Methods for Agricultural workers by V.G. Panse and P.V. Sukhatma, ICAR, New Delhi.
5) http://www.tutorialsforopenoffice.org/category_index/base.html
6) http://mkisan.gov.in/downloadmobileapps.aspx
7) http://www.nrsc.gov.in/Agriculture
8) http://iasri.res.in/
9) http://communicationtheory.org/berlos-smcr-model-of-communication/