PROFESSOR JAYASHANKAR TELANGANA STATE AGRICULTURAL UNIVERSITY

DISCIPLINE-WISE SUMMARY OF CREDIT HOURS

S.N0.	Discipline	Credits
1.	Agronomy	24(13+11)
2.	Genetics & Plant Breeding	14(8+6)
3.	Soil Science & Agricultural Chemistry	8(5+3)
4.	Entomology	10(6+4)
5.	Agricultural Economics	10(7+3)
6.	Agricultural Engineering	8(4+4)
7.	Plant Pathology	12(8+4)
8.	Horticulture	10(5+5)
9.	Food Science	2(2+0)
10.	Agricultural Extension	9(6+3)
11.	Biochemistry / Physiology / Microbiology/ Environmental Sciences / Introduction forestry (2)	10(6+4)
12.	Statistics / Agri informatics / IPR	6(4+2)
13.	Animal Production	4(3+1)
14.	English	2(1+1)
15.	Remedial Courses	---
16.	NSS/NCC/Physical Education & Yoga Practices	2(0+2)
17.	Human Values and Ethics	1(1+0)
18.	Educational Tour	2(0+2)
		134 +9 (E) + = **143**
Total		143
RAWE **ELP**		**20+20**
Grand Total		143 + 20+20= **183**

NEW COURSES

Sl. No.	Course Title	Credit Hours
1.	Geoinformatics, Nanotechnology and Precision Farming	2(1+1)
2.	Rainfed Agriculture and Watershed Management	2(1+1)
3.	Problematic Soils and their Management	2(2+0)
4.	Renewable Energy and Green Technology	2(1+1)
5.	Management of Beneficial Insects	2(1+1)
6.	Fundamentals of Horticulture	2(1+1)
7.	Introduction to Forestry	2(1+1)
8.	Agri- Informatics	2(1+1)
9.	Intellectual Property Rights	1(1+0)
10.	Principles of Food Science & Technology	2(2+0)
11.	Communication Skills and Personality Development	2(1+1)
12.	Principles of Integrated Pest & Diseases Management	3(2+1)
13.	Agricultural Heritage	1(1+0)*
14.	Elementary Mathematics	2(2+0)*
15.	Human Values & Ethics (NG)	1(1+0)**

* Remedial courses ** Non-gradial courses

ELECTIVE COURSES

A student can select three elective courses out of the following and offer during 4th, 5th and 6th semesters.

S.N.	Courses	Credit Hours	Justification
1.	Agribusiness Management	3(2+1)	Out of 12 elective courses PJTSAU selected 10 croses
2.	Agrochemicals	3(2+1)	
3.	Commercial Plant Breeding	3(1+2)	
4.	Food Safety and Standards	3(2+1)	3 elective courses will be offered in each semester i.e in 4th , 5th and 6th semester.
5.	Biopesticides & Biofertilizers	3(2+1)	
6.	Protected Cultivation	3(2+1)	Student will elect one course in each semester out of three
7.	Micro propagation Technologies	3(1+2)	
8.	Weed Management	3(2+1)	
9.	Agricultural Journalism	3(2+1)	
10.	Applied crop physiology	3(2+1)	

B.Sc (Hons) Agriculture

(2018-19 admitted batch onwards)

I Semester (1st Year)

S.No.	Course No.	Credits	Course Title
1.	AGRO-101	3(2+1)	Fundamentals of Agronomy & Agricultural Heritage
2.	ENGL-101	2(1+1)	Comprehension & Communication skills in English
3.	AMBE-101	2(1+1)	Agricultural Microbiology
4.	AGBM-101	1(1+0)	Human Values & Ethics (non gradial)
5.	SSAC-121	3(2+1)	Fundamentals of Soil Science
6.	AECO-141	2(2+0)	Fundamentals of Agricultural Economics
7.	CPHY-161	2(1+1)	Fundamentals of Crop Physiology
8.	PATH-171	3(2+1)	Introduction to Plant Pathogens
9.	HORT-181	2 (1+1)	Fundamentals of Horticulture
10.	EXTN-191	2 (2+0)	Rural Sociology & Educational Psychology
	Total	**22 (15+7)**	

II Semester

S.No.	Course No.	Credits	Course Title
1.	COCA-100	2 (0+2)	Physical Education & Yoga Practices
2.	SMCA-101	2(2+0)	Elementary Mathematics
3.	BICM-101	3(2+1)	Fundamentals of Plant Biochemistry and Biotechnology
4.	AGRO-102	2 (1+1)	Introduction to Forestry
5.	AGRO-103	2(1+1)	Introductory Agro-meteorology & Climate change
6.	LPFM-101	2(2+0)	Live stock, Poultry and Fisheries management - I
7.	FDSN-101	2(2+0)	Principles of Food Science and Nutrition
8.	GPBR-111	3(2+1)	Fundamentals of Genetics
9.	ENTO-131	3(2+1)	Fundamentals of Entomology
10.	AENG-151	2(1+1)	Soil and Water Conservation Engineering
	Total	**23(15+8)**	

III Semester (2nd Year Ist semester)

S.No.	Course No.	Credits	Course Title
1.	GPBR-211	3(2+1)	Fundamentals of Plant Breeding
2.	ENTO-231	1(1+0)	Insect Ecology & IPM
3.	AECO-241	3(2+1)	Farm Management, Production & Resource Economics
4.	AEXT-291	3(2+1)	Fundamentals of Agricultural Extension Education
5.	SMCA-201	2(1+1)	Statistical Methods
6.	AENG-251	2(1+1)	Farm Power and Machinery
7.	AGRO-201	3(2+1)	Crop production technology-I (kharif crops)
8.	HORT-281	2(1+1)	Production Technology for Vegetables and Spices
9.	HORT-282	2(1+1)	Production Technology for Fruit and Plantation Crops
10.	AGRO-203	2(1+1)	Water management
11.	PFSN - 201	1(1+0)	Principles of Food Science & Nutrition
	Total	**24 (15+9)**	
NCC / NSS after regular classes			

IV Semester (2nd Year IInd Semester)

S.No.	Course No.	Credits	Course Title
1.	LPFM-201	2(1+1)	Live stock, Poultry and Fisheries Management – II
2.	AGRO-202	3(2+1)	Crop Production Technology -II (Rabi crops)
3.	GPBR-212	3(1+2)	Principles of Seed Technology
4.	SSAC-221	3 (2+1)	Manures, Fertilizers and Soil Fertility Management
5.	AECO-242	2(1+1)	Agricultural Finance and Cooperation
6.	AENG-252	2(1+1)	Protected Cultivation and Secondary Agriculture
7.	PATH-271	2(2+0)	Principles of Plant Pathology
8.	HORT-283	2(1+1)	Production Technology for Ornamental Crops, MAP and Landscaping
9.	AEXT-292	2(1+1)	Communication Skills and Personality Development
10.	**Elective Course** ELEC-210	3(2+1)	**Micro propagation technology (GPBR)**
	ELEC-320		**Bio-pesticides and Bio-fertilizers (Ento + Microbiology)**
	ELEC-280		**Hi-tech Horticulture (Horticulture)**
	Total	**24(14+10)**	
NCC / NSS after regular classes			

V Semester (3rd Year 1st Semester)

S.No.	Course No.	Credits	Course Title
1.	AGRO-301	2(1+1)	Rainfed Agriculture & Watershed Management
2.	AGRO-302	1(0+1)	Practical Crop Production –I (Kharif Crops)
3.	GPBR-311	2 (1+1)	Crop Improvement-I (Kharif Crops)
4.	SSAC-321	2(1+1)	Management of Problem Soils and irrigation water
5.	ENTO-331	3(2+1)	Pests of Crops and Stored Grains and their Management
6.	AECO-341	3(2+1)	Agricultural Marketing, Trade & Prices
7.	AENG-351	2(1+1)	Renewable Energy and Green Technology
8.	PATH-371	2(1+1)	Diseases of Field Crops and their Management
9.	PATH-373	2(1+1)	Principles of Integrated Plant Disease Management
10.	AEXT-391	2 (1+1)	Entrepreneurship Development and Business Communication
11.	**Elective course** ELEC- 300	**3(2+1)**	**Weed Management (Agronomy)**
	ELEC – 340		**Agribusiness management (SABM / Agril. Economics)**
	ELEC - 350		**Food safety & Standards (Microbiology and Quality Control Lab)**
	Total	**24(13+11)**	
NCC / NSS after regular classes			

VI Semester(3rd Year 2nd Semester)

S.No.	Course No.	Credits	Course Title
1.	EVST-301	3(2+1)	Environmental Studies & Disaster Management
2.	SMCA-301	2(1+1)	Agri informatics
3.	AGRO-303	2 (1+1)	Geoinformatics and Nano-technology for Precision Farming
4.	AGRO-304	1(0+1)	Practical crop production – II (Rabi crops)
5.	AGRO-305	3(2+1)	Farming systems & organic farming for sustainable agriculture
6.	GPBR-312	2 (1+1)	Crop Improvement-II *(Rabi crops)*
7.	GBPR-313	1(1+0)	Intellectual Property Rights (N)
8.	ENTO-332	2(1+1)	Management of beneficial insects
9.	PATH-372	3 (2+1)	Diseases of Horticultural Crops and their Management
10.	HORT-382	2 (1+1)	Post-harvest Management and Value Addition of Fruits and Vegetables
11.	**Elective course** ELEC - 310	**3(2+1)**	**Commercial Plant Breeding (Genetics & Pl Breeding)**
	ELEC – 320		**Agro-chemicals (Soil Science & Agril. Chemistry)**
	ELEC - 360		**Applied crop physiology**
	ELEC - 390		**Agricultural Journalism (Agril. Extension)**
	Total	**24(14+10)**	
NCC / NSS after regular classes			

VII SEMESTER (4th Year)

(RAWE & AIA)

SN.	Rural Agricultural Work Experience and Agro-industrial Attachment		
	Activities	**No. of weeks**	**Credit Hours**
1	General orientation & On campus training by different faculties	1	14
2	Village attachment	8	
	Unit attachment in Univ./ College. KVK/ Research Station Attachment	5	
3	Plant clinic	2	02
	Agro-Industrial Attachment	3	04
4	Project Report Preparation, Presentation and Evaluation	1	
Total weeks for RAWE & AIA		20	20

- **Agro- Industrial Attachment:** The students would be attached with the agro-industries for a period of 3 weeks to get an experience of the industrial environment and working**.**

VIII SEMESTER (4th Year)
(ELP)

V Deans' committee recommendation

Modules for Skill Development and Entrepreneurship: A student has to register 20 credits opting for **two modules of (0+10)** credits each (**total 20 credits**) from the package of modules in the **VIII semester.**

PJTSAU proposal

PJTSAU proposed to have **one module (with 20 credits)**

	V Deans Committee recommendations	Credits	Proposed by PJTSAU	Credits
			Rajendranagar campus (5)	
1	Production Technology for Bioagents and Biofertilizer	0+10	Production Technology for Bioagents and Biofertilizer	0+20
2	Seed Production and Technology	0+10	Seed Production and Technology	0+20
3	Mushroom Cultivation Technology	0+10	Mushroom Cultivation Technology	0+20
4	Soil, Plant, Water and Seed Testing	0+10		
5	Commercial Beekeeping	0+10		
6	Poultry Production Technology	0+10		
7	Commercial Horticulture	0+10	Commercial Horticulture	0+20
8	Floriculture and Landscaping	0+10		
9	Food Processing	0+10		
10	Agriculture Waste Management	0+10		
11	Organic Production Technology	0+10		
12	Commercial Sericulture	0+10		
			Vermicomposting	0+20
	Aswaraopet Campus (2)			
1	Commercial Horticulture			0+20
2	Seed Production and Technology			0+20
	Jagtial Campus (3)			
1	Commercial sericulture			0+20
2	Soil and water testing			0+20
3	Vermicomposting			0+20

DISCIPLINE-WISE COURSES

AGRONOMY

Course Title	Crdit Hrs.
Fundamentals of Agronomy &Agricultural Heritage *	3(2+1)
Introductory Agrometeorology & Climate change	2(1+1)
Crop production technology-I (kharif crops)	3(2+1)
Crop Production Technology -II (Rabi crops)	3(2+1)
Farming systems &Organic farming for sustainable agriculture	3(2+1)
Practical Crop Production -I	1(0+1)
Practical crop production - II	1(0+1)
Geoinformatics and Nano-technology and Precision Farming	2(1+1)
Rainfed Agriculture & Watershed Management	2(1+1)
Introduction to Forestry	2(1+1)
Water management	2(1+1)
Total	**24(13+11)**
*** Remedial course (1 credit)** **New course (2 credits)**	

GENETICS AND PLANT BREEDING

Course Title	Crdit Hrs.
Fundamentals of Genetics	3(2+1)
Principles of Seed Technology	3(1+2)
Fundamentals of Plant Breeding	3 (2+1)
Crop Improvement-I *(Kharif Crops)*	2(1+1)
Crop Improvement-II *(Rabi crops)*	2 (1+1)
Intellectual Property Rights	1(1+0)
Total	**14(8+6)**
New course (1 credit)	

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Course title	Credit Hrs
Fundamentals of Soil Science	3(2+1)
Manures, Fertilizers and Soil Fertility Management	3 (2+1)
Management of Problem Soils and irrigation water	2(1+1)
Total	**8(5+3)**

PLANT PATHOLOGY

Course title	Credit Hrs
Introduction to Plant Pathogens	3(2+1)
Diseases of Field Crops and their Management-I	2(1+1)
Diseases of Horticultural Crops and their Management-II	3(2+1)
Principles of Integrated Disease Management	2(1+1)
Principles of Plant Pathology	2(2+0)
Total	**12(8+4)**

ENTOMOLOGY

Course title	Credit Hrs
Fundamentals of Entomology	3(2+1)
Pests of Crops and Stored Grain and their Management	3(2+1)
Management of beneficial insects	2(1+1)
Insect Ecology & IPM	2(1+1)
Total	**10(6+4)**

AGRICULTURAL ECONOMICS

Course title	Credit Hrs
Fundamentals of Agricultural Economics	2(2+0)
Agricultural Finance and Cooperation	2(1+1)
Agricultural Marketing Trade & Prices	3(2+1)
Farm Management, Production & Resource Economics	3 (2+1)
Human Values & Ethics	1(1+0)
Total	**11(8+3)**

AGRICULTURAL ENGINEERING

Course title	Credit Hrs
Introductory Soil and Water Conservation Engineering	2(1+1)
Farm Power and Machinery	2(1+1)
Renewable Energy Sources	2(1+1)
Protected Cultivation and Secondary Agriculture	2(1+1)
Total	**8(4+4)**

HORTICULTURE

Course title	Credit Hrs
Fundamentals of Horticulture	2(1+1)
Production Technology for Fruit and Plantation Crops	2(1+1)
Production Technology for Vegetables and Spices	2(1+1)
Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
Post-harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
Total	**10(5+5)**

AGRICULTURAL EXTENSION

Course title	Credit Hrs
Fundamentals of Agricultural Extension Education	3(2+1)
Rural Sociology & Educational Psychology	2(2+0)
Entrepreneurship Development and Business Communication	2(1+1)
Communication Skills and Personality Development	2(1+1)
Total	**9(6+3)**

STATISTICS AND MATHEMATICS

Course title	Credit Hrs
Statistical Methods	2(1+1)
Agri- Informatics	2(1+1)
Elementary Mathematics	2(2+0)
Total	**6(4+2)**

BIOCHEMISTRY

Course title	Credit Hrs
Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)
Total	**3(2+1)**

MICROBIOLOGY

Course title	Credit Hrs
Agricultural Microbiology	2(1+1)
Total	**2(1+1)**

CROP PHYSIOLOGY

Course title	Credit Hrs
Fundamentals of Crop Physiology	2(1+1)
Total	**2(1+1)**

ENVIRONMENTAL SCIENCE

Course title	Credit Hrs
Environmental Studies & Disaster Management	3(2+1)
Total	**3(2+1)**

ENGLISH

Course title	Credit Hrs
Comprehension & Communication Skills in English	2(1+1)
Total	**2(1+1)**

ANIMAL PRODUCTION

Course title	Credit Hrs
Livestock and poultry Management	2(1+1)
Total	**2(1+1)**

FOOD SCIENCE

Course title	Credit Hrs
Principles of Food Science & Nutrition	1(1+0)
Total	**1(1+0)**

REMEDIAL COURSES

Course title	Credit Hrs
Agricultural Heritage	1(1+0)
Elementary Mathematics	2(2+0)
Total	**3(3+0)**

NON- GRADIAL COURSES

Course title	Credit Hrs
Physical Education & Yoga	2(0+2)
Human Values & Ethics	1(1+0)
Educational Tour	2(0+2)
Total	**5(1+4)**

AGRONOMY

Course No : AGRO-101
Course Title : Fundamentals of Agronomy & Agricultural Heritage (New)
Credit Hours : 3(2+1)
Degree : B.Sc (Ag)

Theory Lectures

1. Definition of Agriculture-Meaning and Scope of Agronomy
2. Agro climatic zones of India- Soils, land use pattern, major sources of irrigation and ground water potential
3. Agro climatic zones of Telangana- Soils, land use pattern, major sources of irrigation and ground water potential
4. Tillage and tilth- Objectives of tillage- characteristic of ideal seed bed- Effect of tillage on soil properties- pore space , structure bulk density, particle density and colour of the soil.
5. Types of tillage-preparatory tillage- factors effecting preparatory cultivation, after cultivation, puddling
6. Sowing- methods of sowing- time and depth of sowing for major agricultural crops- Cereals, Pulses and Oil seeds-Crop Stand establishment- Factors effecting optimum stand establishment.
7. Crop density – Planting geometry – Competition – Types of competition, intra and inter plant competition- plant population- effect of plant population on growth and yield- Optimum plant density and planting pattern.
8. Soil fertility- soil fertility and soil productivity – fertility losses- maintenance of soil fertility- soil organic matter- uses of organic matter.
9. Weed Control-Definition of weed-losses and uses of weeds- weed influence on crop production-methods of weed control.
10. Irrigation management – importance of irrigation- Objectives of irrigation-methods of irrigation- drainage and its advantage.
11. Crop nutrition- Essential elements – Importance of major , secondary and micro nutrients.
12. Manures and fertilizers- Classification – Nutrient content- Nutrient use efficiency – Factors effecting nutrient use efficiency.
13. Growth and development of crops- factors effecting growth and development.

14. Plant ideotypes- Characteristics of ideal ideotypes of crops – adaptation and distribution- Definition and principles of crop rotation- cropping systems- mixed , inter , relay, ratoon, sequence and multi stored cropping – sole cropping.
15. Crop management technologies in problematic areas.
16. Harvest maturity symptoms – Harvesting and threshing of major agricultural crops.
17. Agricultural heritage- Introduction- Early history: Archeological and historical facts, Geology of Indian subcontinent.
18. Development of human culture- Stone age- Bronze age- Iron age- and beginning of agriculture.
19. Indus civilization – vedic civilization- Current debate – Civilization in other parts of India- Developments in Agriculture.
20. Status of farmers in society- advice by Sages to kings on their duties towards farmers.
21. Kautilya's Artha- Sastra, agriculture, animal husbandry , commodity trade etc.,- features of village.
22. Agriculture and telugu literature.
23. Astronomy- Prediction of monsoon rains, Parashara, Varahamithra, Panchanga, comparison with modern methods.
24. Soil classification- maintenance of soil productivity, water management- water harvesting-storage-distribution and relevance to modern agriculture.
25. Plant protection-(ITK)- harvesting- threshing and storage.
26. Crops- indigenous and introduced- history of rice, sugarcane and cotton.
27. Gardening in ancient and medieval period- arbori horticulture- orchards, vegetable farming-floriculture-perfumes.
28. Heritage of medicinal plants and their relevance today.
29. Seed health in ancient and medieval history and its relevance to present day agriculture.
30. Role of cattle and other domestic animals- management of cattle for draft and milk-indigenous breeds.
31. Description of Indian civilization and agriculture by travelers from China, Europe and USA.
32. Our journey in agriculture, green revolution and its impact and concern, vision for the future.

Practical Exercises

1. Visit to the crop museum
2. Study of tillage implements
3. Practice of different tillage implements
4. Practice of puddling
5. Participation in ongoing field operations
6. Study of seeding equipment & different methods of sowing
7. Computation of seed rate and spacing of different crops
8. Study of different intercultivation implements and practices
9. Classification of manures and fertilizers
10. Methods of preparing composts and farm yard manure
11. Different methods of fertilizer application
12. Effect of sowing depth on germination and seedling vigour
13. Seed viability tests
14. Study of yield attributing characters and yield estimations
15. Identification of harvest maturity symptoms of various crops
16. Study of problematic soils and their management

Reference books

Yellamanda Reddy.T & Sankara Reddi.G.H.2010, Principles of Agronomy, Kalyani Publishers, Ludhiana.

- S. R. Reddy, 2000, Principles of Agronomy, Kalyani Publishers, Ludhiana.
- B. Chandrasekharan, K. Annadurai, E.Somasundaram, 2014, Text book of Agronomy, New age international (P) Limited Publishers, Delhi.

- Balasubramaniyan, P. Palamiappan S.P. 2009, Principles and Practices of Agronomy, Agribios publishers, Jodhpur.
- Panda, S.E.2012, Modern Concepts and advanced principles in crop production. Agribios (India) Publishers, Jodhpur.
- Das.N.R.2009, Practical Manual on Basic Agronomy (with theory) scientific publishers (India), Jodhpur.
- Ayachit, S.M. (Tr) 2002. Kashyapiya Krishisukti (A treatise on Agriculture by Kashyapa). Agri – History Billetin No. 4. Asian – Agri History foundation, Secundrabad.
- Choudhary, S.L., Sharma, G.S. and Nene, Y.L. 2000. Ancient and medievel history of Indian agriculture and its relevance to sustainable agriculture in the 21st century.
- Proceedings of the sumemr school held from 28 May to 17 June 1999. Rajasthan College of Agriculture, Udaipur, India
- Nene, Y.L. and Choudhary, S.L. 2002. Agricultural heritage of India. Asian Agri – History foundation, Secundrabad.
- Randhawa, M.S., 1980 – 86. A histroy of Agriculture in India. Vol. I, II, III and IV. Indian council of Agricultural Research, New Delhi.
- Raychaudhuri, S.P. 1964. Agriculture in ancient India. Indian council of Agricultural Research, New Delhi.
- Razia Akbar (Tr) 2000. Muskha Dar Fauni – Falahat (The art of agriculture). Agri – History Bulletin No. 3. Asian Agri. History foundation, Secundrabad.
- Sadhale Nalini (Tr) 1996. Surapala's Vrikshayurveda (The science of plant life). Asian. History Bulletin No. 1. Asian – Agri – History foundation, Secundrabad.
- Sadhale, Nalini Tr) 1999. Krishi – Parashara (Agriculture by Parashara). Agri- Histroy Bulletin No. 2. Asian Agri – History foundation, Secundrabad, India

Course No : AGRO-102
Course Title : Introduction to Forestry (New)
Credit Hours : 2(1+1)
Degree : B.Sc (Ag)

THEORY

Lec. No.	Topic/Lesson
1	Introduction- Introduction to Indian forest, target area, productivity - Definitions of basic terms related to forestry
2	Definition and Objectives of silviculture – Parts and stages of development of a tree, plantation life history of tree cultivation
3	Forest classification
4	Salient features of Indian Forest Policies
5	Forest regeneration, Natural regeneration – natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers;
6	Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations
7	Crown classification
8	Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning
9	Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement.
10 & 11	Instrumental methods of height measurement – tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees
12 & 13	Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country
14	Shifting cultivation, taungya, alley cropping, wind breaks and shelter belts.
15 & 16	Cultivation practices of two important fast growing tree species of the region – Subabul and Eucalyptus

PRACTICALS

Lec.No.	Topic/Lesson
1.	Identification of tree species suitable for Timber, Fuel wood and Fodder
2.	Identification of tree species suitable for Roadside plantation, Field bunds, Windbreaks and for Wastelands
3.	Identification of Minor forest tree species, trees for Beautification purpose and Nitrogen fixing tree species and other species suitable for Agroforestry
4.	Identification of seeds of Important tree species
5.	Collection, Extraction and Storage of tree seeds
6.	Collection, Extraction and Storage of tree seeds
7.	Application of Pre-sowing Seed Treatment to tree seeds.
8.	Application of Pre-sowing Seed Treatment to tree seeds.
9.	Biomass estimation in Energy plantations.
10.	Cost of cultivation of Commercial trees in wastelands: Bamboo.
11.	Diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees.
12.	Height measurement of standing trees by Shadow method, Single pole method and Hypsometer.
13.	Volume measurement of logs using various formulae.
14.	Forest plantations and their management.
15.	Visits of nearby forest based industries.
16.	Visit to AICRP on Agroforestry

REFRENCES

1. Plantation forestry in India - Luna R K 1990. International book distributor, Dehradun
2. Forestry in India - Dwivedi A P 1980. Jugal Kishore and Company, Dehradun
3. Agroforestry hand book - Negi S S 1999. International book distributor, Dehradun

4. Some favourite trees for fuel and fodder - Ram Prakash and Drake Hocking 1986. International book distributor, Dehradun
5. Silviculture of Indian trees (Vol. II & III) - Troup R S 1986. International book distributor, Dehradun
6. Forestry Mensuration - Chaturvedi A N and Khanna L S 1982 International book distributor, Dehradun
7. Tree Farming - Singh S P 2002 Agrotech publishing academy, Udaipur
8. Favourite Agroforestry Trees - Singh S P 2002 Agrotech publishing academy, Udaipur

Course No : AGRO-103
Course Title : Introductory Agrometeorology & Climate Change (New)
Credit Hours : 2(1+1)
Degree : B.Sc (Ag)

Theory lectures

1. Agricultural meteorology- Introduction- Definitions of meteorology, climatology and agricultural meteorology – Scope and practical utility of agricultural meteorology.
2. Earth atmosphere- its composition, extent and structure- Atmospheric weather variables, atmospheric pressure its variation with heights.
3. Wind, types of wind, daily and seasonal variation of wind speed, Cyclone, Anti cyclone, effect of wind on crops- movement of air and valley winds- land and seas breezes.
4. Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo .
5. Physiological responses of different bands of incident radiation – Function of light, factors affecting distribution of solar radiation with in the plant canopy.
6. Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, cardinal temperature- importance of air temperature- Energy balance of earth.
7. Low air temperature and plant injury- high air temperature and plant injury- Soil temperature- importance of soil temperature.
8. Atmospheric humidity, concept of saturation, vapor pressure, effect of humidity on crops., concept of saturation, vapour pressure and process of condensation.
9. Precipitation and condensation – Definition- Different forms of precipitation and condensation – Cloud seeding (Artificial rain making).
10. Clouds- clouds formation – Classification and characteristics- Worlds Meteorological Organization.
11. Rainfall- importance of rainfall on crops- types of rain fall-Monsoon definition – origin and distribution of south west monsoon and North west monsoon-mechanism and importance in Indian agriculture.
12. Weather hazards- drought , floods, frost, tropical cyclones .
13. Weather hazards- extreme weather conditions such as heat weave and cold wave, wind , storms, hail storms, thunder storms, dust storms, tornadoes and defective insulations
14. Agricultural and weather relations, modifications of crop micro climate, climatic normals for crop and live stock production.
15. Weather forecasting, types of weather forecast and their uses.
16. Climate change, climatic variability, global warming , causes of climate change and its impact on regional and national agriculture.

Practical exercises

1. Visit to Agrometeorology Observatory
2. Site selection & layout for Observatory
3. Measurement of total, short wave and long wave radiation and its estimation using Planck's intensity law.
4. Measurement of albedo and Sunshine duration
5. Measurement of maximum and minimum Air temperature, its tabulation, trend and variation analysis
6. Measurement of Soil temperature and computation of soil heat flux
7. Determination of Vapor pressure, Relative humidity and dew point temperature
8. Measurement of atmospheric pressure and analysis
9. Measurement of Wind Speed and direction and preparation of windrose
10. Measurement of Rainfall and its tabulation
11. Rainfall analysis
12. Measurement of Evaporation & Evapotranspiration
13. Measurement of Dew - Dew Gauge
14. Weather forecasting , types and its importance in agriculture
15. Use of Synoptic chart and weather reports
16. Climatic variability and analysis of its impact n agriculture

Reference books

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- Radha Krishna Murthy.V. Yakadri.M and Prasad P.V.V.2006, Terminology and Agricultural Meteorology and Agronomy, B.S. Publications, Hyderabad.
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- Prasad Rao.G.S.L.H.V.2015, Agricultural Meteorology, Eastern Economy Edition (PH1) Learning Pvt Limited Publishers, Delhi.
- Smita . A and Elizabeth .M. 2010 climate change issue and concern. The IOP Publishers Agaratala.
- Data.M.Singh N.P. and Das Choudari D. 2008. Climate change and food security. New India Publishing Agency, New Delhi.
- Reddy .S.R.Reddy D.S. 2011, Agrometeorology, Kalyani Publishers, Ludhiana.
- Nanjappa and Ramachandrappa, 2007, Manual on Practical Agricultural Meteorology, Agribios (India) publishers, Jodhpur.
- Reddy.K.R. and Hudges, MF.2000, Climate Change and Global crop productivity, CAB publishing House, USA.
- Sahu.D.D. Chopda.M.C and Kacha.HL,2012, Practical Agrometeorology Agribios (India), Jodhpur.

Course No : AGRO-201
Course Title : **Crop Production Technology-I (Kharif Crops)**
Credit Hours : 3(2+1)

THEORY

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

PRACTICAL

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

Additions : Minor millets, Sesamum, Castor, Fodder maize, Horsegram, Paragrass
Deletions : Groundnut shifted to rabi crops

OBJECTIVES

- To impart updated technology and skills in performing different operations in raising the crop.
- By the end of the course, the students will be,
- Able to know the statistics of different crops at different levels and also learn constraints for low production in India and Telangana.
- Able to understand the effect of climate, soil and varieties.
- Able to understand the concepts of integrated weed control, Integrated nutrient management and conjunctive use of water.
- Knowing cropping systems in India and state, post harvest operations in different crops.
- Learn about seed production, Farm Mechanization and resource conservation technology.

Lec.No.	THEORY
1	**Rice** – Introduction, Origin, distribution, area, production and productivity inWorld India and Telangana. Rice plant types – concept of new plant types – important features of new plant types of rice – Golden Rice – Super rice.
2	Eco systems – upland, lowland, Deep water and, floating rice, SRI, MSRI, DSRI, Aerobic rice -differences between upland and low land rice.
3	**A**daptation - influence of climate and soil factors- growth stages–land preparation and puddling.- sequential changes
4	Methods of planting - manures and fertilizers – N, P, K, Zinc, Iron and bio-fertilizers, integrated nutrient management – steps for increasing fertilizer use efficiency.
5	Water management – water requirement, critical stages, water use efficiency– weed control, weed flora in upland & low land- critical period-weed control in nursery and in main field.
6	Harvesting- threshing- post harvest operations – yield attributes and yield – Bi product utilization- par boiling- production constraints and strategies for increasing yield.-cropping systems.
7	**Maize –** introduction – origin – distribution – area – production and productivity in World-India and Telangana and varieties/ hybrids- special types of maize – Adaptation and climate.
8	Soils - land preparation – season – seeds and sowing- manures and fertilizers -irrigation including fertigation – weed control – harvesting- threshing – yield attributes and yield – cropping systems.
9	**Sorghum –** Introduction – Origin – distribution – area – production – productivity in World-India and Telangana – Adaptation – soils – land preparation – seasons in Telangana, varieties.
10	Seeds and sowing – manures and fertilizer – irrigation – weed control ratooning- yield & yield attributes – sweet sorghum – cropping systems.
11	**Pearl Millet** – Introduction – Economic importance – Origin – distribution – area – production - productivity in World-India and Telangana – Adaptations – Soils – land preparation – seasons – seeds and sowing varieties/hybrids – manures and fertilizers – irrigation and weed control – harvesting – threshing & processing – yield attributes and – yield cropping systems
12	**Finger millet** – Introduction – economic importance – origin – distribution – area - production and productivity in World-India & Telangana – Adaptation - Soils – Land preparation – seasons – seeds and sowing – varieties/hybrids – manures and fertilizers irrigation – weed control – harvesting – threshing & processing – yield attributes and yield - cropping systems.
13	**Minor millets** – Foxtail/Millet Kodo Millet and Common Millet and Little Millet origin – distribution – area – production – productivity in World- India & Telangana soils-land preparation – seasons – seeds and sowing- varieties – manures and fertilizers – irrigation - inter cultivation – harvesting – threshing – yield attributes and yield - cropping systems.
14	**Pulses –** Importance of pulses in Indian agriculture – Area, Production and productivity of pulses in World-India Telangana – importance of pulses - utilization as food, fodder, feed - green manuring - crop mixtures and crop rotations for improving soil fertility.
15	**Pulses** – Reason for low yields of pulses in India (Genetical, Physiological and agronomical reasons). Production strategy for improving productivity of pulses.
16	**Red gram** – Importance area – production and productivity in world- India-Telangana-varietal improvement – origin – distribution – soils - climate – seasons seeds and sowing methods – square planting – transplanting manures, fertilizers and Irrigation – weed control

	- harvesting – threshing – yield attributes and yield - cropping systems.
17	**Black gram & Green gram** - production constraints - Area - production and productivity – World- India- Telangana - soils – climate- seasons - seed rate-spacing-fertilizers and bio-fertilizers- weed control – irrigation - harvesting - threshing and processing – yield components and yield - cropping systems.
18	**Cluster bean** – Introduction - origin, distribution, soils, land preparation – seasons seeds & sowing- fertilizer- irrigation- critical stages - weed management- harvesting, yield attributes and yield- major cropping systems.
19	**Sesame** – importance - area, production – productivity in World- India and Telangana origin – spread – soils – climate – land preparation –seeds and sowing-varieties manures and fertilizers- weed management – irrigation – critical stages – symptoms of maturity-harvesting – yield and yield attributes - cropping systems.
20	**Soybean** – importance - area, production – productivity in World- India and Telangana origin - soils – climate – seeds and sowing- manures and fertilizers weed management – irrigation- critical stages – symptoms of maturity- harvesting yield and yield attributes – crop rotations – cropping systems.
21	**Castor** – Economic importance – area – production – productivity – World - India and Telangana – origin- soils – climate – manures – fertilizers – irrigation – weed management – harvesting – threshing and processing – yield components and yield, cropping systems.
23	**Cotton** - Importance – origin – area – production, productivity in World- India & Telangana – cotton species - Cotton growing zones of India –Varieties/Hybrids.
24	soil and climatic requirements -seasons- seeds - seed treatment – methods of sowing-manures and fertilizers - water & weed management.
25	harvesting – threshing– yield and yield attributes - Topping – Boll shedding – reasons measures - quality parameters- cropping systems.
26	**Bt- cotton** production technology.
27	**Jute** - Importance – origin – area – production, productivity in World- India Telangana-jutetypesand properties of jute- soil and climatic requirements – seasons seeds / seed treatments –varieties.
28	manures and fertilizers - water management – critical stages of irrigation- method of irrigation-weed management – harvesting – Retting –Fibre extraction – yield attributes and yield-Institutes.
29	**Fodders/Forage crops** – importance, classification of fodders – **Fodder Sorghum and maize** - Introduction – origin, distribution, soils, land preparation – seasons – seeds & sowing, fertilizer, irrigation, weed management, harvesting, yield and major cropping systems.
30	weed management, harvesting, yield and major cropping systems- toxicities –mode of action and remedial measures.
31	**Fodder cowpea and horse gram** - Introduction – origin, distribution, soils, land preparation – varieties - seasons – seeds & sowing, fertilizer, irrigation, weed management- harvesting-yield and major cropping systems.
32	**Napier hybrid** - Introduction – origin, distribution, soils, land preparation – seasons seeds & sowing, fertilizer, irrigation, weed management, harvesting, yield and major cropping systems.
33	**Paragrass** - Introduction – origin, distribution, soils, land preparation – seasons – seeds & sowing, fertilizer, irrigation, weed management, harvesting, yield and major cropping systems.

PRACTICALS

1. Preparation and methods of raising of rice nursery
2. Study of methods of transplanting.
3. Field preparation and sowing of *kharif* crops. {Maize, cotton, pigeon pea, soybean, etc.}
4. Study of effect of seed size and sowing depth on germination % and seedling vigor index.
5. Identification of weeds and weedicide calculation.
6. Top dressing and foliar feeding of nutrients.
7. Recording bio-metric observations of the standing *kharif* crops.
8. Study of yield contributing characters of *kharif* crops.
9. Calculation of estimated yield for *kharif* crops.
10. Study of varieties of *kharif* crops.
11. Visit to ongoing agronomic experiments at farm.
12. Visit to forage production farm.
13. Visit to units of mechanization and resource conservation technology.
14. Preparation of balance sheet including cost of cultivation.
15. Visit to research centers of related crops.
16. Visit to processing units.

REFERENCES

1. Jeswani L M and Baldev B 1990. Advances in Pulse Production Technology ICAR, New Delhi.
2. Mahendra Pal, Jayanta Deka and Rai R.K. 1996. Fundamentals of Cereal Crop Production, Tata
3. Reddy S R 2004. Agronomy of Field Crops. Kalyani Publishers, Ludhiana.
4. Rajendra Prasad 2002. Textbook of Field Crops Production. ICAR, New Delhi.
5. Subashchandra Bose M, Balakrishnan V. 2001. Forage Production. South Asian Publishers, Delhi
6. Das, N.R. 2007. Introduction to Crops of India. Scientific publishers, Jodhpur, Rajasthan, India.
7. Singh, C., Singh, P. & Singh, R. 2003. Modern Techniques of Raising Field Crops. Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi.

Course No : AGRO-202
Course Title : **Crop Production Technology-II (Rabi Crops)**
Credit Hours : 3 (2+1)

THEORY

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, pulses-chickpea, lentil, peas, oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops- lemon grass and citronella, Forage crops-berseem, lucerne and oat.

PRACTICAL

Sowing methods of wheat and sugarcane, identification of weeds in *rabi* season crops, study of morphological characteristics of *rabi* crops, study of yield contributing characters of *rabi* season crops, yield and juice quality analysis of sugarcane, study of important agronomic experiments of *rabi* crops at experimental farms. Study of *rabi* forage experiments, oil extraction of medicinal crops, visit to research stations of related crops.

Additions : Oat, Quinoa, Rabi Red gram, Rice fallow production technologies, Groundnut as rabi crop, Safflower, Linseed, Sugar beet, Potato, Tobacco, Agave and Hay + silage making

Deletions : Medicinal and Aromatic crops shifted to horticulture

Lec. No.	THEORY
1	**Wheat -** Introduction – Origin and distribution – Area, production and productivity in World, India and Telangana- Wheat growing zones of India- classification of Indian wheat varietal improvement
2	Climate - Influence of temperature - light intensity- rainfall - soils – land preparationseasons – time of sowing- methods of sowing - seed rate- pacing - manures and fertilizers
3	Water management- critical stages of irrigation- method of irrigation and weedmanagement-harvesting-threshing-yield attributes and yield- byproduct utilizationquality parameters - post harvesting technology- wheat basedcropping systems.
4	**Barley** -Introduction- economic importance – origin and distribution, area, production and productivity in the World- India and Telangana- classification of barley- climate soils, land preparation- varieties- seasons - seed rate -sowing time -spacing- nutrientmanagement-water and weed management- harvesting- threshing-yield attributes &yield -major cropping systems under rainfed and irrigated conditions
5	**Oat.** -Introduction - economic importance- origin and distribution, area, production, Productivity in the World, India and Telangana - varieties – soils – climate - land preparation-seasons - sowing time - seed rate - method of sowing- spacing-fertilizer requirement - irrigation – critical stages - harvesting – yield attributes and yield
6	**Quinoa -** Introduction -Economic importance - Origin and distribution, area, production productivity in the World, India and Telangana- climate - soil requirements - field preparation seasons-varieties- seeds- seed rate and seed treatment-sowing time and method- spacing-

	manures and fertilizers- irrigation, weed control - harvesting threshing - yield and yield attributes - cropping systems.
7	**Chickpea** - Introduction-economic importance-origin and distribution-area-productionProductivity in the World, India and Telangana-climate-soils-land preparation-seasons seed rate, varieties different types-desi and kabuli types- spacing- manures & fertilizers Irrigation- weed control – harvesting – threshing - yield attributes & yield- cropping systems.
8	**Rabi Red gram :** Reasons for increasing rabi red gram area – regions suitable for rabi red gram area – production and productivity in – India – Telangana - suitable rabi varieties origin – soils - climate – seasons – sowing time - seed rate – spacing- manures, fertilizers - irrigation – water requirement - critical stages - weed control - harvesting threshing – yield attributes and yield cropping systems.
9	**Lentil -** Introduction- economic importance-origin and distribution, area, production productivity in the World, India and Telangana- climate – soils - tillage- seasons varieties seed rate - seed treatment - sowing – spacing – manures - fertilizers and bio-fertilizers- irrigation - weed control – harvesting – threshing - yield attributes & yield- cropping sequence.
10	**Pea -** Introduction - Economic importance - origin and distribution, area, production, productivity in the World, India and Telangana - climate - soils - land preparation season- seed rate and seed treatment – varieties- different types – field pea and garden pea- sowing time and method of sowing- spacing- manures and fertilizers-irrigation weed control- harvesting - threshing-yield attributes and yield- cropping systems.
11	**Rajmash -** Introduction **–** area, production and productivity -World- India- Telangana, origin & distribution – soils- climate- seasons- seeds and sowing- manures and fertilizers - irrigation – weed control – harvesting – threshing - yield attributes and yield cropping systems.
12	**Rice fallow pulses production technology** – Area ,production and productivity of rabi pulses scenario in India and in state – Constraints of pulse production systems in rice in India and in state - Improving pulse production in rice fallows – c rops & varieties seasons- sowing time – method of sowing- weed control- foliar sparys- harvesting-yield.
13	**Rapeseed & Mustard** - Introduction - economic importance - origin and distribution, area, production, productivity in World, India and Telangana-classification of rapeseed & mustard climate & soil requirements.
14	Field preparation - seasons - varieties - seed rate and treatment sowing time and method-spacing- manures and fertilizers – irrigation- weed control – cropping systems harvesting - threshing - yield and yield attributes.
15	**Groundnut.-**Introduction-economic importance-origin and distribution, area, production, productivity in World, India and Telangana- habitat groups- varieties - climate & soil requirements - field preparation- seasons - seed rate and treatment - sowing time and method-spacing.
16	Manures and fertilizers- biofertilizers - rhizobium- gypsum application- irrigation- weed control – maturity symptoms- harvesting- yield and yield attributes-quality parameters-aflatoxin contamination- cropping systems.
17	**Sunflower-**Introduction- economic importance- origin and distribution- area, production productivity in the World, India and Telangana- climate and soil requirements - field preparation seasons- varieties- seeds – seed rate and treatment - sowing time and method-spacing- manures and fertilizers-irrigation- intercultivation-weed control- harvesting-threshing-yield and yield attributes –cultivation problems – poor seed set – reasons & remedies.
18	**Safflower-** Introduction -economic importance - origin and distribution, area, production productivity in the World, India and Telangana- climate & soil requirements - field preparation

	seasons – varieties/ hybrids - seed rate and treatment - sowing time and method - spacing- manures and fertilizers – irrigation - weed control - harvesting-threshing - yield & yield attributes - cropping systems.
19	**Linseed** - Introduction - economic importance - origin and distribution, area, production, productivity in World, India and Telangana-varieties- climate & soil requirements - field preparation-seasons - seed rate and treatment - sowing time and method-spacing- manures and fertilizers- irrigation- weed control - maturity symptoms- harvesting- yield and yield attributes- pyra /utera cultivation details.
20	**Sugarcane -** Introduction - economic importance - Origin and distribution, Area, production productivity in the World, India and Telangana - Latest varieties for different situations.
21	Climate - soils - planting seasons - different planting material- setts- short crop, nursery crop, split cane, bud chip seed /sett rate – sett treatment - spacing - planting method ridge and furrow method.
22	Manures and fertilizers, time and method of application, bio-fertilizers water management scheduling, method & time of irrigation -inter cultivation – weed control- ripening, judging ripening- factors affecting ripening - harvesting ,yield and yield attributes- by products – crop logging - special operations - blind hoeing - trash mulching
23	Ratoon management- varieties suitable for rationing- stubble shaving- weed management fertilizers- irrigation – special operations - jaggery making.
24	**Sugar beet -**Introduction -economic importance - origin and distribution, area, production productivity in the World, India and Telangana- climate & soil requirements - field preparation- seasons - varieties - seed rate and treatment - sowing time and method-spacing- manures and fertilizers-irrigation -weed control - harvesting-cleaning-crushing-sugar extraction- yield& yield attributes - cropping systems
25	**Potato**.-Introduction-economic importance-origin and distribution, area, production productivity in the World, India and Telangana - soil and climatic requirements- field preparation – seasons – seeds / seed material- seed rate and seed treatment- sowing time and methods – manures and fertilizers – irrigation – weed control – cropping systems – harvesting – cleaning – yield and yield attributes.
26	**Tobacco -** Introduction - economic importance - origin and distribution, area, production productivity in the World, India and Telangana- varieties – latest -different types of tobacco.
27	Climate and soil requirements - field preparation- nursery management - season – seed rate and treatment - sowing - manures and fertilizers - types and method of application- water management
28	Weed control - harvesting- special operations - quality characters - physical and chemical properties - principle of flue curing of virginia tobacco - cropping systems.
29	**Agave -** Importance – origin – area – production, productivity in World-India & Telangana- soil - climatic requirements- seasons – seeds - seed treatment- sowing nursery raising- manures and fertilizers - water & weed management - harvesting-poling– reasons and strategies for poling- yield and yield attributes.
30	**Berseem** –Introduction - economic importance- origin and distribution, Area, production productivity in the World, India and Telangana – soils and seed bed preparation varieties and seasons – seed rate - sowing time & method – spacing- manures and fertilizer requirement irrigation -time and method of harvesting – yield
31	**Lucerne -**Introduction - economic importance - origin and distribution, area, production productivity in the World, India and Telangana – soils and seed bed preparation varieties and seasons – seed rate- sowing time & method – spacing- fertilizers requirement- irrigation – time and method of harvesting – yield – nutritional values

32	**Hay & Silage making :** Importance of preservation of fodders - methods of preservation - silage- advantages and disadvantages of ensiling - materials required - crops suitable for silage, steps in silage making - difference between additives and preservatives – changes in silo material - physical – chemical – bacterial – losses during silage making - hay making materials required - steps in preparation of hay – losses during hay making – advantages and disadvantages of hay making.

PRACTI CALS

1. Preparation and methods of raising of nursery.
2. Study of methods of transplanting.
3. Field preparation and sowing of *rabi* crops.
4. Study of effect of seed size and sowing depth on germination % and seedling vigor index.
5. Identification of weeds and weedicide calculation.
6. Top dressing and foliar feeding of nutrients.
7. Recording bio-metric observations of the standing *rabi* crops.
8. Study of yield contributing characters of *rabi* crops.
9. Calculation of estimated yield for *rabi* crops.
10. Study of varieties of *rabi* crops.
11. Visit to ongoing agronomic experiments at farm.
12. Visit to forage production farm.
13. Visit to units of mechanization and resource conservation technology.
14. Preparation of balance sheet including cost of cultivation.
15. Visit to research centers of related crops.
16. Visit to processing units.

REFERENCES

1. Chidda Singh 1983. Modern Techniques of raising field crops. Oxford & I B H Publishing, Delhi.
2. Jeswani L M and Baldev B 1990. Advances in Pulse Production Technology ICAR, New Delhi.
3. Mahendra Pal, Jayanta Deka and Rai R.K. 1996. Fundamentals of Cereal Crop Production, Tata
4. Varma S C and Singh M P. 1992. Agronomy of New Plant types, Tara Publications, Varanasi.
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Course No. : AGRO-203
Course Title : **Irrigation Water Management**
Credit Hours : 2(1+1)

New course proposed by adding below component from Fundamentals of Agronomy.

THEORY

Water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation-scheduling criteria and methods, quality of irrigation water, water logging.

PRACTICAL

Study of soil moisture measuring devices, Measurement of field capacity, bulk density and infiltration rate, Measurement of irrigation water.

Lec. No.	Topic/Lesson
1.	Irrigation –, Importance, Definition & Objectives. Water Resources of India – Surface & Ground water resources – Irrigation Development in India – Important major irrigation projects.
2.	Water Resources of Telangana – Surface & Ground water resources - Important major irrigation project in Telangana- Command Area Development & Water Management.
3.	Soil-water relations - Physical properties of soil. Effective root zone depth – Moisture extraction pattern – Moisture sensitive periods of important crops.
4.	Water retention in soil – Adhesion & cohesion – Soil moisture tension - pF - Soil moisture characteristic curves. Water movement in soils – infiltration – Percolation – Hydraulic conductivity – Saturated & Unsaturated water flow.
5.	Kinds of water in soil – Gravitational Water - Capillary water - Hygroscopic water. Soil moisture constants - Saturation capacity - Field capacity – Permanent wilting point – Available soil moisture – Hygroscopic coefficient – Theories of soil water availability – Moisture retentive capacity (FC, PWP & ASM) of different soils
6.	Measurement of soil moisture – Direct methods – Gravimetric & Volumetric method - Infra-red moisture balance method – Spirit burning method- Indirect methods –Soil moisture probe – Tensiometer - Resistance blocks - Pressure plate and pressure membrane apparatus – relative merits and demerits.
8.	Evaporation- transpiration. – Factors influencing evapotranspiration, - Daily, seasonal and peak period consumptive use. Reference crop evapotranspiration – Soil plant atmospheric continuum
9.	Crop co-efficient – crop co-efficient curve - Water requirement – Irrigation requirement – Net & Gross irrigation requirement – Irrigation interval – Irrigation period – Seasonal water requirement of important crops.
10.	Scheduling of irrigation – Different criteria - Soil water regime approach - Feel and appearance method, Soil moisture tension and Depletion of available soil moisture method. Climatological approach – IW/CPE ratio method
11.	Scheduling of irrigation – Plant indices approach –Visual plant symptoms, Soil-cum-sand mini plot technique, Growth rate, Relative water content, Plant water potential, Canopy

	temperature, Indicator plants & Critical growth stages.
12.	Surface irrigation methods – Wild flooding, Check basin, Ring basin, Border strip, Furrow & Corrugations – Advantages and disadvantages.
13.	Water use efficiency (WUE) – Crop water use and Field water use efficiency – factors influencing WUE
14.	Micro irrigation - Sprinkler , drip irrigation method – Definition - Advantages & disadvantages.- fertigation scheduling in drip irrigation method. Recommended water soluble fertilizers
15.	Quality of water – Salinity hazard, Sodicity hazard, Residual sodium carbonate and Boron toxicity - Criteria and threshold limits – Management practices for using poor quality water.
16.	Agricultural drainage – Surface and Sub-surface drainage systems – Relative merits and suitability to different soils.

PRACTICALS

S.No.	Topic/Lesson
1.	Determination of bulk density
2.	Determination of soil moisture content by gravimetric and volumetric methods
3.	Installation and working of tensiometer in a cropped field
4.	Installation and working of resistant block in a cropped field
5.	Determination of field capacity by field method
6.	Determination of permanent wilting point by field method
7.	Measurement of irrigation water through flumes, weirs and water meters.
8.	Scheduling of irrigation by IW/CPE ratio method
9.	Measurement of plant water status using Pressure bomb apparatus/ porometer
10.	Calculation of irrigation water needs (problems)
11.	Determination of infiltration rate
12.	Demonstration of surface methods of irrigation (basin, check basin and furrow)
13.	Demonstration of drip irrigation system (filter cleaning, flushing of laterals) and calculation of crop water requirement.
14.	Component, operation and maintenance of sprinkler irrigation system
15.	Fertigation scheduling in important crops
16.	Visit to farmers' field and Cost estimation of drip and sprinkler irrigation system

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1. Dastane N G 1967. A Practical manual for Water Use Research, , Navbharat Publications, Poona.
2. Misra R.D and Ahmed M. 1998, Manual on Irrigation Agronomy, Oxford and IBH Publishing Co., Ltd., New Delhi.
3. Water requirement of crops in India. Monograph 4, 1977, IARI, ICAR publication, New Delhi.
4. Israelsen O W and Hansen V E 1962. Irrigation – Principles & Practices, John Willey and Sons, Inc, U.S.A.
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7. D.K. Majumdar, 2002. Irrigation Water Management: Principles & Practices, Prentice hall of India Private Limited, New Delhi.
8. Michael A M, 2006. Irrigation – Theory & Practice. Vikas publishing house private ltd.
9. Sivanappan R k Padma Kumari O and Kumar, V 1987. Drip Irrigation –. Keerthi Publishing House Pvt., Ltd., Coimbatore.
10. Tiwari K N T 2006. Manual on pressurized Irrigation Scientific Publication No: PFDC, ITT, Kharagpur.
11. Keller J and R D Bliesner 1990. Sprinkler and Trickle Irrigation Van Nortrand Reinhold, New York.
12. Doorenbos J and Pruitt W O 1975. Crop Water Requirement Irrigation Irrigation and Drainage Paper No.24, F.A.O., Rome.

Course No. : AGRO-301
Course Title : **Rainfed Agriculture and Watershed management**
Credit Hours : 2(1+1)

THEORY

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

PRACTICAL

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

Lec. No.	Topic/Lesson
1.	Rainfed Agriculture: Introduction, types- Dry farming, dryland farming and rainfed farming - History of rainfed agriculture in India – CRIDA, objectives and activities.
2.	History of watershed concept in India – guidelines for Integrated watershed management programme.
3.	Characteristics and prospects of rainfed agriculture in India – Significance of crop production in rainfed agriculture.
4	Problems of crop production in drylands - Climatic parameters- Rainfall- Variability- Temperature and other constraints.
5	Problems of crop production in drylands- Soil characteristics and their problems – other problems (weed, socio economic, infrastructure and policy constraints)
6.	Drought-Classification of drought -Effect of water deficit on physio-morphological characteristics of the plants.
7	Mechanism of crop adaptation under moisture deficit condition- drought escaping-tolerence and resistance.
8.	Fertilizer use in dry lands – use of organic manures – introduction of legumes in crop rotation – organic recycling and bio-fertilizer use in dryland agriculture – time and method of fertilizer application .

9.	Water harvesting, importance and its techniques- In-situ and Ex-situ water harvesting in arid and semiarid areas.
10.	Efficient utilization of water through soil and crop management practices- Agronomic, mechanical and agrostological measures.
11.	Management of crops and cropping systems in rainfed areas – Intercropping, sequence cropping and crop rotation- Choice of crops and cropping systems based on length of crop growing season – Potential cropping systems.
12.	Contingent crop planning for aberrant weather conditions – Late onset, dry spell and early withdrawal of monsoon in India and in Telangana
13.	Concept, objectives and principles of watershed management- Application of remote sensing and GIS in delineation of watershed
14.	Components of watershed management- Natural resource management in arable and non arable lands- Soil and water conservation
15.	Alternate land use systems- different types of ALUS based on land capability classification.
16.	Factors effecting watershed management- Technical, social, economic and policy constraints.

PRACTICALS

S.No.	Topic/Lesson
1.	Study on climate classification
2.	Study of rainfall pattern in rainfed areas of the country and in Telangana
3.	Study of pattern of onset ,withdrawal of monsoons and length of crop growing season
4.	Studies on cropping pattern of different dry land areas in the country and demarcation of dry land area on map of India.
5.	Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops
6.	Drought, its significance and estimation of drought indices- MAI, AI
7.	Critical analysis of rainfall and possible drought period in the country,
8.	Effective rainfall and its calculation.
9.	Studies on cultural practices viz; mulching and anti transpirants for mitigating moisture stress.
10.	Studies on cultural practices viz; plant density, depth of sowing, thinning and leaf removal for mitigating moisture stress.
11.	Characterization and delineation of model watershed.
12.	Field demonstration on soil & moisture conservation measures
13.	Field demonstration on construction of water harvesting structures
14.	Visit to rainfed research station or CRIDA **.**
15.	Visit to watershed**.**
16.	Alternate land use systems- different types of ALUS and visit to AICRP on Agroforestry

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Course No : Agro -302
Course Title : **Practical Crop Production-I *(Kharif Crops)***
Credit Hours : 1 (0+1)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

LECTURE OUTLINE FOR PRACTICAL

1. Crop planning in multiple cropping systems.
2. Field preparation and layout of experiment plots.
3. Seed treatment and nursery raising in paddy.
4. Sowing of crops in individual plots.
5. Time and method of fertilizer application for *kharif* crops.
6. Recording bio-metric observations
7. Water management for different *kharif* crops.
8. Study of weed control methods in *kharif* crops (Rice, redgram, , cotton etc.)
9. Study of plant protection measures in *kharif* crops (Rice, cotton, etc,)
10. Methods of harvesting, yield recording and post harvest care.
11. Visit to seed production farm.
12. Visit to Integrated Farming system unit.
13. & 14. Visit to plant protection unit (Pests and diseases)
15. Visit to farm mechanization unit.
16. Preparation of Balance sheet.

Course No : AGRO 303
Course Title : **Geo-informatics and Nanotechnology for Precision Farming**
Credit hours : 2 (1+1)

THEORY

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

PRACTICALS

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

THEORY

Lec. No.	Topic/Lesson
1	Precision Agriculture: Concepts and techniques; their issues and concerns for Indian Agriculture
2	Geo-informatics – definition, concepts,; Tools and techniques; Applications of Geo-informatics and its use in Precision Agriculture
3	Crop discrimination and Yield monitoring – Spectral signatures, NDVI concept and principles, yield monitors, GPS receiver.
4	Soil mapping and fertilizer recommendation using geospatial technologies – Supervised and unsupervised mapping and classification
5	Spatial data and their management in GIS – Stages of GIS data modeling; graphic representation of spatial data.
6	Vector & Raster GIS models and their comparison; data base management systems; GIS data file management; database models and storage.

7	Remote sensing concepts and application in Agriculture – Principles; electromagnetic remote sensing process; electromagnetic spectrum; atmospheric interactions with electromagnetic radiation; remote sensing platforms and sensors; key elements of visual image interpretation; applications in agriculture.
8	Image processing and interpretation – Characters of digital image; preprocessing, corrections, image registration, enhancement, filtering & transformations; Image classification.
9	Global positioning system (GPS), components and its functions – Maps; classification and scale of maps; spatial referencing system; linkage between RS, GPS and GIS.
10	Introduction to Crop Simulation Models – Concepts and principles; Overview of DSSAT and APSIM; System Simulation models (CERES, ORYZA, AQUACROP) - their use for optimization of Agricultural Inputs
11	STCR approach for Precision Agriculture – Assessing, defining, monitoring and amending the variability in STCR approach.
12	Introduction/Historic developments and Fundamentals of Nano-science & Nano-technology – Nano-scale materials – definition and properties.
13	Natural nano-particles and their occurrence, manufacturing and characterization of nano-particles.
14	Nano-pesticides, nano-fertilizers, nano-sensors – Types and strategies for synthesis of nano-materials.
15	Use of nano-technology in tillage, seed ,water, fertilizer, plant protection for scaling up of farm productivity.
16	Nano-Biosensors, Nanotechnology in precision farming, Nanotech Delivery Systems for Pests (nano-pesticides), Nutrients (nano-fertilizers) and Plant Hormones - Bio-safety of nanoscale material – Environmental regulation of nano-materials.

PRACTICALS

S.No.	Topic/Lesson
1.	Introduction to GIS software
2.	Spatial data creation and editing
3.	Introduction to image processing software
4.	Visual and digital interpretation of remote sensing images.
5.	Generation of spectral profiles of different objects
6.	Supervised and unsupervised classification and acreage estimation
7.	Multispectral remote sensing for soil mapping
8.	Creation of thematic layers of soil fertility based on GIS
9.	Creation of productivity and management zones based on GIS
10.	Fertilizers recommendations based on VRT and STCR techniques
11.	Crop stress (Abiotic/Biotic) monitoring using geospatial technology
12	Use of GPS for agricultural survey
13	Formulation and characterization of nano-particles
14	Different nano-particles and its application in agriculture
15	Smart nano-scale systems for targeted delivery of nutrients and pesticides
16	Projects formulation and execution related to precision farming

REFRENCES

1. Aditya Kumar Singh and Ram Sakal Singh, 2011. Crop modeling for land use planning. Agrotech Publishing Academy, Udaipur.
2. Anji Reddy. M, 2008. Text book of Remote sensing and Geographical information systems (III edition). B.S. Publications, Hyderabad-95.
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4. Debashis Chakraborty and Rabi. N. Sahoo, 2009. Fundamentals of GIS. Viva Books, New Delhi – 02.
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Course No : Agro -304
Course Title : **Practical Crop Production-II *(Rabi Crops)***
Credit Hours: 1 (0+1)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

PRACTICALS

1. Crop planning in multiple cropping systems.
2. Field preparation and layout of experiment plots.
3. Seed treatment and nursery raising .
4. Sowing of crops in individual plots.
5. Time and method of fertilizer application for *rabi* crops.
6. Recording bio-metric observations
7. Water management for different *rabi* crops
8. Study of weed control methods in *rabi* crops
9. Study of plant protection measures in *rabi* crops
10. Methods of harvesting, yield recording and post harvest care.
11. Visit to seed production farm.
12. Visit to Integrated Farming system unit.
13. &14. Visit to plant protection unit (Pests and diseases)
15. Visit to farm mechanization unit.
16. Preparation of Balance sheet.

Course No. : AGRO- 305
Course Title : **Farming systems & Organic Farming for Sustainable Agriculture**
Credit Hours : 3(2+1)
Degree : B.Sc (Ag)

THEORY

Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment.

Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products.

PRACTICAL

Visit of IFS model in different agro-climatic zones of nearby state university/ institutes and farmers field. Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling.

OBJECTIVES

1. To impart fundamental principles of farming systems & organic farming towards sustainable agriculture to improve the economic conditions of the farmer.
2. Impart practical knowledge involved in vermicomposting, biofertilizers and other components of organic farming.

Lec. No.	Topic/Lesson
1	Modern agriculture- problems and its impact on agriculture and resources - Sustainable agriculture
2	Indicators of sustainability- adaptation and mitigation.
3	Conservation agriculture strategies in agriculture – soil degradation, water availability, climate change and its effect on agriculture, adaptation and mitigation
4	Management of natural resources -HEIA, LEIA and LEISA and its techniques for sustainability.
5	Farming System-scope, importance, and concept – related terminology.
6	Types and systems of farming system and factors affecting types of farming.
7	Farming system- components and their importance and maintenance.
8	Cropping systems and patterns-multiple cropping system- Efficient cropping system and their evaluation.
9	Integrated farming system-historical background-objectives and characteristics.
10	Components of IFS and its advantages - Site specific development of IFS model for different agro-climatic zones in rainfed, irrigated and irrigated dry conditions
11	Resource use efficiency and optimization techniques - Resource cycling and flow of energy in different farming system.
12	Farming system and environment- Conservation of natural resources and maintenance of biodiversity.
13	Allied enterprises and their importance - complementary and competitive interactions - Dairy, Sheep and Goat rearing – Aquaculture
14	Allied enterprises and their importance- complementary and competitive interactions- Poultry , Apiculture, sericulture and mushroom cultivation.
15	Tools for determining production and efficiencies in cropping and farming system.
16	Organic farming- Definition- principles and its status and scope in India.
17	Milestones in organic farming movement in the World and in India - its comparison with conventional system.
18	Initiatives taken by Government (Central/State) - NGOs and other organizations for promotion of organic agriculture.
19	Organic ecosystem and their concepts - Soil and water management- soil organic matter and humus- Their physical, chemical and biological properties.
20	Choice of crops and varieties in organic farming – Conversion of soil to organic farming.
21	Organic nutrient management-types of organic manures - biofertilizers- efficient use of organic sources of nutrients.
22	Organic nutrient resources and its fortification- Constraints of nutrient use in organic farming.
23	Weed management in organic farming – cultural-mechanical-Biological –Bio herbicides.
24	Pest management in organic farming- different components – parasites- predators, microbial pesticides (Bio) -resistant varieties and pheromones.
25	Disease management in organic farming – cultural, mechanical, biological- biofungicides.
26	Organic production package of important field crops- Rice, sorghum, fingermillet, cotton, groundnut and soybean.
27	Operational structure of NPOP- Accreditation agencies in the World and India- Role of APEDA and IFOAM
28	Accreditation-– standards- procedure of accreditation
29	Certification-Agencies/organizations. – standards- procedure for certification.

30	Post harvest processing- labeling and sanitation procedures in organic farming.
31	Marketing and export potential of organic products- Opportunities and constraints
32	Impact of organic farming on food security , environment and health .

PRACTICALS

Pra. No.	Topic/Lesson
1	Components of organic ecosystem – soil, water, environment and biodiversity
2	Vermicompost and enriched vermicompost methods from crop residues and organic wastes
3	Biofertilizers production techniques and its application methods
4	Biopesticides (Trichoderma , BT, NPV) and their quality standards and its application methods
5	Preparation of neem products and other botanicals and their use for pest and disease control.
6	Indigenous technology knowledge (ITK) for nutrient and weed management
7	Indigenous technology knowledge (ITK) for pest and disease management
8	Study of quality parameters of organic products.
9	Visit to organic farm and cost economics of organic production system
10	Visit to organic farmer field.
11	Grading, labelling and packaging of organic products.
12	Visit to organic outlet
13	Visit to Agroforestry unit.
14	Visit to IFS unit in different agro-climatic zones of nearby states University/ institutes and farmers field.
15	Visit to Dairy unit/ poultry unit
16	Visit to Mulberry unit/ mushroom unit

REFRENCES

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5. Gupta, H.M .2005, Organic farming and sustainable Agriculture, ABD Publishers, Udaipur.
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GENETICS & PLANT BREEDING

Course No : GPBR-111
Course Title : Fundamentals of Genetics
Credit Hours : 3(2+1)
Degree : B.Sc (Ag)

A) THEORY LECTURE OUTLINES

Lec. No.	Topic
1.	Pre Mendelian concepts and Post Mendelian concepts of heredity
2.	Mendelian principles of heredity. Law of segregation
3.	Law of independent assortment
4.	Exceptions to Mendel's 1st law. Dominance relationships
5.	Exceptions to Mendel's 2nd law. (Law of incomplete dominance and interaction of factors)
6.	Epistatic gene interactions (3 interactions with examples)
7.	Epistatic gene interactions
8.	Cell division, cell cycle, mitosis
9.	Meiosis
10.	Probability and chi-square
11.	Multiple alleles examples
12.	Blood group genetics, pleiotropism and pseudo alleles
13.	Sex determination mechanisms
14.	Sex determination mechanisms
15.	Sex linkage, sex limited and sex influenced traits
16.	Linkage – its estimation, two point test cross
17.	Crossing over mechanisms
18.	Three point test cross, chromosome mapping
19.	Structural changes in chromosomes Deletions, Duplications and inversions
20.	Translocations, examples of all structural alternations
21.	Mutations and classifications
22.	Mutagenic agents, methods of inducing mutations
23.	CLB techniques and induction of mutations

24.	Qualitative and quantitative traits
25.	Polygenes, continuous variations, multiple factor hypothesis
26.	Cytoplasmic inheritance
27.	Genetic disorders
28.	Nature and structure of DNA, RNA
29.	Replication of genetic material, DNA and RNA
30.	Protein synthesis, transcription
31.	Translational mechanisms of genetic material gene concept, gene structure
32.	Gene function and regulation. Lac operon and top operators

B) PRACTICAL LECTURE OUTLINES

Lec. No.	Topic
1.	Study of microscope. Study of cell structure
2.	Study of cell organelles
3.	Study of cellorganelles
4.	Experiments on monohybrid
5.	Experiments on Dihybrid
6.	Experiments on trihybrid
7.	Test cross, backcross, experiments on gene interactions (monohybrid)
8.	Experiments on Study of cell gene interactions (Di hybrid)
9.	Experiments on epistatic gene interactions
10.	Experiments on epistatic gene interactions 1
11.	Experiments on probability
12.	Experiments on chi-square test
13.	Determination of linkage and cross over analysis through two point test cross data
14.	Determination of linkage and cross over analysis through three point test cross data
15.	Sex linked inheritance in *Drosophilla*
16.	Study of models on DNA and RNA structure

References

Gupta, P.K. 1985. *Cytology, Genetics and Cytogenetics*. Rastogi Publications, Meerut.

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Verma, P.S. and Agarwal, V.K. 2005. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand and Co., New Delhi.

Course No : GPBR 211
Course Title : **Fundamentals of Plant Breeding**
Credit hours : 3 (2+1)

THEORY LECTURE OUTLINES

Lec. No.	Topic Details
1	Plant Breeding - Definition, Concept, Nature, Aims & Objectives and Role. Major Achievements and future prospects of plant breeding
2	History and Development of Plant Breeding - Scientific contributions of eminent scientists - landmarks in plant breeding
3	Genetics in relation to plant breeding – Modes of reproduction – Asexual reproduction (vegetative reproduction and apomixis) and sexual reproduction – their classification and significance in plant breeding – Modes of pollination – classification of crop species on the basis of mode of pollination – self-pollination – mechanisms promoting self and cross pollination
4	Self-incompatibility – classification – heteromorphic, homomorphic, gametophytic and sporophytic systems of incompatibility – mechanisms of self-incompatibility – Relevance of self-incompatibility – methods to overcome self-incompatibility – advantages and disadvantages – utilization in crop improvement
5	Male sterility – different types – genetic, cytoplasmic and cytoplasmic genetic male sterility – inheritance and maintenance – Utilization of male sterile lines in hybrid seed production – their limitations, advantages and disadvantages
6	Genetic consequences of self-pollination, cross-pollination and often cross-pollinated crops – Cultivar options – Method of plant breeding – classification of plant breeding methods – methods of breeding for self-pollinated, cross-pollinated and asexually propagated species – brief account of breeding methods
7	Plant Introduction - Types, history, purpose, procedure, merits and demerits - plant introduction agencies in India - NBPGR and its' activities - germplasm collections, genetic erosion, gene sanctuaries - centres of origin/diversity
8	Biometrical genetics - definition, qualitative and quantitative characters, role of environment on quantitative characters - biometrical techniques used in plant breeding - components of genetic variation - additive, dominance and epistatic variance - differences between additive and dominance variance
9	Selection – natural and artificial selection – basic principles of selection – basic characteristics and

	requirements of selection – selection intensity – selection differential – heritability – genetic advance
10	Genetic basis and breeding methods in self pollinated crops – Mass selection – procedure for evolving a variety by mass selection – modification of mass selection – merits, demerits and achievements
11	Genetic basis of pure line selection– general procedure for evolving a variety by pure line selection – merits, demerits and achievements – comparison between mass and pure line selection – Johannsen's pure line theory and its concepts and significance – origin of variation in pure lines – characters of pure lines – progeny test
12	Hybridization – aims and objectives – types of hybridization – pre-requisites for hybridization – procedure / steps involved in hybridization
13	Handling of segregating generations – pedigree method – procedure – modifications of pedigree method – merits, demerits and achievements
14	Handling of segregating generations – bulk method – procedure – merits, demerits and achievements of bulk method – comparison between pedigree and bulk method – single seed descent method
15	Back cross method - requirements and applications, procedure for transfer of single dominant gene, recessive gene - transfer of two or more characters (simultaneous, step-wise, simultaneous but separate transfer)
16	Back cross method - merits, demerits and achievements, comparison between pedigree and back cross methods - Multiline variety - definition, characteristics, development of multiline varieties and achievements
17	Population genetics - concepts, Hardy Weinberg law, factors affecting equilibrium frequencies in random mating populations
18	Heterosis - heterosis and hybrid vigour, luxuriance, brief history in self and cross pollinated crops, types, manifestations of heterosis, genetic basis - dominance, over dominance and epistasis hypotheses, objections and their explanations
19	Heterosis - Comparison between dominance and over dominance hypothesis - physiological bases of heterosis - commercial utilization of heterosis in different crops
20	Inbreeding depression - brief history, effects of inbreeding depression, degrees of inbreeding depression – procedure for development of inbred lines and their evaluation Composites and synthetics - production procedures, merits and demerits, achievements, factors determining the performance of synthetics, comparison between synthetics and composites
21	Population improvement – selection without progeny testing – selection with progeny testing – progeny selection – merits and demerits of progeny selection – line breeding – achievements – Recurrent selection – different types – detailed procedure of simple recurrent selection and brief description of other recurrent selection methods – conclusion on the efficiency of different selection schemes
22	Methods of breeding for vegetatively propagated crops – clone – characteristics of asexually propagated crops – characteristics of clones – importance of a clone – sources of clonal selection – procedure – advantages and disadvantages – problems in breeding asexually propagated crops – genetic variation within a clone – clonal degeneration – achievements – comparison among clones, purelines and inbreds
23	Wide hybridization – history – objectives – barriers to the production of distant hybrids – techniques for production of distant hybrids – applications of wide hybridization in crop improvement – sterility in distant hybrids – cytogenetic, genetic and cytoplasmic bases of sterility – limitations and achievements
24	Polyploidy – autopolyploids – origin and production – morphological and cytological features of

	autopolyploids – applications of autopolyploidy in crop improvement – limitations of autopolyploidy – segregation in autotetraploids – allopolyploidy – morphological and cytological features of allopolyploids – applications of allopolyploidy in crop improvement – limitations of allopolyploidy
25	Mutation breeding – spontaneous and induced mutations – characteristic features of mutations – procedure of mutation breeding – applications – advantages, limitations and achievements
26	Breeding for resistance to biotic stresses – disease resistance – mechanisms of disease resistance in plants (disease escape, tolerance, resistance, immunity and hypersensitivity) – causes of disease resistance – genetic basis of disease resistance – sources of disease resistance – breeding methods for disease resistance – achievements – Insect resistance – mechanism of insect resistance in plants (non preference, antibiosis, tolerance and avoidance) – nature of insect resistance – genetics of insect resistance – horizontal and vertical – genetics of resistance – sources of insect resistance – breeding methods for insect resistance – problems in breeding for insect resistance – achievements
27	Breeding for resistance to abiotic stresses – drought resistance – mechanisms of drought resistance (drought escape, avoidance, tolerance, and resistance) – features associated with drought resistance – sources – breeding methods– limitations – achievements; breeding for resistance to water logging – effects of water logging mechanism of tolerance – ideotype for flooded areas – breeding methods – Breeding for salt tolerance – response of plants to salinity – symptoms – mechanisms – breeding methods – problems – achievements; Cold tolerance – chilling resistance – effects of chilling stress on plants – mechanism – sources – selection criteria –freezing resistance – effects of freezing – mechanism of freezing resistance – genetic resources for freezing tolerance – selection criteria – problems in breeding for freezing tolerance
28	Molecular markers – Definition – Brief description of different types of molecular markers, RFLP, AFLP, RAPD and SSR markers– Importance, procedure and applications
29	DNA finger printing - procedure, applications - QTL mapping and MAS and its applications in crop improvement,
30	Pre breeding – Definition, Concept, need, methods and factors affecting pre breeding, Participatory Plant Breeding – Concept Relevance, activities and goals of PPB, kinds of PPB, perspectives and prospects, advantages, disadvantages and limitations.
31	Intellectual Property Rights (IPR) and Patents – Types, protection of IPR, trade secret, copy rights, Plant Variety Protection and Geographical Indications, Plant Breeders' Rights – benefits and disadvantages
32	Protection of Plant Varieties and Farmers' Rights Act – Introduction, types of varieites, NDUS, salient features, National Gene Fund, Awards and Recognitions

PRACTICAL LECTURE OUTLINES

Lec. No.	***Topic Details***
1.	Plant Breeder's kit for hybridization, study of germplasm of various crops
2.	Study of megasporogenesis and microsporogenesis, fertilization and life cycle of an angiospermic plant
3.	Study of floral structure of self pollinated crops – Floral biology, anthesis, pollination, selfing and crossing techniques in Rice
4.	Study of floral structure of cross pollinated crops – Floral biology, anthesis, pollination, selfing and crossing techniques in millets – Maize, sorghum and pearl millet.
5.	Floral biology, anthesis, pollination, selfing and crossing techniques in oilseeds and pulses –

	sunflower and redgram
6.	Types of Male Sterility – Genetic, Cytoplasmic and Cytoplasmic Genetic Male Sterility, transfer of male sterile cytoplasm and restorer gene to a normal strain
7.	Types of self incompatibility, gametophytic and sporophytic incompatibility.
8.	Terminology in backcross method, transfer of a dominant gene and recessive gene for disease rust resistance through the backcross method in self pollinated crops
9.	Handling of segregating populations – Pedigree, Bulk and Single seed decent methods.
10.	Consequences of inbreeding on genetic structure of resulting populations – Types of recurrent selection, simple RS, RS for GCA & SCA and reciprocal recurrent selection
11.	Field layout of experiments – Designs used in plant breeding experiments – Analysis of Randomized Block Design (RBD) – Field trails – maintenance of records and registers.
12.	Basic statistics, commonly used in plant breeding – Mean, range, variance, Phenotypic Coefficient of Variation (PCV), Genotype Coefficient of Variation (GCV), Heritability and genetic advance.
13.	Estimation of Heterosis, Heterobeltiosis and Standard heterosis – Prediction of performance of double cross hybrids.
14.	Estimation of General combining ability, specific combining ability, variances and effects.
15.	Visit to RARS / Local / ICAR stations to acquaint about the mode of pollination in a given crop and extent of natural out crossing
16.	Visit to Regional Agricultural Research Station (RARS) / Local Research Station / Indian Council of Agricultural Research (ICAR) Institute to acquaint about the handling of segregating generations – Pedigree, bulk and back cross methods – Preliminary Yield Trail (PYT), Advanced Varietal Trail (AVT) and other methods.

REFERENCES

- Singh, B.D. 2006. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
- Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and Sons, New York.
- Phundan Singh, 2006. Essentials of Plant Breeding. . Kalyani Publishers, New Delhi.
- Poehlman, J.M. and Borthakur, D. 1995. Breeding Asian Field Crops. Oxford and IBH Publishing Co., New Delhi.
- Sharma, J.R.1994. Principles and Practice of Plant Breeding. Tata McGraw Hill Publishing Company Ltd., New Delhi.

Course No. : GPBR-212
Course Title : **Principles of Seed Technology**
Credits Hours : 3 (1+2)

Theory Lecture Outlines

Lec. No.	Lecture Outline
1.	Introduction to seed technology – definitions – concept, role and goals of seed technology – differences between scientifically produced seed and grain used as seed.
2.	Deterioration of crop varieties – Factors responsible for loss of genetic purity – Maintenance of genetic purity during seed production – Safeguards for maintenance of genetic purity
3.	Definition – Characters of good quality seed – Factors affecting seed quality – Classes of seed – Nucleus, Breeder foundation and certified seed.
4.	Seed certification – Phases of seed certification – Procedure for seed certification – Field inspection
5.	Foundation and certified seed production of important cereal crops
6.	Foundation and certified seed production of important pulse crops
7.	Foundation and certified seed production of important oilseed crops
8.	Foundation and certified seed production of important fodder crops
9.	Foundation and certified seed production of important vegetables
10.	Seed drying – methods of seed drying – sun drying – forced air drying – principle of forced air drying – Seed drying – heated air drying system – management of seed drying operations
11.	Seed treatment its importance – Method of application and seed packing
12.	Seed storage – general principles – Stages and factors affecting – Seed longevity during storage – Measures for pest and disease control during storage
13.	Seed marketing – Structure and organization – Sales generation activities, promotional media – Factors affecting seed marketing – Role of WTO and OECD in Seed Marketing
14.	Varietal identification through Grow Out Test (GOT) and electrophoresis
15.	Molecular biochemical test – Detection of genetically modified crops – Transgene contamination in non-GM crops – GM crops and organic seed production.
16.	Seed Act 1966 – main features of the Seed Act, 1966 – Seed act enforcement. Duties and powers of seed inspectors, offences and penalties. Seed control order 1983.

Practical Lecture Outlines

Lec. No.	Lecture Outline
1.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in rice crop
2.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in wheat crop
3.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in maize crop

4.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in sorghum crop
5.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in pearl millet crop
6.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in pigeon pea crop
7.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Mung and Urd bean crops
8.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Lentil, Lathyrus, Rajmash and Pea crops
9.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Bengal gram crop
10.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Groundnut and soybean crops
11.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Castor crop
12.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Rapeseed and Mustard crops
13.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in sunflower crop
14.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Sesame and Safflower crops
15.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Cotton, Jute and Mesta crops
16.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Berseem, Lucerne and Other fodder crops
17.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in sugarcane crop
18.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in tobacco crop
19.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in vegetable crops – Tomato, Brinjal, Chillies Okra, cluster beans
20.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in Leaf, root, and stem vegetables – Spinach, Amaranthus, Methi, Radish, Carrot, Onion and Potato
21.	Seed production techniques of nucleus seed, breeder seed, foundation seed, certified seed in vegetable crops – Ridge gourd, Bottle gourd, Cucumber, Muskmelon, Watermelon, Cauliflower, Cabbage and Knol-khol
22.	Seed sampling and testing – Principles and procedures
23.	Physical Purity analysis of field crops and vegetable crops.
24.	Germination analysis of field crops and vegetable crops
25.	Seed viability test of field crops and vegetable crops
26.	Moisture tests of field crops and vegetable corps

27.	Seed and seedling vigour tests of field crops and vegetable crops
28.	Genetic purity test – Grow out test and electrophoresis
29.	Seed certification – Procedure, Field inspections, preparation of field inspections reports
30.	Visit to seed production farms
31.	Visit to seed testing laboratory
32.	Visit to seed processing plant

REFERENCES

1. An introduction of Seed Technology — Thomson J R 1979, Leonard Hill, London
2. Techniques in Seed Science and Technology — Agarwal P K and Dadlani M 1986. South Asian Publishers, New Delhi
3. Principles of Seed technology — Agarwal P K 1994. ICAR, New Delhi
4. Seed Technology — Agarwal R L 1996. Oxford and IBH Publication Co., New Delhi
5. Seed Technology — Dhirendra Khare and Mohan S. Bhale. 2007. Scientific Publishers (India), Jodhpur.

Course No : GPBR 311
Course Title : **Crop Improvement – I (*Kharif* Crops)**
Credit hours : 2 (1+1)

THEORY LECTURE OUTLINES

Lec. No.	Topic Details
1.	Introduction-definition, aim, objectives and scope of Crop Improvement - Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops.
2	Centers of origin-Law of homologous series- types of centres of diversity-gene sanctuaries-genetic erosion-main reasons of genetic erosion-extinction-introgression-gene banks-types of gene banks-distribution of crop species
3	Centres of origin, distribution of species, wild relatives in different cereals – Rice, Maize
4	Centres of origin, distribution of species, wild relatives in different millets - Sorghum, Pearl millet and Ragi
5	Centres of origin, distribution of species, wild relatives in different pulses – Redgram, Urdbean, Mungbean and Soybean
6	Centres of origin, distribution of species, wild relatives in different Oilseeds – Ground nut, Sesamum and Castor
7	Centres of origin, distribution of species, wild relatives in different fodder crops – Napier grass and Para grass
8	Centres of origin, distribution of species, wild relatives in different fibre crops/cash crops – Cotton and Tobacco
9	Centres of origin, distribution of species, wild relatives in different vegetable crops – Tomato, Brinjal, Chilli, Bhendi
10	Centres of origin, distribution of species, wild relatives in different horticultural crops – Mango, Banana, Guava and Papaya
11	Study of genetics of qualitative and quantitative characters
12	Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops
13	Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)
14	Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops
15	Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea,
16	Ideotype concept and climate resilient crop varieties for future – Breeding for drought, salinity, water logging, high temperature and low temperature tolerant varieties in different crops

PRACTICAL LECTURE OUTLINES

Lec. No.	Topic Details
1	Floral biology – Types of inflorescence, flower structure of monocots and dicots, floral formula and diagram
2	Emasculation and hybridization techniques in Rice and Maize
3	Emasculation and hybridization techniques in Sorghum, Pearl millet and Ragi
4	Emasculation and hybridization techniques in Pigeon pea, urdbean, mungbean and cowpea
5	Emasculation and hybridization techniques in Soybean, Groundnut and Sesamum
6	Emasculation and hybridization techniques in Castor, Cotton and Tobacco
7	Maintenance breeding of different kharif crops – Rice, Maize, Sorghum, Redgram, Grundnut
8	Maintenance breeding of different kharif crops – Castor, Cotton and Tobacco
9	Handling of germplasm and segregating generations by different methods – Pedigree, Bulk and Single Seed Descent methods
10	Study of field techniques for varietal seed production and hybrid seed production in Rice, Maize
11	Study of field techniques for varietal seed production and hybrid seed production in Sorghum and Redgram
12	Study of field techniques for varietal seed production and hybrid seed production in Castor and Cotton
13	Estimation of heterosis, inbreeding depression and heritability
14	Layout of field experiments
15	Study of quality characters, donor parents for different traits in different kharif crops
16	Visit to Seed production plots – AICRP plots for different field crops

REFERENCES

- Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and Sons, New York.
- Copra V.L. and Paroda R.S. 1986. Approaches for Incorporating Salinty Resistance in Crop Plants. Oxford and IBH Publishing Co., New Delhi.
- Kalloo, G. 1994. Vegetable Breeding. Panima Educational Book Agency, New Delhi.
- Kumar, N. 2006. Breeding of Horticultural Crops – Principles and Practices. New India Publishing Agency, New Delhi.
- Phundan Singh, 2006. Essentials of Plant Breeding. . Kalyani Publishers, New Delhi.
- Poehlman, J.M. and Borthakur, D. 1995. Breeding Asian Field Crops. Oxford and IBH Publishing Co., New Delhi.
- Sharma, J.R.1994. Principles and Practice of Plant Breeding. Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Singh, B.D. 2006. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.

Course No : GPBR 312
Course Title : **Crop Improvement – II (*Rabi* Crops)**
Credit hours : 2 (1+1)

THEORY LECTURE OUTLINES

Lec. No.	Topic Details
1	Introduction-definition, aim, objectives and scope of Crop Improvement - Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops.
2	Centers of origin-Law of homologous series- types of centres of diversity-gene sanctuaries-genetic erosion-main reasons of genetic erosion-extinction-introgression-gene banks-types of gene banks-distribution of crop species
3	Centres of origin, distribution of species, wild relatives in different cereals – Wheat, Oat and Barley
4	Centres of origin, distribution of species, wild relatives in different pulses Chickpea, Lentil, Field pea
5	Centres of origin, distribution of species, wild relatives in different Oilseeds – Rapeseed and Mustard, Sunflower
6	Centres of origin, distribution of species, wild relatives in different fodder crops – Berseem and Leucerne
7	Centres of origin, distribution of species, wild relatives in cash crops - Sugarcane
8	Centres of origin, distribution of species, wild relatives in different vegetable crops – Cucumber, Potato
9	Centres of origin, distribution of species, wild relatives in different horticultural crops – Rose, Chrysanthmum
10	Centres of origin, distribution of species, wild relatives in different horticultural crops – Marigold and Gerbera
11	Study of genetics of qualitative and quantitative characters
12	Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops – Wheat, Chickpea, Sunflower, Sugarcane
13	Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)
14	Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops
15	Hybrid seed production technology in Wheat, Sunflower, Rapeseed and Mustard
16	Ideotype concept and climate resilient crop varieties for future – Breeding for drought, salinity, water logging, high temperature and low temperature tolerant varieties in different crops

PRACTICAL LECTURE OUTLINES

Lec. No.	Topic Details
1	Floral biology – Types of inflorescence, flower structure in different Rabi crops
2	Emasculation and hybridization techniques in Wheat, Oat and Barley
3	Emasculation and hybridization techniques in Chickpea, Lentil, Field pea
4	Emasculation and hybridization techniques in Rapeseed and Mustard, Sunflower
5	Emasculation and hybridization techniques in Potato, Berseem and Sugacane
6	Maintenance breeding of different Rabicrops – Sunflower
7	Handling of germplasm and segregating generations by different methods – Pedigree, Bulk and Single Seed Descent methods
8	Handling of germplasm and segregating generations by different methods – Pedigree, Bulk and Single Seed Descent methods
9	Study of field techniques for varietal seed production and hybrid seed production in Sunflower, Chickpea
10	Study of field techniques for varietal seed production and hybrid seed production in Rapeseed and Mustard, Potato and Sugarcane
11	Estimation of heterosis, inbreeding depression and heritability
12	Layout of field experiments
13	Study of quality characters, donor parents for different traits in different Rabi crops
14	Study of quality characters, donor parents for different traits in different Rabi crops
15	Visit to Seed production plots
16	Visit to AICRP plots for different field crops

REFERENCES

- Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and Sons, New York.
- Copra V.L. and Paroda R.S. 1986. Approaches for Incorporating Salinty Resistance in Crop Plants. Oxford and IBH Publishing Co., New Delhi.
- Kalloo, G. 1994. Vegetable Breeding. Panima Educational Book Agency, New Delhi.
- Kumar, N. 2006. Breeding of Horticultural Crops – Principles and Practices. New India Publishing Agency, New Delhi.
- Phundan Singh, 2006. Essentials of Plant Breeding. . Kalyani Publishers, New Delhi.
- Poehlman, J.M. and Borthakur, D. 1995. Breeding Asian Field Crops. Oxford and IBH Publishing Co., New Delhi.
- Sharma, J.R.1994. Principles and Practice of Plant Breeding. Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Singh, B.D. 2006. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.

Course No. : GBPR - 313
Course Title : **Intellectual Property Rights (N)**
Credits : 1 (1+0)

THEORY LECTURE OUTLINES

Lec. No.	Topic
1.	Introduction and meaning of intellectual property
2.	brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection
3.	Madrid protocol, Berne Convention, Budapest treaty, etc.
4.	Types of Intellectual Property and legislations covering IPR in India
5.	Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.
6.	Patents Act 1970 and Patent system in India
7.	Patentability, process and product patent, filing of patent, patent specification, patent claims
8.	Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database
9.	Origin and history including a brief introduction to UPOV
10.	For protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India
11.	Plant breeders rights
12.	Registration of plant varieties under PPV&FR Act 2001
13.	breeders, researcher and farmers rights
14.	Traditional knowledge-meaning and rights of TK holders.
15.	Convention on Biological Diversity
16.	International treaty on plant genetic resources for food and agriculture (ITPGRFA).

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

1	Course No.	**SSAC - 121**
2	Course Title	**Fundamentals of Soil Science**
3	Credits Hours	3 (2+1)
4	General Objectives	To impart knowledge to the students on the Fundamentals of Soil Science and impart skills in collecting and analyzing soils for basic physical, physicochemical and chemical properties for using it as a medium for plant growth.
5	Specific objective: a) Theory:	By the end of the course, the B.Sc.(Ag) students will be able to: i. Understand the fundamentals and principles of Soil Science ii. Explain how different soils are formed and how does soils act as a medium for plant growth. iii. Explain soils of India and Land use capability, soil pollution and its effect on crop and mitigation of soil pollution.
6	b) Practical:	By the end of the practical exercises , the students will be able to: i. Identify important rocks , minerals and soils ii. Describe soil profiles iii. Collect a representative soil sample from field and iv. Analyze the soils for basic physical, physico-chemical & chemical properties.

Lecture Outline

Lec. No.	Lecture outline Credits : 3 (2+1)
1	Introduction – Evolution and origin of earth, Soil, land and landscape, functions of soil, branches of Soil Science. Concepts of Soil, Spheres of Earth and composition of earth crust. Pedological and edaphalogical concepts of soil.
2&3	Rocks- Formation, Classification -igneous rocks , their classification based on mode of origin and silica content, Sedimentary rocks – formation , classification, Metamorphic rocks – formation, agents causing metamorphosis and classification, Description of important rocks.
4&5	Minerals – formation, classification based on origin, quantity, specific gravity and chemical composition, primary minerals– quartz, feldspars, micas, amphiboles, pyroxenes- weatherability of primary minerals. Non – silicate minerals- P, Ca, Mg, S and micronutrient containing minerals, secondary silicate minerals-basic structural units.
6&7	Weathering of rocks and minerals – types of weathering –physical – agents and their role, chemical – weathering processes and biological weathering – role of flora and fauna in weathering.
8	Soil formation – soil forming factors – Parent material – classification based on their mode of transport and deposition, active and passive factors – their role in soil formation.
9	Soil forming or pedogenic processes- basic or fundamental processes –eluviation, illuviation and humification.
10	Specific pedogenic processes – calcification, podzolization, laterization, salanization, alkalization, pedoturbation, Gleization.

11	Concepts and definition of soil, soil profile – description of a theoretical soil profile- master horizons and subordinate horizons. Differences between surface and subsurface soil. Components of soil - mineral matter, organic matter, water and air.
12	Soil genesis, historical developments, concepts of soil genesis, Soil classification- early systems of classification. Soil taxonomy – purpose, salient features, advantages of soil taxonomy, diagnostic horizons- epipedons and endopedons.
13	Soil orders, sub order, great group family and series – nomenclature according to soil taxonomy. Important soil groups of India – alluvial soil, black soil, red soil, laterite soils and coastal sands. Soil of India and Telangana.
14	Soil as a three phase system – Soil physical properties – nature and properties of soil separates, soil texture – definition and various systems of classification of soil texture.
15	Soil texture -mechanical analysis – methods, Stoke's law – assumptions and limitations – Importance and significance of soil texture in agriculture.

1	Course No.	SSAC- 221
2	Course Title	**Manures, Fertilizers and Soil Fertility Management**
3	Credits Hours	3 (2+1)
4	Semester / Year	IV semester
5	Academic level of entry	2nd year B.Sc. (Ag)
6	General Objectives	To impart to the student thorough understanding of plant nutrients, soil fertility, nutrient management, manures and fertilizers so that he/she can describe influence of soil biological, physical and chemical properties and their interactions on nutrient availability to plant and identify soil, plant and nutrient management practices that maximize productivity and profitability using suitable manures and fertilizers while maintaining or enhancing the soil and environmental quality.
7	Specific objective A) Theory	At the end of the course, the student will be able to (i) Describe how plants absorb plant nutrients and how the soil system supply these nutrients (ii) Identify and describe plant nutrient deficiency symptoms and methods used to quantify nutrient problems (iii) Quantify application rates of nutrients and needed to correct plant nutrition problems in the field (iv) Identify different sources of nutrients and efficient use of these nutrients and (v) Describe, evaluate soil and nutrient management practices that either impair or sustain soil productivity and environmental quality
	B) Practicals	At the end of the course, the student will be able to : (i) Estimate the soil fertility status of soils (ii) Estimate the nutrient contents of plants (iii) Estimate the nutrient contents in manures &to detect the adulteration in fertilizers

THEORY LECTURE OUTLINES

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. Fertilizer recommendation approaches. Integrated nutrient management.

Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

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. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Lecture No.	Topic
1.	Introduction – Definition and importance of organic manures in improving soil properties – Differences between organic manures and fertilizers - Classification of organic manures
2.	Preparation of FYM (collection and storage) – Properties (nutrient contents) of FYM and factors affecting quality of FYM
3.	Compost – preparation of compost from agricultural wastes – urban compost preparation - Vermicompost – preparation and properties
4.	Green manuring – Green manuring *in situ* and Green leaf manuring – criteria for selection of crops – crops suitable – advantages – disadvantages
5.	Concentrated organic manures – preparation and nutrient contents of animal and plant origin manures
6.	Classification of fertilizers with examples - Nutrient content and properties of nitrogenous fertilizers - ammonia, ammonium hydroxide, ammonium sulphate
7.	Nutrient content and properties of nitrogenous fertilizers - ammonium nitrate, calcium ammonium nitrate, urea. Urea super granules – slow release N fertilizers - coated urea – nitrification inhibitors
8.	Nutrient content and properties of phosphatic fertilizers – Rock phosphate, SSP, TSP, Basic slag –Nutrient content and properties of potassic fertilizers – MOP, potassium sulphate
9.	Secondary and micronutrient fertilizers – nutrient contents – Complex fertilizers – incomplete and complete complex fertilizers - properties and nutrient contents of MAP, DAP, UAP, nitrophosphates and complete complex fertilizers
10.	Nano fertilizers – definition - fertilizers available – nutrient contents and properties. Amendments – amendments for acid soils and alkali soils – examples and mode of action.
11.	Fate and effect of application of N, P, K fertilizers to soil with chemical reactions – Calculations for application of fertilizers and manures to soil for crops
12.	Biofertilizers – classification with examples – constraints for use in agriculture – biofertilizers used for different crops/situations
13.	Introduction to soil chemistry & fertility–their importance in crop production–concept of soil fertility & soil productivity-Arnon's criteria of essentiality of nutrients
14.	Essential, functional and beneficial elements – classification of essential nutrients- forms of nutrients in soils and ionic forms of nutrient uptake by plants.
15.	Mechanisms of nutrient transport to plants – mass flow, diffusion, root interception, cation exchange
16.	Nitrogen chemistry– functions, deficiency and toxicity symptoms of nitrogen in plants – corrective measures - nitrogen cycle
17.	Nitrogen transformations in soil – mineralisation – immobilization - ammonium fixation – nitrification – denitrification - nitrogen fixation
18.	Phosphorous chemistry - functions, deficiency and toxicity symptoms of phosphorous in plants – phosphorous cycle – phosphorous fixation in soils – forms and factors affecting phosphorous fixation in soils

19.	Potassium chemistry – functions and deficiency symptoms of potassium in plants - potassium fixation in soils – factors affecting potassium fixation in soils – luxury consumption of potassium
20.	Calcium and magnesium chemistry – functions and deficiency symptoms in plants- corrective measures – factors affecting their availability to plants
21.	Sulphur chemistry – functions and deficiency symptoms in plants – corrective measures – sulphur transformation in soils – mineralisation, immobilization – factors affecting sulphur availability in soils
22.	Micronutrients – sources, forms and content in soils – critical limits in soils and plants - functions, deficiency and toxicity symptoms in plants for zinc, iron, manganese and copper– corrective measures
23	Cationic micronutrient –chemistry- pools in soils- factors affecting their availability- predisposing factors for occurrence of micronutrient deficiencies in soils and plants
24 &25.	Boron and Molybdenum -chemistry – content and forms in soils – critical limits in soils and plants – factors affecting availability - functions – deficiency and toxicity symptoms – corrective measures Chlorine & beneficial nutrients–role in plant nutrition – sources of supply to plants
26.	Soil fertility evaluation – approaches – using nutrient deficiency symptoms for evaluation – soil testing objectives – chemical methods of estimating available nutrients
27.	Plant analysis – rapid tissue tests – diagnosis and recommendation integrated system (DRIS) – indicator plants
28& 29.	Biological methods of soil fertility evaluation – microbiological methods – Sacket and Stewart technique, Mehlich technique, *Cunninghamella* plaque method and Mulder' *Aspergillus niger* test, Pot culture test – Neubauer's seedling method – A value
30.	Fertilizer recommendation approaches–soil test based fertilizer recommendation-Integrated nutrient management-Definition & components–critical nutrient concept
31.	Nutrient use efficiency – soil, plant and management factors influencing use efficiency – improving nutrient use efficiency for NPKS and Zn fertilizers
32.	Source, method and time of nutrient application under irrigated and rainfed conditions

PRACTICAL

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of soil organic carbon, Estimation of alkaline hydrolysable N in soils. Estimation of soil extractable P in soils. Estimation of exchangeable K; Ca and Mg in soils . Estimation of soil extractable S in soils.. Estimation of DTPA extractable Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants.

PRACTICAL LECTURE OUTLINES

S. No.	Experiment
1.	Introduction of analytical instruments and their principles – pH meter and Electrical Conductivity meter
2.	Introduction of analytical instruments and their principles –flame photometer, colorimeter/spectrophotometer and atomic absorption spectrophotometer
3.	Estimation of available nitrogen content of soils
4.	Estimation of nitrogen content in organic manures
5.	Estimation of available phosphorous content of soils
6.	Estimation of available potassium content of soils
7.	Estimation of available sulphur content of soils
8.	Estimation of exchangeable calcium and magnesium in soils
9.	Estimation of available micronutrients in soils
10.	Collection of plant samples and digestion of plant samples
11.	Estimation of nitrogen content of plants
11.	Estimation of phosphorous content of plants
12.	Estimation of potassium content of plants
13.	Estimation of sulphur content of plants
14.&15.	Quick tests for soil and plant analysis and interpretation of analysis results
16.	Detection of adulteration in fertilizers

REFERENCE BOOKS

S. No.	Authors	Title	Year	Publishers
1.	Manures and Fertilizers	Yawalkar, K. S., Agarwal, J.P. and Bokde, S.	1992	Agri. Horticultural Publishing House, Nagpur
2.	Fertilizer Guide	Tandon HLS	1994	Fertilizers Development Consultation Organization, New Delhi.
3.	Handbook on fertilizer usage	Seetharaman, S., Biswas, B.C., Yadav, D.S. and Matheswaran, S.	1996	Oxford and IBH Publishing Company, New Delhi
4.	Fertilizer control order 1985	The Fertiliser Association of India		The fertilizer Association of India, 10, Shaheed Jit Singh Marg, New Delhi.
5.	Fertilizers - A Text Book	Ranjan Kumar Basak	2000	Kalyani publishers, New Delhi
6.	Soil fertility and Fertilizers	Tisdale, S.L., Nelson, W.L. and Beaton, J.D.	1993	Macmillan Publishing Company, New York
7.	Chemistry of Soil	Bear, F.E.	1964	Oxford and IBH Publishing Company, New Delhi
8.	Fundamentals of Soil Science	-	2015	Indian Society of Soil Science, New Delhi
9.	Soil fertility – Theory and practice	Kanwar, J.S.(Ed.)	1976	ICAR, New Delhi

1	Course No.	**SSAC - 321**
2	Course Title	**Management of Problem Soils and Irrigation Water**
3	Credits Hours Semester	2 (1+1) V
4	General Objectives	To impart knowledge to the students on the Problem Soils, irrigation water quality, management of problem soils, bad quality water and impart skills in collecting and analyzing soils and irrigation water for basic physical, physicochemical and chemical properties. Students will also study how to reclaim these problem soils and how best we can make use of bad quality water for agriculture by following suitable treatment measures. Phytoremediation, using advanced technology like remote sensing and GIS in diagnosis and management of problem soils.
5	Specific objectives a) Theory:	By the end of the course, the B.Sc.(Ag) students will be able to: i. identify & diagnose different problem soils ii. categorize quality of water and its suitability for plant growth. iii. explain physical problem soils, Land use capability and problem soils under different agro ecosystems.
	b) Practical:	By the end of the practical exercises , the students will be able to: i. diagonize different types of problem soils ii. collect a representative soil sample and irrigation water sample and iii. analyze the soil and water for both quantitative and qualitative properties to identify their suitability for crop production.

Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties. Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.

Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils.

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro-ecosystems.

THEORY LECTURE OUTLINES

Lec. No.	Topic
1	Soil quality- soil health – definition – criteria for judging health and quality. Problem soils – categorization and classification based on types of problems – distribution of different problem soils and waste lands in India and Telangana.
2	Salt affected soils – Types – saline, alkali and saline alkali soils – properties and diagnostic criteria – history and nomenclature. Origin of saline soils – effect of soil salinity on soil conditions and plant growth – Relative crop tolerance to soil salinity.
3	Reclamation of saline soils – leaching – leaching requirement – Mechanical and agronomic practices – crops suitable.

4	Alkali soils – origin – effect on soil conditions and plant growth – Relative crop tolerance to sodicity. Reclamation of alkali soils – different practices – amendments – gypsum requirement – crops suitable.
5	Saline alkali soils – characterization – effect on soil conditions and plant growth – reclamation and management.
6	Acid soils – characteristics – origin and causes of soil acidity – Effect on plant growth – Reclamation of acid soils – benefits of liming – harmful effects of over liming.
7	Acid sulphate soils – characterization, effect on soil conditions and plant growth – Reclamation.
8	Physical problems in soils and management – crusting and compaction, hard pans – light soils – soil erosion – eroded soils.
9	Physical problems – soil and management – shallow soils – ill drained and flooded soils.
10	Biological degradation / problems in soils – polluted soils.
11	Irrigation water – criteria for judging quality – salinity of irrigation water – use of saline water for irrigation.
12	Irrigation water – sodium content of irrigation water – effect on soil – use of high sodium water for irrigation.
13	Irrigation water – specific ion effect toxicity in irrigation water - their contents and effect on soil and plant growth.
14	Land suitability classification and land capability classification.
15	Bioremediation – use of multipurpose trees - Problem soils in different agro ecosystems.
16	Remote sensing and GIS – role in detection and management of problem soils.

Practical (as per 5th Deans/ Committee): not proposed by Deans' Committee but included by University

PRACTICAL LECTURE OUTLINES

S. No	Experiment
1	Collection of water sample for analysis for assessing the quality of irrigation water
2.	Determination of pH and Electrical Conductivity of irrigation water
3.	Determination of carbonates and bicarbonates in irrigation water sample
4.	Determination of chlorides in irrigation water sample
5.	Determination of calcium and Magnesium in irrigation water by EDTA method
6.	Determination of sodium content in irrigation water
7.	Determination of boron content in irrigation water
8.	Determination of pH and Electrical Conductivity of soil
9. & 10.	Determination cation exchange capacity and exchangeable Na in alkali soil.
11.	Determination of lime requirement of acid soil
12.	Determination of gypsum requirement of alkali soil
13.	Assessment of irrigation water quality and management required
14.	Determination of bulk density at different depths in soil
15.	Determination of soil strength
16.	Determination of coefficient of linear extensibility in soils

REFERENCE BOOKS

S. No.	**Title**	**Author (s)**	**Year**	**Publishers**
1	Soil Science – An Introduction		2015	Indian Society of Soil Science, IARI, New Delhi
2	Saline and alkaline soils of India	R.P. Agarwal, J.S.P. Yadav and R.N. Gupta	1968	IARI, New Delhi
3	Saline and Alkaline soils	Richard, L.A.	1997	USDA, Oxfords & IBM publishers
4	Nature , properties and management of saline and alkali soils	G.L. Maliwal and L.L. Sumani	2014	Agrotech Publishing Academy
5	Soil Testing Manual	Dhyan Singh, Chonkar, P.K and Pandey, R.N.	2010	IARI, New Delhi
6	Reclamation of Alkali soils in India	K.K. Mehta.		Oxford and IBH Publishing
7	Acid soils management	M.A. Mohsin, A.K. Sarkar and B.S. Mathal.		Kalyani Publishers
8	Methods of Analysis of Soils, Plant, water, and Fertilizers.	Tandon, H.L.S.	1993	FDCO. Greater Kaliash, New Delhi.
9	Bioremediation and Phytoremediation	Wikram Nayak		International Book services, C-5/50, Lawrence Road, Delhi - 110035

ENTOMOLOGY

Course No : ENTO - 131

Course Title : Fundamentals of Entomology

Credit Hours : 3(2+1)

Degree : B.Sc (Ag)

LECTURE OUTLINES **COURSE NO: ENT 131** **CREDITS 3(2+1)**		
LECTURE NO.	**TOPIC**	**REMARKS**
1	History of Entomology in India – Arthropoda – mention of insects in scripts – contributions of Fabricius, Caroleus Linnaeus, Rothney , L De Niceville, H.M Lefroy, T.B.Fletcher, T.V. Ramakrishna Ayyar, B.V.David, Ronald Ross, H.S. Pruthi, M.R.G.K. Nair and S. Pradhan; Locations and year of establishment of Zoological Survey of India (ZSI), Directorate of Plant Protection, Quarantine and Storage (DPPQS), Indian Institute of Natural Resins and Gums (IINRG), National Bureau of Agriculturally Important Insects (NBAII), National Institute of Plant Health Management (NIPHM), National Centre for Integrated Pest Management (NCIPM) and Forest Research Institute (FRI)	
2	Major points related to domonence of Insecta in Animal kingdom- structural characters, developmental characters and protective characters (morphological, physiological, behavioral and construction of protected niches)	
3	Classification of Phylum Arthropodaupto Orders – different Classes of Arthropoda and comparison of characters of Class Insecta with Arachnida, Crustacea, Symphyla, Chilopoda, Diplopoda and Onychophora; Subphyla Apterygota and Pterygota – names of Orders of Apterygota and Pterygota with examples	
4	Characters of Class Insecta – Ectognata and entognatha- orders under each group with characters.	
5	Characters of Class Insecta – Ectognata and entognatha- orders under each group with characters.-Economic classification of insects	
6.	Morphology - Structure and functions of body wall – different layers, chemical composition, functions and cuticular appendages – cuticular processes and cuticular invaginations – chaetotaxy – moulting – apolysis, ecdysis and sclerotization	
7.	Body segmentation – Structure of head – procephalon and gnathocephalon, types of head, sclerites and sutures of insect head; Thorax and abdomen-segments and appendages (furcula, cornicles, tracheal gills and pseudoovipositor in Diptera, propodeum, petiole and gaster in Hymenoptera); Epimorphic and anamorphic development in insects	

8.	Structure and modifications of insect antenna - structure of typical antenna and its modifications; Mouth parts - biting and chewing type	
9	Mouth parts- sucking type-piercing and sucking, rasping and sucking, chewing and lapping, sponging and siphoning, mask and degenerate types with examples	
10	Structure and modifications of insect legs- structure of a typical insect leg and modifications of insect legs with examples- Structure of male and female genitalia.	
11.	Metamorphosis- ametamorphosis, holo and hemi metamorphosis, intermediate and hyper metamorphosis and diapause – obligate and facultative diapause in insects.	
12	Types of larvae and pupae – differences between nymph and larva	
13	Structure and functions of Digestive system – alimentary canal – structure of foregut, midgut and hindgut – histology, functions, filter chamber and peritrophic membrane – process of digestion	
14	Circulatory system – open and closed types – organs of circulatory system – dorsal blood vessel (diaphragms, sinuses and accessory pulsatile organs) – process of circulation – properties and functions of haemolymph	
15	Excretory system – structure, functions and modifications of malpighian tubules – structure and functions of other organs of excretion	
16	Respiratory system – tracheal system – structure of spiracle and trachea – classification based on functional spiracles and other means of respiration	
17	Nervous system – neuron and its types (based on structure and function) – synapse, ganglia, central nervous system, sympathetic nervous system and peripheral nervous system- Secretory (endocrine) system – structure and functions of neurosecretory organs (neuro secretory cells of brain, corpora cardiaca, corpora allata, prothoracic glands and ring gland)	
18	Reproductive system – structure of male and female reproductive systems – structure and types of ovarioles and structure of follicle	
19	Types of reproduction in insects	
20	Sense organs – compound eyes – structure of ommatidium – ocelli – dorsal ocelli and lateral ocelli – types of images and auditory organs (tympanum and Jhonston's organ)	
21	Taxonomy – importance - history – Binomial nomenclature –definitions of biotype, holotype, allotype and paratype – suffixes of tribes, subfamily, family and superfamily – law of priority – synonyms and homonyms - Species - subspecies – genus - family and order	
22	Classification of class Insecta up to orders, basic groups present today.	
23.	Orthoptera – General characters - family Acrididae, Tettigonidae, Gryllidae. –characters with examples Blattodea and Mantodea –general characters – family Mantidae – Characters with examples Order: Odonata–Characters with examples	
24	Isoptera – general characters – family Termitidae – Characters with examples; Order – Thysanoptera – general characters – family Thripidae	
25	Order -Hemiptera – general charecters - Sub order Hetroptera – charecters - families Pentatomidae, Lygaeidae, Miridae, Pyrrhocoreidae and Coreidae -	

	Characters with examples	
26	Order -Hemiptera - Suborder Homoptera – Characters – families Cicadellidae, Delphacide, Aphididae, Pseudococcidae, Coccidae,Lophopidae and Aleurodidae - characters with examples	
27	Order-– Lepidoptera –general characters - differences between moths and butterflies - families Noctuidae- characters with examples	
28	Lymantriidae,Pieridae,Saturnidae,Bombycidae and Sphingidae – characters with examples	
29	Order – Coleoptera - general characters – families Coccinellidae, Bruchidae - Scarabaeidae, Chrysomelidae, Cerambycidae, - characters with examples	
30	Order – Coleoptera - general characters – families Apionidae and Curculionidae - characters with examples	
31	Order – Hymenoptera - general characters – families Tenthredinidae, TrichogrammatidaeIchneumonidae, Braconidae, Chalcididae and Apidae- characters with examples	
32	Order – Diptera - general characters families Cecidomyiidae, Tephritidae, Agromyzidae, ,Culicidae and Muscidae - characters with examples	

	PRACTICAL	
1	Methods of collection and preservation of insects including immature stages	
2.	Classification And identification of important group of insects	
3	Study of different types of insect antennae and legs	
4.	Study of types of mouthparts – biting and chewing, piercing and , rasping and sucking	
5	Study of types of mouthparts – chewing and lapping, sponging and sucking and siphoning	
6	Study of wing venation, types of wings and wing coupling organs	
7.	Study of different types of insect larva and pupa	
8	Dissection of digestive system in insects	
9.	Dissection of female and male reproductive systems in insects	
10.	Study of characters of Orders OrthopteraBlattodea and Mantodea and their families	
11	Study of characters of Orders Isoptera and Thysanoptera and its families	
12	Study of characters of Order Hemiptera and the sub order Heteroptera and its families	
13	Study of characters of Sub Order Homoptera and its families	
14.	Study of characters of Order Lepidoptera and its families	

15	Study of characters of Order Coleoptera and its families	
16	Study of characters of Order Hymenoptera and Diptera and their families	

References

Chapman, R.F. 1988. Insects: Structure and Function. Cambridge Univ. Press, UK.

Charles A Triplehom and Norman F. Johnson 2005 Borror and De Long's Introduction to the Study of Insects Thomson Brooks/Cole Publishing. U.S.A.

Pant, N.C. and Ghai, S. 1981. Insect Physiology and Anatomy. ICAR, New Delhi.

Richards, O.W. and Davies, R.G. 1977. Imm's General Text Book of Entomology (Vol.I and II). Chapman and Hall, London.

Course No : ENTO-231
Course Title : **Fundamentals of Entomology -IIand IPM**
Credit Hours : 2(2+0)

Sl.No.	Content	Remarks
1.	**Ecology** – introduction - autecology and synecology – population, community - importance of insect ecological studies in Integrated Pest Management (IPM) - environment and its components – soil, water, air and biota.	
2.	**Abiotic factors** - temperature-its effect on the development, fecundity distribution, dispersal and movement of insects - adaptations of insects to temperature - thermal constant Moisture- adaptation of insects to conserve moisture. - humidity- its effect on development, fecundity and colour of body - rainfall - its effect on emergence, movement and oviposition of insects	
3.	**Ligh**t – phototaxis - photoperiodism - its effect on growth, moulting activity or behaviour, oviposition and pigmentation - use of light as a factor of insect control; Atmospheric pressure and its effect on behavior. Air currents - effect on dispersal of insects – edaphic factors – water currents.	
4.	**Biotic factors** – **Food** - classification of insects according to nutritional requirements - **other organisms – Parasitoids, Predators & Pathogens** Biological control - types of biological control – introduction , augmentation and conservation – parasite – parasitoid - parasitism - grouping of parasitoids based on nature of host, stage of host, site of parasitisation, duration of attack, degree of parasitisation and food habits – Kinds of parasitism – qualities/attributes of an effective parasitoid to be successful one. Biological control - Predators – predatism – qualities of insect predator – differences between predator and parasitoid	
5.	**Concept of balance of life** – biotic potential and environmental resistance –	

	normal coefficient of destruction - factors contributing to increase or decrease of population - causes for outbreak of pests in agro-ecosystem – explanation for these causes.	
6.	**Chemical control** - importance and ideal properties of insecticide - classification of insecticides based on origin, mode of entry, mode of action and toxicity - toxicity evaluation of insecticides - LC50 (Lethal Concentration), LD50 (Lethal Dose), ED50 (Effective Dose), LT50 ((Lethal time), KD50 (Knockdown Dose) and KT50 (Knock Down Time) – Formulations of insecticides - dusts, granules, wettable powders, water dispersible granules, solutions, emulsifiable concentrates, suspension concentrates, concentrated insecticide liquids, fumigants, aerosols, baits and mixtures of active ingredients. Inorganic insecticides - arsenic Compounds - fluorine and sulphur	
7.	**Synthetic organic insecticides** – chlorinated hydrocarbons – toxicity and mode of action. Organo phosphates - systemic, non-systemic and translaminar action of insecticides with examples – brief mode of action – toxicity. Carbamates - mode of action – toxicity. Synthetic pyrethroids - brief mode of action – toxicity.	
8.	**Novel insecticides** – nicotinoid insecticides - brief mode of action – toxicity. Macro cyclic lactones – Oxadaizines – Thioureas - Pyridine azomethines - Pyrroles -. Formamidines – Ketoenols b -Diamides brief mode of action – toxicity.	
9.	**IGR - Chitin synthesis inhibitors** – brief mode of action - toxicity;Juvenile hormone (JH) mimics – brief mode of action - toxicity, ;Anti JH or precocenes, Ecdysone agonists - brief mode of action – toxicity, formulations.	
10.	**Recent methods of pest control**- repellants (physical and chemical) and antifeedants - importance of antifeedants and limitations of their use – attractants - sex pheromones - list of synthetic sex pheromones - use in IPM - Insect hormones – gamma irradiation – genetic control – sterile male technique.	
11.	**Application techniques of spray fluids** - high volume, low and ultra low volume sprays - phytotoxic effects of insecticides - advantages and limitations of chemical control	
12.	**Safe use of pesticides. Symptoms of poisoning** - first aid and antidotes for important groups of insecticides; Insecticide resistance-insect resurgence-insecticide residues – importance - Maximum Residue Limits (MRL) – Average Daily Intake (ADI) – waiting periods – safety periods - Insecticides Act 1968 – important provisions.	
13.	**Rodents**- Important major rodent sps.- Nature of damage- management - Rodenticides – zinc phosphide, aluminum phosphide, bromodilone; Fumigants - aluminum phosphide	
14.	**Mites**- Importance - morphology and biology of mites. Mites- Classification- characters of important families tetranychidae, tenuipalpidae, tarsonimidae and eriophyidae- host range - Management	
15.	**Other non-insect pests** - Mollusc pests, vertebrate pests and their management.	

16.	**House hold and livestock insect pests-** Important pests of domestic and veterinary importance and their management.	

REFERENCES

- **Vasanthrai David, B. 2003.** Elements of Economic Entomology. Popular Book Depot, Coimbatore.
- **Nair KK, Anantha Krishnan TN and BV David 1976**. General and applied entomology, Tata Mc Graw Hill publishing co. Ltd, New Delhi
- **Yazdani, S.S and Agarwal,M.L.1979.** Elements of Insect Ecology. Narosa Publishing House,New Delhi

Course No. : ENTO: 331
Course title : **Pests of crops and stored grains and their Management**
Credit Hours : 3 (2+1)

THEORY

L.No.	Lesson
1	Introduction of Economic Entomology and Economic Classification of Insect Pests
2-3	**Rice: Yellow stem borer, gallmidge, brown plant hopper,** green leafhopper, hispa, leaf folder, ear head bug, panicle mite, IPM practices in rice.
4-5	**Sorghum and other millets: Red hairy caterpillar, Sorghum shoot fly, stem borer,** sorghum midge, ear head bug, maize shoot bug, ragi cutworm, ragi pink borer, termites. Wheat: Ghujia weevil,
6-7	**Sugarcane: Early shoot borer, leafhoppers, woolly aphid**, internode borer, top shoot borer, scales, white grub**,** mealy bugs, termites.
8-10	**Cotton: Spotted bollworm, *Helicoverpa*, pink bollworm, tobacco caterpillar, leafhopper, whiteflies, aphids, mites**, **thrips,Mealybugs** red cotton bug, dusky cotton bug, leaf roller, mirid bug, IPM in cotton. Jute semilooper, jute stem weevil, Mesta Hairy caterpillar, Sunhemp Hairy caterpillar.
11-12	**Pulses: Gram caterpillar, spotted pod borer,** plume moth, pod fly,cowpea aphid, pod bug, leafhopper, stink bug, green pod boring caterpillar, blue butterfly, redgram mite. **Pea:** pea leaf miner and pea stem fly **Soyabean**: **Stem fly**, leaf miner, whitefly.
13-14	**Castor: Semi looper, shoot and capsule borer,** tobacco caterpillar, **Ground nut: White grub, leaf miner,** leafhopper, thrips, aphids, **Sesamum: Leaf and pod borer,** gall fly,sphinx caterpillar. **Safflower**: **Aphids,** **Mustard: Aphids, saw fly,Sunflower:** *Helicoverpa,Spodoptera,*leafhopper, Bihar hairy caterpillar, thrips
15	**Brinjal: Epilachna beetle, shoot and fruit borer,** leafhopper, lacewing bug, **Bhendi: Shoot and fruit borer,** leafhopper and spider mite **Tomato: Serpentine leaf miner, fruit borer,** whitefly
16	**Cucurbits: Fruitflies, pumpkin beetle,** **Crucifers: Diamond back moth,** cabbage head borer, leaf webber, aphids, painted bug
17	**Chillies: Thrips, mites,** pod borers, aphids, mites,blossom midge **Potato: Tuber moth**. **Sweet potato: Sweet potato weevil,** **Moringa**: **Hairy caterpillar,** budworm.
18	**Mango: Leafhoppers, stem borer,** nut weevil, fruitfly,shoot borer, fruit borer, mealy bug, leaf webber, leaf gall midge,
19	**Citrus: Leafminer, butterfly,** fruit sucking moths, rust mite, bark eating caterpillar, **Pomegranate: Butterfly,** thrips, fruit sucking moths.
20	**Guava: Tea mosquito bug,** mealy bug, spiralling whitefly. **Custard apple:** Mealy bug**Grapevine: Mealy bug,** Flea beetle, thrips, stem girdler, stem borer
21	**Sapota: Leaf webber,** parijatha hairy caterpillar, mealy bugs. **Ber: Fruitfly,** fruit borer,fruit weevil **Cashew:** Tree borer, shoot and blossom webber,
22	**Banana**: **Rhizome weevil,** aphid**,** pseudostem weevil, **Apple**: Woolly aphid, Codling moth

	Tobacco: Tobacco caterpillar, whitefly **Onion: Thrips,**
23	**Coconut: Black headed caterpillar, rhinoceros beetle, red palm weevil, mite,** slug, termites, scale.
24	**Turmeric and ginger: Rhizome fly,** Lace wing bug. **Coffee:** White borer**,** red borer, green scale **Tea**: Tea mosquito bug, thrips, red spider mite, pink mite, purple mite and scarlet mite Betelvine: Shoot bug, Coriander: Aphids
25	**Rose: Thrips, scales,** chaffer beetles. **Jasmine:** Stink bug, bud worm, gall mite. **Chrysanthemum:** Aphid.**Locust and their management**
26-32	**Stored grain:** Study of physical, biological, mechanical and chemical factors in deterioration of grains. Insect pests and microorganisms associated with stored grains and their management. Storage structures and methods of storage and fundamental principles of grain store management

PRACTICALS

L.No.	Practical
1	Typical symptoms of damage by various phytophagous insects
2	Identification of major insect pests of cereals & millets and their damage symptoms
3	Identification of insect pests of sugarcane & pulses and their damage symptoms
4	Identification of insect pests of cotton & other fibre crops and their damage symptoms
5	Identification of insect pests of oil seed crops and their damage symptoms
6	Identification of insect pests of vegetables and their damage symptoms
7	Identification of insect pests of mango, cashew & banana and their damage symptoms
8	Identification of insect pests of citrus, sapota & ber and their damage symptoms
9	Identification of insect pests of grapevine, pomegranate & guava and their damage symptoms
10	Identification of insect pests of coconut, turmeric, betelvine, onion, ginger & tobacco and their damage symptoms
11	Identification of insect pests of flower & ornamental plants and their damage symptoms
12	Identification of insect pests of Stored grains & their products and their damage symptoms
13	Determination of insect infestation and moisture content of grain
14	Methods of grain sampling under storage conditions
15	Assessment of losses due to insects in storage calculations on the doses of insecticides and application techniques. Fumigation of grain store/godown.
16	Visit to nearest FCI godowns

REFERENCES

1. Atwal, A.S. 1976. *Agricultural Pests of India and South East Asia*. Kalyani Publishers, Ludhiana.
2. Butani, D.K. and Jotwani, M.G. 1984. *Insects in Vegetables*. Periodical Export Book Agency, New Delhi.
3. Butani, D. K. 1984. *Insects and Fruits*. Periodical Export Book Agency, New Delhi.
4. Dennis S Hill 1987 *Agricultural Insect Pests of tropics and their control*, Cambridge Universtiy Press , New York
5. Khare, S.P. 1993. *Stored Grain Pests and Their Management.* Kalyani Publishers, Ludhiana.
6. Nair MRGK. 1986. *Insects and Mites of crops in India*. Indian Council of Agricultural Research New Delhi.
7. Ramakrishna Ayyar, T.V. 1963. *Handbook of Economic Entomology for South India*. Government Press, Madras.
8. Upadhyaya K.P. and Kusum Dwivedi. 1996. *A Text Book of Plant Nematology*. Aman Publishing House, Meerut.
9. Vasantharaj David, B. 2003. *Elements of Economic Entomology*. Popular Book Depot, Coimbatore.
10. Vasantharaj David, B and Aanathakrishnan, T.N.. 2006. *General and Applied Entomology*. Tata McGraw-Hill Publishing House, New Delhi.

Course No : ENT-332
Course Title : **Management of Beneficial Insects**
Credits : 2(1+1)

Lecture Outlines

THEORY

S.No.	Topic
1.	Importance of beneficial insects, role of pollinators in cross-pollination. **Apiculture**: Beekeeping as an industry, species of honeybees- Little bee, Dammar bee, Indian honey bee, European bee and Rock bee.
2.	Brief Morphology and bee-biology- Life cycle and caste distinction in all stages of European and Indian honey bee
3.	Commercial methods of rearing, equipment used-types of beehives & their description, equipment for handling of bees & swarm catching; honey extraction equipment
4.	Bee colony activities and seasonal management- starting of new colony-location, site, catching a swarm, transferring a colony, replacement of queen, combining colonies, swarm prevention, colony management in different seasons
5.	Bee pasturage, bee foraging and communication. Honey extraction, bee products and their uses
6.	Bee enemies and their diseases: Insect pests like greater wax moth, lesser wax moth, wax beetle, wasps, black ants, birds etc.; their identification marks, nature & extent of damage-prevention & control. Important bee diseases-bacterial, fungal & viral diseases-detection, prevention &control
7.	**Moriculture**-Botanical description of mulberry plant, establishment of mulberry garden- planting season, land preparation, planting material, raising nursery .
8.	Planting under rainfed and irrigated conditions. Pests & diseases in mulberry & their management
9.	**Sericulture-** Brief history of sericulture in India, kinds of silkworms, their systematic position, brief life cycle & distribution, morphology and classification of mulberry silkworm; silk glands
10.	Silkworm rearing- Grainage, chawki rearing and late age rearing
11.	Mounting and harvesting of cocoons
12.	Uses of silk & its by-products, economics of silk production. Pests of silkworm: Uzifly & its control.
13.	Silkworm diseases: Protozoan, viral, bacterial & fungal diseases , prevention& control disinfection & hygiene.
14.	**Lac culture:** Lac growing areas in India, sps. of lac insects,morphology, biology, host plants, lac production- seed lac, button lac, shellac. Identification of major parasites and predators of lac
15	**Predators and Parasitoids:** Insect orders bearing predators & parasitoids used in insect control.
16.	Important species of **pollinators, weed killers and scavengers** and their importance in agriculture.

PRACTICALS

S.No.	Topic
1.	Study of important species of honey bees and caste of honey bees.
2. & 3.	Study of different types of beehives, beekeeping appliances & seasonal management of bees
4.	Study of enemies & diseases of honey bees
5.	Study of bee pasturage, foraging and communication in bees.
6.	Study of mulberry varieties and preparation of planting material of mulberry.
7. & 8.	Raising of mulberry nursery & planting of mulberry in main field
9.	Study of methods of harvesting and preservation of leaves
10.	Study of different species of mulberry & non-mulberry silkworms
11.	Rearing equipment and appliances used in sericulture
12.	Dissection of silkworm larvae for study of silk glands
13.	Study of lac insect, types of lac and host plants
14.	Collection & identification of important pollinators, weedkillers and scavengers
15	Visit to silkworm rearing station and reeling unit
16.	Visit to biocontrol laboratory.

REFERENCES

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PLANT PATHOLOGY

Course No : PATH 171

Course Title : Introduction to Plant Pathogens

Credit Hours : 3(2+1)

Degree : B.Sc (Ag)

A) Theory Lecture Outlines

1. Introduction- importance of plant pathogens - important phytopathogenic organisms, *viz.,* fungi, bacteria, fastidious vascular bacteria (RLO's),phytoplasmas (MLO's), spiroplasmas, viruses, viroids, algae, Nematode protozoa and Phaneorogamic parasites.

2. General characteristics of fungi - fungus - definition - somatic structures –types of fungal thalli - plasmodium, unicellular and filamentous, eucarpic, holocarpic mycelium - ectophytic, endophytic, intercellular, intracellular and vascular - septation in fungi - fungal tissues - plectenchyma (prosenchyma, pseudoparenchyma)

3. Modifications of mycelium (rhizomorphs, rhizoids, sclerotium, stroma,haustoria and appressorium) – Fungal cell, nutrition, groups of fungi based on nutrition -Reproduction - asexual reproduction - fragmentation, fission, budding and sporulation

4 Sexual reproduction – planogametic copulation, gametangial contact, gametangial copulation, spermatization, somatogamy, parasexual cycle –various life cycle patterns displayed by fungi - haplobiontic and diplobiontic with examples

*5.*Taxonomy and nomenclature of fungi - Classification of fungi – important characteristics of divisions -Myxomycota and Eumycota and Sub-divisions - Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.

6. Division - Myxomycota - important characteristics of Class Plasmodiophoromycetes, Order Plasmodiophorales and Family Plasmodiophoraceae - differences in the characteristics of *Plasmodiophora* and *Spongospora* and diseases caused by them

7. Division Eumycota - Sub-division Mastigomycotina - important characteristics of Class Chytridiomycetes, Order Chytridiales and Family Synchytriaceae – diseases caused and transmitted by *Synchytrium*

8 Important characteristics of Class Oomycetes, Order Peronosporales and Family Pythiaceae - *Pythium* and *Phytophthora*

9. Family Albuginaceae - disease caused by *Albugo Candida* – Family Peronosporaceae - *Sclerospora, Peronospora, Peronosclerospora, Plasmopara, Pseudoperonospora* and *Bremia* (sporangiophore branching and sporangia and example of a disease caused by each genus)

10. Sub-division Zygomycotina - important characteristics of Class Zygomycetes, Order Mucorales - diseases caused by *Rhizopus*

11. Sub-division Ascomycotina - typical life cycle - *Pyronema omphalodes* Important characteristics of Class Hemiascomycetes, Order Taphrinales, Family Taphrinaceae - diseases caused by *Taphrina deformans* and *T. maculans*

12 Important characteristics of Class Plectomycetes, Order Erysiphales, Family Erysiphaceae - *Erysiphe, Leveillula, Phyllactinia, Uncinula, Sphaerotheca, Podosphaera* and *Microsphaera* (characteristics of ascocarps and their conidial stages)

13. Important characteristics of Class Pyrenomycetes, Order Hypocreales, Family Clavicipitaceae - diseases caused by *Claviceps purpurea*

14 Important characteristics of Class Loculoascomycetes, Order Pleosporales, Family Venturiaceae - disease caused by *Venturia inaequalis* – Family Pleosporaceae - diseases caused by *Cochliobolus miyabeanus.*

15 Important characteristics of Order Myriangiales, Family Myriangiaceae - diseases caused by *Elsinoe fawcetti* - Important characteristics of Order Dothideales, Family Dothideaceae - diseases caused by *Mycosphaerella arachidicola, M.berkeleyi* and *M. musicola* - imperfect stages for the genera of Loculoascomycetes.

16 Sub-division - Basidiomycotina - important characteristics of Class Teliomycetes, Order Uredinales, Family Pucciniaceae – distinguishing characteristics of Genera - *Puccinia, Uromyces* and *Hemileia* – disease caused by *Puccinia graminis tritici, Uromyces appendiculatus* and *Hemileia vastatrix.*

17. Life cycle of *Puccinia graminis tritici* - important characteristics of Family Melampsoraceae Genus *Melampsora* - disease caused by *Melampsora ricini.*

18 Important characteristics of Order - Ustilaginales, Family Ustilagenaceae – distinguishing characteristics of *Ustilago, Sphacelotheca* and *Tolyposporium* - diseases caused by *Ustilago tritici, Sphacelotheca sorghi* and *Tolyposporium ehrenbergii*

19. Important characteristics of Family Tilletiaceae - distinguishing characteristics of *Tilletia, Neovossia* and *Urocystis* - diseases caused by *Tilletia caries, Neovossia indica* and *Urocystis cepulae*

20 Important characteristics of Class Hymenomycetes, Order Aphyllophorales, Family Ganodermataceae - diseases caused by *Ganoderma lucidum*

21.Sub-division Deuteromycotina - Saccardoan spore group system –important characteristics of Class Coelomycetes, Order Sphaeropsidales, Family Sphaeropsidaceae - distinguishing characteristics of *Phomopsis, Macrophomina, Phyllosticta, Septoria, Diplodia* and *Botryodiplodia*

22.Important characteristics of Family Excipulaceae and Family Nectrioidaceae important characteristics of Order Melanconiales, Family Melanconiaceae - distinguishing characteristics of *Colletotrichum, Gloeosporium,Pestalotiopsis and pestalotia.*

23. Important characteristics of Class Hyphomycetes, Order Moniliales, Family Moniliaceae - distinguishing characteristics of *Aspergillus, Penicillium, Pyricularia, Botrytis* and *Verticillium*

24. Important characteristics of Family Dematiaceae – distinguishing characteristics of *Alternaria, Helminthosporium, Bipolaris , Cercospora and Phaeoisariopsis.*

25. Important characteristics of Order Tubercularíales, Family Tuberculariaceae - distinguishing characteristics of *Fusarium* – important characteristics of Order Stilbellales, Family Stilbellaceae – distinguishing characteristics of *Graphium* - important characteristics of Order Agonomycetales, Family Agonomycetaceae – distinguishing characteristics of *Sclerotium* and *Rhizoctonia*

26&27. Prokaryotes - Classification (Bergey's Manual of Systematic Bacteriology,(1984) into divisions - Gracilicutes, Firmicutes, Tenericutes and Mendosicutes with examples
Bacteria - important characterstics of phytopathogenic bacteria with key for identification of important Genera - *Streptomyces* (common scab), *Pseudomonas* (wild fire of tobacco) and *Ralstonia* (wilt of solanaceous crops) *Xanthomonas* (citrus canker), *Agrobacterium* (crown gall), *Erwinia (* fire blight of apple) and *Clavibacter* (tundu disease of wheat)

28. Fastidious vascular bacteria (RLOs) - important characteristics of *Leifsonia xyli* (sugarcane ratoon stunt), *Candidatus liberobacter asiaticus* (citrus greening) and *Xylella fastidiosa* (Pierce's disease of grapes) –vectors
29. Phytoplasmas and Spiroplasmas - important characteristics of Phytoplasmas and Spiroplasmas - little leaf of brinjal, sesamum phyllody, corn stunt and citrus stubborn – vectors

30. Viruses and viroids - important characteristics of plant viruses and viroids - classification of viruses - single stranded (ss) RNA, double stranded (ds) RNA, ss DNA and ds DNA - methods of transmission - examples of important plant viral diseases - Tobacco Mosaic Virus (TMV) and Rice Tungro Virus (RTV); Examples of important viroid diseases - potato spindle tuber viroid and coconut cadang-cadang

31&32 Phyto pathogenic nematodes-important characteristics-morphology- reproduction- symptoms and nature of damage- classification- key for identification of important Genera *Meloidogyne, Heterodera, Rotylenchulus, Globodera, Anguina, Pratylenchus, Tylenchulus, Tylenchorhinchus, Xiphenema, Ditylenchus.*

B) Practical Class Outlines

1. Acquaintance with various laboratory equipments and Microscopy

2. Study of vegetative structures of fungi and their modifications, reproductive (sexual and asexual) structures of fungi

3,4&5. Study of Oomycetes fungi -*Pythium* and *Phytophthora* and *Albugo*- Study of downy mildew fungi - *Sclerospora, Peronosclerospora - Pseudoperonospora, Peronospora, Plasmopara* and *Bremia* and Zygomycetes fungi - *Rhizopus*

6. Study of powdery mildew fungi - *Oidium, Oidiopsis, Ovulariopsis*- Study of ascocarps of *Erysiphe, Phyllactinia, Uncinula, Podosphaera* and *Microsphaera*

7. Study of rust fungi - *Puccinia* (different stages), *Uromyces* and *Hemileia*

8. Study of smut fungi - *Sphacelotheca, Ustilago, Tolyposporium* ; - Study of *Ganoderma*

9. Study of imperfect fungi - *Septoria, Colletotrichum* and *Pestalotiopsis*

10 Study of imperfect fungi - *Aspergillus, Penicillium* and *Pyricularia*

11. Study of imperfect fungi - *Drechslera, Helminthosporium, Alternaria, Cercospora* and *Phaeoisariopsis, Fusarium, Rhizoctonia* and *Sclerotium*

12. Isolation of phytopathogenic bacteria (locally available diseased plant material) and study of colony characteristics and Gram's staining

13. Demonstration of mechanical transmission of plant viruses

14&15. Demonstration of extraction of Nematodes from soil and plant samples

16. **Final Practical Examination**

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Alexopoulos, C.J., Mims C.W. and Blackwell M. 1996. ***Introductory Mycology***. Wiley Eastern Ltd, New York.

Mandahar, C.L. 1987. ***Introduction to Plant Viruses***. Chand and Co Pvt Ltd, New Delhi.

Mehrotra, R.S. and Aneja, K.R. 1990. ***An Introduction to Mycology***. New Age International (P) Ltd, New Delhi.

Singh, R.S. 1982. ***Plant Pathogens - The Fungi***. *Oxford* & IBM Publishing Co. Pvt. Ltd., New Delhi.

Singh, R.S. 1989. ***Plant Pathogens - The Prokaryotes***. Oxford & IBM Publishing Co. Pvt. Ltd., New Delhi.

Course No. : PATH 271
Course Title : **Principles of Plant Pathology**
Credit Hours : 2 (2+0)

Lecture No.	TOPIC
1	Introduction-Definition, objectives of Plant Pathology- Importance of plant diseases in terms of losses caused and socio economic changes by citing plant disease epidemics (Late blight of potato, brown spot of rice, coffee rust, Southern corn leaf blight and wheat rust)
2 &3	History of plant pathology- Ancient records of plant diseases (Vriksha Ayurveda, Bible, Enquiry into plants of Theophrastus)- Contributions of Prevost, Tillet, Anton de Bary, J. G.Kuhn, Millardet, Woronin, Brefeld, Biffen, E.C. Stakman, E.J. Butler, B.B. Mundkur, J.F. Dastur, K.C. Mehta and T.N. Sadasivan
4	Terms and concepts in Plant Pathology – disease – disorder – pathogen – parasite – pathogenicity – pathogenesis – sign – symptom – syndrome – biotroph – hemibiotroph –perthotroph – inoculum – inoculum potential – infection – incubation period –predisposition – hypersensitivity disease triangle and disease pyramid
5&6	Classification of plant diseases based on cause, occurrence, host affected, plant parts affected and symptoms a. Cause-parasitic and nonparasitic diseases, disorders, excess or deficiency of nutrient and atmospheric pollution b. Occurrence- Endemic, epidemic, sporadic and pandemic c. Host affected- Diseases of cereals, pulses and oilseeds d. Plant parts affected- Diseases of leaf, stem, root, flower etc. e. Symptoms- Necrotic, hyperplastic and hypoplastic diseases Study of symptoms of various diseases caused by fungi, bacteria, viruses, viroids, molicutes, FVB and symptoms due to abiotic causes
7&8	Survival of plant pathogens – kinds of inoculum – primary and secondary inoculum– pattern of survival – infected host (main host, alternate host and collateral host) –saprophytic survival outside the host (soil, root inhabitants and rhizosphere colonizers)- dormant spores or structures (seed borne, soil borne and on infected plant parts)
9& 10	Dispersal of plant pathogens – Meaning and importance of dispersal -Active dispersal – seed, soil and plant parts- Passive dispersal – dispersal by air, water, members of animal kingdom (Man, insects, nematodes, other animals and birds), Fungi and phanerogamic parasites (with suitable examples)
11& 12	Phenomenon of infection – pre-penetration, penetration and post-penetration 1.Pre-penetration activities of plant pathogenic fungi- spore germination, germ tube growth, formation of specialized structures like appressorium, infection cushions and rhizomorphs), bacteria and virus 2. Penetration – indirect penetration through wounds or natural openings like stomata, hydathodes and lenticels – direct penetration through plant surface (cutinized and non cutinized surfaces) by chemical or mechanical methods

	3. Post penetration –colonization of the host (ectoparasitic development, endoparasitic development with external mycelium, subcuticular, endobiotic, vascular and parenchymatous hypha development)
13,14&15	Pathogenesis – Role of enzymes, toxins, growth regulators and polysaccharides in plant diseases with examples 1. Enzymes – Cutinases, pectinases, cellulases, hemicellulases, lignases, proteases and lipases (examples of plant pathogens) 2. Toxins – Pathotoxins, phytotoxins and vivotoxins – selective (host specific) and non-selective (host non-specific) toxins; Effect of toxins on plant tissues (Example of plant pathogens which which produce the toxins) 3. Growth regulators – Growth promoting substances (auxins, gibberellins and cytokinins) and growth inhibiting substances (Ethylene and Abscicic acid) 4. Polysaccharides- Role of polysaccharides in pathogenesis with special reference to bacterial wilt
16&17	Defense mechanisms in plants – i. Structural defense mechanisms a. Pre-existing structural defense mechanisms – waxes, thick cuticle and epidermalcell wall – structure of natural openings, internal structural barriers b. Post-infectional structural defense – histological defense (cork layer, abscission layer, tyloses and gum deposition) and cellular defense (hyphal sheathing) structures
18	ii. Biochemical defense mechanisms a. Pre-existing biochemical defense mechanisms – inhibitors released by the plant in its environment (protocatechuic acid and catechol) and inhibitors present in the plant cell (phenolic compounds – chlorogenic acid) b. Post-infectional defense mechanisms – phytoalexins- important phytoalexins produced in different host-pathogen systems- hypersensitive reaction– defense through plantibodies
19 &20	Plant Disease Epidemiology – Meaning and importance- Differences between compound interest (polycyclic) and simple interest (monocyclic) diseases- factors affecting plant disease epidemics-host, pathogen, environment and time factor
21	Remote sensing- meaning, scope, objectives, advantages, aerial photography (examples of different films) and satellite imaging- mention Indian Remote Sensing satellite example of plant diseases for which remote sensing is employed (Kerala coconut wilt, stem rust of wheat and citrus canker in USA)
22&23	Variability of plant pathogens- meaning, importance, mechanisms of variation in fungi, bacteria and virus. In fungi- hybridization, heterokaryosis, parasexuality, mutation and cytoplasmic adaptation. In bacteria- conjugation, transformation and transduction. In virus- hybridization, mutation
24	General principles of Plant Disease Management – importance – general principles – Avoidance of the pathogen
25	Exclusion of inoculum : concept- plant quarantine

26	Eradication: cultural methods: role of different cultural methods in plant disease management
27 &28	Physical methods and Biological methods: concept, examples of biocontrol agents
29&30	Protection and therapy- definition of terms - nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics
31	Immunization -Definition, importance of resistant varieties, sources of resistance
32	Biotechnology and its application in Plant Disease Management

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1. **Agrios, G.N. 2005**. *Plant Pathology*. Elsevier Academic Press, New York.
2. **Chaube, H.S. and Ramji Singh. 2001.***Introductory Plant Pathology*. International Book Distribution Co., Lucknow.
3. **Chet, I. 2001**. *Biotechnology in Plant Diseases Control*. John Wiley, New York.
4. **Mehrotra, R.S. 1980.***Plant Pathology*. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
5. **Singh, R.S. 2002.***Introduction to Principles of Plant Pathology.* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. **Vidyasekharan, P. 1993.***Principles of Plant Pathology*. CBS Publishers and Distributors, New Delhi.

Course No :PATH 371
Course Title :**Diseases of Field Crops & their Management**
Credit hours : 2 (1+1)

THEORY

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

1. Rice: Blast, brown spot, bacterial blight, sheath blight, **Stem rot, Sheath rot,** false smut, khaira and tungro
2. Maize: stalk rots, downy mildew, leaf blight
3. Sorghum: smuts, grain mold and anthracnose, **Rust**, **Downy mildew, Striga**
4. Bajra :downy mildew and ergot, **Blast**; Finger millet: Blast and leaf spot (Helminthosporium and Cercospora)
5. Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight and ear cockle
6. Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and PokkahBoeng, **Ring spot**
7. Cotton: anthracnose, vascular wilt **(Fusarium & Verticillium)**, and black arm, **leaf spots – Alternaria, Cercospora, Grey mildew**
8. Tobacco: black shank, black root rot and mosaic, **Frog eye leaf spot;** Castor: Phytophthora blight, **Wilt**, **Grey mould**
9. Groundnut: early and late leaf spots, wilt, **Stem rot, rust, Kalahasthi malady**, **Bud and stem necrosis**
10. Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic and r**ust**
11. **Sesamum : Phyllody, Powdery mildew, Alternaria leaf spot**
12. Sunflower: Sclerotinia stem rot and Alternaria blight, **downy mildew**; **Saffflower: Alternaria leaf spot, wilt**
13. Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot
14. Pigeonpea: Phytophthora blight, wilt and sterility mosaic
15. Black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic, **Corynespora leaf spot**
16. Gram: wilt, grey mould and Ascochyta blight**, Macrophomina stem and root rot**; Lentil: rust and wilt; Pea: downy mildew, powdery mildew and rust

PRACTICAL

Lecture No	**Lecture outline**
1	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of rice
2	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of sorghum
3	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of pearl millet and wheat
4	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of finger millet and maize

5	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of sugarcane
6	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of tobacco
7	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of groundnut
8	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of safflower and sunflower
9	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of castor and sesamum
10	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of mustard
11	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of cotton
12	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of redgram, greengram and blackgram
13	Study of symptoms, cause, etiology, host-parasitic relationship and specific control measures of diseases of bengalgram, Pea, Lentil and soybean
14	Field visits at appropriate time during the semester – I
15	Field visits at appropriate time during the semester – II
16	Field visits at appropriate time during the semester – III

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems.Collection and preservation of plant diseased specimens for herbarium.

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

REFERENCES

Cook, A.A. 1981. Diseases of Tropical and Subtropical Field, Fibre and Oilplam. Mac Millan Publishing Co., New York.

Rangaswamy, G. and Mahadevan, K. 2001. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.

Singh, R.S. 2005. Plant Diseases. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Course No :PATH 372

Course Title :**Diseases of Horticultural Crops and Their Management**
Credit hours : **3 (2+1)**

Lecture No	Crop and Diseases
1&2	**Mango:** Anthracnose, Malformation, Bacterial blight, Powdery mildew, Sooty mold, Red rust, Loranthus
3&4	**Citrus :**Canker, Gummosis, Tristeza, Greening , Dry Root Rot, Felt, Scab, Twig blight
5	**Guava:**Wilt , Anthracnose
6&7	**Banana:** Panama wilt, Bacterial wilt, Sigatoka, Bunchy top, Erwinia rhizome rot, Banana mosaic, Banana bract mosaic, Anthracnose
8	**Papaya** : Foot rot, Leaf curl, mosaic, Powdery mildew, Anthracnose
9	**Grapevine:**Downy mildew, Powdery mildew, Anthracnose , Alternaria Leaf spot, Rust
10	**Apple:** Scab, Powdery mildew, Fire blight, Crown gall **Peach**: leaf curl
11	**Pomegranate** : Bacterial blight, Anthracnose, **Strawberry:**Leaf spot **Ber:**Powdery Mildew and Sooty mold
12-14	**Crucifers**: Alternaria leaf spot, Black rot, Club root, Downy mildew, Powdery mildew, White rust **Cucurbits**: Downy mildew, Powdery mildew, Wilt, Cucumber mosaic virus, Cercospora leaf spot, Alternaria leaf spot, Fruit rot
15	**Brinjal:**Phomopsis blight and fruit rot, Sclerotinia blight , Little leaf, Bacterial wilt
16&17	**Tomato:**Damping off, Wilt, Early and late blight, Buck eye rot, Leaf curl, Mosaic, Septoria leaf spot, Tomato spotted wilt, Bacterial fruit canker, Root knot nematode, Stemphylium leaf blight
18&19	**Chillies:**Anthracnose and fruit rot, Wilt, Leaf curl, Damping off, Powdery mildew, Choanephora blight, Chilli virus complex, Bacterial leaf spot, Cercospora leaf spot, Alternatria leaf spot
20	**Bhendi:**Yellow vein mosaic virus, Cercospora leaf Spot, Powdery mildew
21	**Onion and Garlic:**Purple blotch, Stemphylium blight, Smudge, Smut
22&23	**Potato:**Early and late blight, Black scurf, Leaf roll, Mosaic , Common scab, Brown rot, Wart, Potato spindle tuber viroid
24	**Beans:**Anthracnose, Bacterial blight, Rust, Mosaic (Green mosaic And Yellow mosaic)
25	**Turmeric:**Leaf spot, Leaf blotch, Rhizome rot , **Ginger**: Soft rot, Phyllosticta leaf spot

26&27	**Coconut:**Wilt , Bud rot, Ganoderma basal stem Rot, Stem Bleeding, Tatipaka disease, Grey blight, **Oil palm:** Bunch rot spear rot
28	**Tea:**Blister blight, **Coffee:**Rust, **Colocasia:**Phytophthora blight, **Coriander:**Stem gall
29	**Rose:**Die back, Powdery mildew, Black leaf spot **Marigold:**Botrytis blight**,** Cercospora leaf spot
30	**Jasmine:** Rust, Cercospora leaf spot **Chrysanthemum:** Septoria blotch, Stunt, Fusarium Wilt, Alternaria leaf spot
31	**Crossandra:** Fusarium wilt, Cercospora leaf spot, Anthracnose **Betelvine:** Wilt, Anthracnose, Root rot, Leaf rot and foot rot
32	**Mulberry:** Powdery mildew, Cercospora leaf spot, Bacterial leaf spot, Mosaic

PRACTICALS

Study of symptoms, etiology, host – parasite relationship and specific control measures of the following crop diseases.

1. Diseases of Mango
2. Diseases of Citrus
3. Diseases of Apple and Grape
4. Diseases of Ber, Guava, Sapota, Papaya
5. Diseases of Banana and Pomegranate
6. Diseases of Strawberry and Chilli
7. Diseases of Brinjal and Bhendi
8. Diseases of Potato and Tomato
9. Field visit
10. Diseases of Crucifers of Cucurbits
11. Diseases of Betel vine, Onionand garlic
12. Diseases of Coconut, Oil Palmand Colocassia
13. Diseases of Tea, Coffee andCoriander
14. Diseases of Turmeric, Ginger, Mulberry and Beans
15. Diseases of Rose, Jasmine, Chrysanthemum and Crossandra
16. Field visit .

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1. Pathak V N 1980. Diseases of fruit crops.Oxford and IBH Publ Co. New Delhi.
2. Sohi H S 1992. Diseases of ornamental plants in India. ICAR, New Delhi.
3. Singh R S 1994. Diseases of vegetable crops.Oxford and IBH Publ Co. New Delhi.
4. Singh R S 2000. Diseases of fruit crops.Oxford and IBH Publ Co. New Delhi.
5. Varma L R and Sharma R C 1999. Diseases of Horticultural crops. Indus Publishing Co., New Delhi.

Course No :PATH 373

Course Title :**Principles of Integrated Disease Management**

Credit hours : **3 (2+1)**

Lecture No	**Details of the Lecture as indicated in the Vth Deans Committee**
THEORY (Entomology Portion)	
1.	IPM – introduction history - importance – collapse of control systems, patterns of crop protection and environmental contamination – evolution of
2.	Different **categories of pests**based on occurrence – regular, occasional, seasonal, persistent, sporadic, epidemic and endemic pests with examples based on quantum of damage, major, minor and negligible and based on ETL and EIL.
3.	**Concepts and principles of IPM** – Economic Threshold Level (ETL) – Economic Injury Level (EIL) and General Equilibrium Position (GEP)
4.	**Economic importance** of insect pests and pest risk analysis
5.	**Host-plant resistance-** principles of host plant resistance – ecological resistance – phenological asynchrony, induced resistance and escape – genetic resistance – mono, oligo and polygenic resistance - major gene resistance (vertical/specific/qualitative) and minor gene resistance (horizontal/nonspecific/quantitative) – host-plant selection process- host habitat finding, host finding, host recognition, host acceptance, host suitability- Mechanisms of Genetic resistance- non-preference(antixenosis), antibiosis and tolerance – transgenic plants
6.	**Cultural control**- normal cultural practices which incidentally control the pests and agronomic practices recommended specifically against the pests with examples;
7.	**Mechanical control**- different mechanical methods of pest control with examples.**Physical control** – use of inert carriers against stored product insects - steam sterilization – solarization - solar radiation - light traps - flame throwers etc.;
8.	**Legislative measures** - importance of quarantine - examples of exotic pests - different legislative measures enforced in different countries including India.
9.	**Biological control** - types of biological control – introduction , augmentation and conservation – parasite – parasitoid - parasitism - grouping of parasites based on nature of host, stage of host, site of parasitisation, duration of attack, degree of parasitisation and food habits – Kinds of parasitism – qualities/attributes of an effective parasitoid to be successful one. Biological control - Predators – predatism – qualities of insect predator – differences between predator and parasite
10.	**Microbial control** - Bacteria, viruses, fungi, nematodes and protozoa - important species of micro organisms against major pests for incorporation in IPM- entomopathogenic nematodes – important species - mode of infectivity and examples; - advantages and disadvantages of biological control.
11.	**Introduction to conventional pesticides for pest management -Botanical Insecticides**-Plant derived insecticides - neem based products - different commercial formulations containing azadirachtin, neem seed kernel extract, neem cake and their uses – nicotine, rotenone, plumbagin and pyrethrum – source – properties and uses.

12.	**Pest surveillanceand Forecasting** – definition - importance in IPM – advantages - components of pest surveillance - pest forecasting - types of forecasting (short term and long term forecasting and their advantages) – insect pests – definitions of negligible, minor and major pests; Different categories of pests – regular, occasional, seasonal, persistent, sporadic, epidemic and endemic pests with examples
13.	**Development and Validation** of IPM module for important crops
14.	**Implementation and impact** of IPM module for insect pests
15.	**Limitations of IPM** Political, Social and legal implications of IPM
16.	Case histories of IPM programmes
THEORY (Plant Pathology Portion)	
17 & 18	IDM: Introduction, importance, difference between control and management concepts, principles of IDM.
19	Economic importance of diseases
20	Methods of detection and diagnosis of diseases
21	Assessment of disease severity and Calculation of disease incidence levels
22	Methods of control: Cultural methods (roguing, eradication of alternate and collateral host,crop rotation, manure and fertilizer management, mixed cropping, sanitation, summer ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage)
23	Methods of control: Physical (Solarization and hot water treatment), legislative (Seed treatment, inspection and certification, plant quarantine– plant quarantine and inspection, quarantine rules and regulations)
24	Methods of control: Biological control (mechanisms – competition, antibiosis, hyperparasitism and Induced Systemic Resistance (ISR), fungal and bacterial biocontrol agents– Plant Growth Promoting Rhizobacteria (PGPR) against phytopathogens)
25&26	Methods of control: Chemical control– fungicides, antibiotics, methods and time of applications
27	Methods of control: Host plant resistance (Importance and advantage of resistant varieties, selection, hybridization and mutation, sources of resistance- meaning of vertical, horizontal, monogenic, oligogenic and polygenic resistance), Biotechnology
28	Survey, surveillance and forecasting of diseases.
29	Pest risk analysis
30	IDM strategies for plant parasitic nematodes
31	Implementation and impact of IDM module for disease. Case histories of important IDM programmes
32	Political, social and legal implication of IDM
PRACTICALS	
Entomology	
1.	Methods of diagnosis and detection of various insect pests
2.	Sampling techniques for estimation of insect population and damage
3.	Pest surveillance through light traps pheromone traps and pest forecasting
4.	Assessment of crop yield losses, calculations based on economic of IPM

5.	Compatibility of Pesticides, Phytotoxicity of insecticides
6.	Calculation of doses / Concentrations of different insecticide formulations
7.	Mass multiplication of important microbial pathogens
8.	Mass multiplication of Parasitoids
9	Mass multiplication of Predators
Plant Pathology	
10	Methods of diagnosis and detection of plant diseases
11	Methods of plant disease measurement-phytopathometry, monitoring, assessment of disease severity and calculation of incidence levels
12	Forecasting of plant diseases
13	Isolation and Identification of biocontrol agents. Mass multiplication of *Trichoderma, Pseudomona*s
14&15	Study of fungicides and their formulations.
16	Methods of application and Safety issues in Fungicide uses. Calculation of fungicide sprays concentrations**.**

HORTICULTURE

Course : **B.Sc (Ag)**

Course No. : HORT-181

Course Title : Fundamentals of Horticulture

Credit Hours : 2 (1+1)

Semester/Year First Semester/First year

General Objective : To impart knowledge on fundamentals of horticulture

Specific objective

A) Theory : By the end of the course the students will be able to know the fundamentals of horticulture

B) Practicals : Learn about the different tools and their use in propagation of horticultural crops and identification of horticultural crops

Theory lecture outlines

S.No.	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book (s)
1.	Definitions of Horticulture - Divisions of Horticulture-their definition with crop examples, Role of Horticulture in Human nutrition, Importance and scope of Horticulture in National Economy	Interactive Lecture	Chalk Board/ PPT	1	1,2,3&4
2.	Horticulture and Botanical classification. Climate and Soil for Horticultural crops- Temperature, Humidity, Wind, Rainfall and Solar Radiation	Interactive Lecture	Chalk Board/ PPT	1	1,2,3&4
3.	Points to be considered for Selection of site for establishment of orchard. Steps in establishment of orchard-Clearing the Land, Levelling, Fencing, Wind breaks, Selection of Plants from the nursery, Season of Planting, Planting and Healing inn.	Interactive Lecture	Chalk Board/ PPT	1	1,2,3&4
4.	Planting systems- Lay out- Different systems of Planting -Square, Rectangular, Quincunx, Hexagonal, and contour Planting with their merits and demerits	Interactive Lecture	Chalk Board/ PPT	1	1,2,3&4
5.	Propagation –Definition- Methods of	Interactive	Chalk	1	5,6& 7

	Propagation-Sexual and Asexual - Advantages and disadvantages of each method. Definition of division and Separation –Methods of division-Bulbs and Corms and Separation Stem tuber, Tuberous root, Rhizome, Suckers, (shoot and root suckers) runner and Off sets- Example for each type.	Lecture	Board/ PPT		
6.	Plant Propagation Structures- Green house, Lath house, Hot bed, Cold Frame, and other propagating frames. Propagation by Cuttings-Definition of Cutting-Different methods of Cuttings-Stem cuttings- Hard wood cuttings, Semi hard wood, Soft wood and Herbaceous stem cuttings –example for each type. Leaf cuttings.	Interactive Lecture	Chalk Board/ PPT	1	5,6& 7
7.	Seed germination- Dormancy-Reasons for Seed dormancy, Methods to overcome Seed Dormancy	Interactive Lecture	Chalk Board/ PPT	1	5,6& 7
8.	Plant propagation by layering-Definition of Layering and Layer-Types of Layering- Tip layering, Simple layering, Trench layering, mound or Stool layering, Compound or Serpentine layering-Air layering- Examples for each layering.	Interactive Lecture	Chalk Board/ PPT	1	5,6& 7
9.	Plant Propagation by Grafting-Definition of Grafting-Methods of Grafting- Attached scion method of Grafting, Simple or Approach grafting, Detached methods of Grafting-Veneer grafting, Side Grafting, Epicotyl grafting, Soft wood grafting, Double working, Top working.	Interactive Lecture	Chalk Board/ PPT	1	5,6& 7
10.	Plant propagation by Budding-Definition of Budding-Methods of Budding-T- budding and Inverted T budding, Patch budding, Ring budding	Interactive Lecture	Chalk Board/ PPT	1	5,6& 7
11.	Training- Definition –Objectives of Training fruit trees-Methods of Training- Central leader , Open centre and Modified Leader system with merits and demerits.	Interactive Lecture	Chalk Board/ PPT	1	1,2,3& 4
12	Pruning-Definition –Objectives of Pruning-Response of plant to pruning-Methods of Pruning-Thining out, Trimming, Heading Back, Pollarding, Pinching, Disbudding, Deblossoming, -Season of Pruning- Pruning and Manuring, Care of Pruned wounds.	Interactive Lecture	Chalk Board/ PPT	1	1,2,3& 4
13	Unfruitfulness in fruit trees, Causes-Environmental causes, Nutritional causes,	Interactive Lecture	Chalk Board/	1	1,2,3& 4

	Inherent causes, Bilogical causes, and cultural causes and their remedies. Pollination, Pollinizers, and Pollinators,		PPT		
14	Juvenility-Definition, Flower bud differentiation, Types of Buds, Fertilization-Definition and Types of Fertilization and Parthenocarpy-Definition and Types of Parthenocarpy.	Interactive Lecture	Chalk Board/ PPT	1	1,2,3& 4
15	Role of bio regulators in Propagation-Control of Flowering, Fruit set, Fruit drop, Parthenocarpy, Fruit ripening, Fruit size, quality, and Sex expression.	Interactive Lecture	Chalk Board/ PPT	1	1,2,3& 4
16	Irrigation - Methods of Irrigation- Surface Check basin, Furrow, Ring Basin, Basin, Flood, Pitcher, Drip and Sprinkler irrigation system. Fertilizer application in Fruit crops-Types of Fertilizers-Time of Fertilizer application, Methods of Fertilizers application-Broad casting-advantages and Disadvantages, Band placement, Ring Placement, Foliar application, Starter solutions, Fertigation.	Interactive Lecture	Chalk Board/ PPT	1	1,2,3& 4

Practicals

S.No.	Topic/Lesson	Teaching Methodology	Time (hrs)	Reference
1.	Visit to College Orchard	Field Visit	2.30	-
2.	Study of Horticultural tools and Implements	Field Exercise	2.30	1&2
3.	Identification of Horticultural crops	Field Exercise	2.30	-
4.	Preparation of Potting mixture and Potting	Field Exercise	2.30	1&2
5.	Preparation of Seed bed/ Nursery bed	Field Exercise	2.30	1&2
6.	Vegetative Propagation by corms, Bulbs, Rhizomes, etc.,	Field Exercise	2.30	5,6&7
7.	Vegetative Propagation by Cuttings	Field Exercise	2.30	5,6&7
8.	Vegetative Propagation by Layerings	Field Exercise	2.30	5,6&7
9.	Vegetative Propagation by Grafting	Field Exercise	2.30	5,6&7
10	Vegetative Propagation by Budding	Field Exercise	2.30	5,6&7
11	Lay out and Planting of Orchard	Field Exercise	2.30	1&2
12	Preparation of Growth regulators-powder, Solution, and Lanolin paste,	Field Exercise	2.30	1&2
13	Study of Pruning and Training in Fruit trees	Field Exercise	2.30	1&2
14	Methods of Fertilizer application in different fruit crops	Field Exercise	2.30	1&2
15	Visit to Commercial Nursery/ Orchard	Field Visit	2.30	-
16	Visit to Micro propagation laboratory	Visit to Tissue culture Lab	2.30	-

EVALUATION

THEORY

Mid Semester Examination : 50 Marks Reduced to 20 marks

Semester Final Theory Examination: 100 Marks Reduced to 30 Marks

Total : 150 Marks Reduced to 50 Marks

PRACTICAL

Class Work and Record : 25 Marks

Semester Final Practical : 25 Marks

Total ; 50 Marks

Total: (Theory 50 + Practical 50): 100 and Presented in 10 Scale Grade Point

References

S.No.	Author, Book Title	Publisher
1.	Kumar, N. Introduction to Horticulture	Oxford & IBH Publishing Co. Pvt. Ltd., New Deli
2.	Jitendra Singh. Basic Horticulture	Kalyani Publishers, Ludhiana
3.	Edmond, J.B., Senn, T.L and Andrews, F.S. Fundamentals of Horticulture	McGraw Hill Book C., New York
4.	George Acquaash. Horticulture – principles and practices	PHI Learning Pvt. Ltd., New Delhi.
5.	Sadhu, M.K. Plant Propagation	New age International Publishers, New Delhi.
6.	Sharma, R.R. Propagation of horticultural crops – principles and practices	Kalyani Publishers, Ludhiana
7.	Hartmen, H.T and Kester, D.E. Plant propagation – principles and practices	Prentice Hall of India Publishing Ltd, Bombay.

Course No : HORT– 281

Course Title :**Production technology for vegetables and spices**
Credit Hours : 2(1+1)

S. No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
1.	Olericulture -definition –importance of vegetables in human nutrition and national economy – types of vegetable gardens	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
2	Classification of vegetables based on botany, plant part used as vegetables, life cycle, seasons of growing and method of cultivation- Kitchen garden	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
3.	Tomato - Origin, climate, soil, improved varieties, cultivation practices, such as time of sowing, transplanting, planting distance, fertilizer requirements, irrigation, weed management, harvesting , yield and physiological disorders	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
4	Brinjal – importance – varieties – climate and soil – cultivation practices, such as time of sowing, transplanting, planting distance, fertilizer requirements, irrigation, weed management– harvesting – yield	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
5.	Chilli and Capsicum –importance – varieties – climate and soil-seeds and sowing –manuring –irrigation – intercultivation – harvesting – yield	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
6.	Cucurbits – Cucumber – gourds – Ridge gourd, Bottle gourd, Snake gourd Bitter gourd and Ash gourd – Melons- Watermelon and Musk melon -importance – varieties – climate and soil – seeds and sowing – manuring – irrigation – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
7.	Beans – French bean and Cluster bean – Peas, Cow pea and Dolichos bean - introduction – importance – varieties – seeds and sowing –planting –	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

	intercultivation –irrigation – manuring – harvesting – yield				
8.	Cole crops –Cabbage-Cauliflower-knol-khol - introduction – importance –varieties – climate and soil – seeds and sowing – nursery raising – planting – manuring – irrigation – intercultivation – harvesting – yield- - physiological disorders	Interactive Lecture	Chalk Board/ PPT	1	1,2 and 3
9.	Bulb crops – onion and garlic- climate, soil, improved varieties, cultivation practices, such as time of sowing, transplanting, planting distance, fertilizer requirements, irrigation, weed management, harvesting , Curing -yield– Physiological disorder	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
10.	Root crops – Carrot, Raddish, Beetroot- introduction – importance – varieties – climate and soil – seeds and sowing –manuring –irrigation-intercultivation –harvesting –yield.	Interactive Lecture	Chalk Board/ PPT	1	1,2 and 3
11.	Tuber crops – Potato – colacasia - introduction –importance – varieties – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	1,2 and 3
12.	Leafy vegetables – Amaranthus, Palak - introduction –importance – varieties – climate and soil – seeds and sowing – manuring – irrigation – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
13.	Perennial vegetables – Drumstick, Curryleaf, Coccinia – introduction – importance – varieties – climate and soil – propagation – manuring – irrigation – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	1,2 and 3

14.	Turmeric – scientific name – family – plant parts used – origin and distribution – importance – botany – varieties – propagation – climate –soil – preparation of land – systems of planting – planting seasons – seed rate –spacing –sowing –mulching – irrigation – manuring – intercultural operations – provision of shade – intercropping – rotations – harvesting –processing – preservation of seed material.	Interactive Lecture	Chalk Board/ PPT	1	4 and 6
15.	Ginger- botanical name – family – origin – plant parts used – introduction –botany –varieties – propagation – climate – soil – preparation of land – planting season – seed rate – spacing – mulching – irrigation – manuring – intercultural operations – harvesting and processing – preservation of seed material.	Interactive Lecture	Chalk Board/ PPT	1	4 and 6
16.	Coriander, Cumin and Fenugreek – botanical name – family – botany - plant parts used – origin and distribution – economic part - varieties – climate – soil – preparation of land – season – seed rate and sowing – irrigation –manuring – intercultivation – harvesting and yield	Interactive Lecture	Chalk Board/ PPT	1	4 and 6

S.No	Practical class outlines
1.	Identification of vegetables and their seed
2	Identification of spices and their seed
3	Raising of vegetable nurseries
4	Direct seed sowing and transplanting
5	Study of morphological characters of different vegetables
6	Study of different characteristics of different spices
7	Fertilizer application
8	Harvesting and preparation for market
9	Economics of vegetable cultivation
10	Economics of spices cultivation
11	Harvesting indices of different vegetable crops
12	Grading and packing of vegetables
13.	Visit to commercial vegetable fields
14.	Intercultural operations in vegetable crops
15.	Processing of Spices
16.	Visit to spice garden

REFERENCES

Sl.No.	Book title & Author	Publisher
1.	Vegetable Crops in India, Bose, T.K. and Som, T.K.1986.	NayaPrakash, Calcutta
2.	Production Technology of Vegetable Crops-Shanmugavelu,K.G.1985	Oxford and IBM Publishing Co.Pvt. Ltd., New Delhi.
3.	Vegetables – Thompson, I.C.C. and Kelley, W.C.1957.	Tata McGraw-Hill, Publishing co.Ltd., Mumbai
4.	Spices and Plantation Crops-Shanmugavelu, K.G.and Madhava Rao, V.N.1977	Popular Book Depo., Chennai
5.	Spices (Vol-I and II) – Purseglove, J.W.E.G., Brown Gren, C.L.and Robbins S.R.J.1980	Academic Press, New Delhi
6.	Introduction to spices, plantation crops, medicinal and aromatic plants	Oxford and IBM Publishing Co.Pvt. Ltd., New Delhi.

Course No : Hort-283

Course Title : **Production technology for ornamental crops, MAPand Landscaping**
Credit Hours : 2(1+1)

S.No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
1.	Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping.	Interactive Lecture	Chalk Board/ PPT	1	1 and 3
2	Principles of **Landscaping.** Landscape useof trees, shrubs and climbers	Interactive Lecture	Chalk Board/ PPT	1	1 and 3
3.	Features of **ornamental gardening** – importance – features of ornamental gardening.	Interactive Lecture	Chalk Board/ PPT	1	1 and 3
4.	Production technology of **Rose –** under protected condition importance – types of roses– varieties – propagation – planting **–** pruning – manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
5.	Production technology of **Gerbera-** under protected condition importance – climate and soil –varieties – propagation – planting **–**manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
6.	Production technology of **Carnation -** under protected condition- importance – climate and soil – varieties – propagation – planting **–** manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
7.	Production technology of **Lillium and orchids -** under protected condition - importance – climate and soil –varieties – propagation – planting **–**manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
8.	Production technology of **Gladiolus and Tuberose** under open conditions - importance – climate and soil – classification based on petals – varieties – propagation – planting **–** manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
9.	Production technology of –	Interactive	Chalk	1	2 and 3

	Chrysanthemum - under open conditions **–** importance – climate and soil – classification – varieties – propagation – planting **–** pinching – manuring – irrigation – harvesting – yield.	Lecture	Board/ PPT		
10.	Package of practices -**Marigold** under open conditions -importance – climate and soil –varieties – propagation – planting **–**manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
11	Production technology of **Jasmine** under open conditions - importance – climate and soil – different species of jasmine – varieties – propagation – planting – pruning – manuring – irrigation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	2 and 3
12.	Production technology of Medicinal plants – **Ashwagandha, Asparagus** – introduction – botany varieties – propagation – climate-soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	4
13.	Production technology of **Aloe, Costus, Cinnamomum** - introduction – botany varieties – propagation – climate-soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	4
14.	Production technology of **Periwinkle and Isabgol-** introduction – botany - varieties – propagation – climate-soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	4
15.	Production technology of Aromatic plants – **Lemon grass, Citronella, Palmarosa, Ocimum, Geranium, Vettiver** – botanical name – family-origin – economic part – importance – botany – varieties – climate-soil – preparation of land – propagation and planting – manuring – irrigation – intercultivation – harvesting – yield.	Interactive Lecture	Chalk Board/ PPT	1	4
16.	Processing and value addition in ornamental crops, MAP's produce	Interactive Lecture	Chalk Board/ PPT	1	4

S.No	**Practical class outlines**

1.	Identification of ornamental plants
2	Identification of medicinal plants
3	Identification of aromatic plants
4	Botanical description of aromatic plants
5	Nursery bed preparation and seed sowing
6	Propagation of ornamental plants
7	Propagation of aromatic plants
8	Training and pruning of ornamental plants
9	Planning and layout of garden
10	Bed preparation and planting of MAP's
11	Intercultural operations in flowers
12	Intercultural operation in MAP's
13.	Post harvest handling of cut flowers and loose flowers
14.	Processing of Medicinal and Aromatic Plants
15.	Protected structures care and maintenance
16.	Visit to commercial flower and MAP Unit

Sl.No.	Book title & Author	Publisher
1.	Floriculture and Landscaping, Bose, T.K.1999.	NayaPrakash, Calcutta
2.	Commercial Flowers, Bose, T.K. and Yadav, L.P.1992.	NayaPrakash, Calcutta
3.	Floriculture in India-Randhawa, G.S. and Mukhopadhyaya, A.1994	Allied Publishers Pvt.Ltd., New Delhi.
4.	Introduction to spices, plantation crops, medicinal and aromatic plants	Oxford and IBM Publishing Co.Pvt. Ltd., New Delhi.

Course No : Hort-282
Course Title : **Production technology for fruits and plantation crops**
Credit Hours : 2(1+1)

S.No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
1.	Importance and scope of fruit crops	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
2	Production technology of **Mango** , origin- importance – climate- soil- varieties – propagation – planting – plant preparation – spacing – digging of pits – filling of pits – seasons of planting – Irrigation – manuring – method and time of application – intercultivation and intercropping – training and pruning – flowering – pollination-fruit set – cropping – harvesting – maturity indices – yield- problems in mango cultivation – alternate or biennial bearing and irregular bearing, mango malformation, spongy tissue and fruit drop – causes and remedies				1 and 2
3.	Production technology of **Banana,** origin – importance –climate-soils – varieties – planting – land preparation –system of planting – spacing – digging of pits – filling of pits – application of manures – seasons of planting – intercultivation –desuckering – trashing – mattocking – wrapping of bunches – removal of male bud – removal of	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

	floral remnants – propping – earthing up – weeding - harvesting – maturity indices – yield.				
4	Production technology of **Citrus** – origin – importance -different citrus species – climate – soils – varieties of different citrus fruits – sweet orange – propagation – different methods of propagation adopted in different citrus fruits also commercial method adopted – planting – land preparation – method of planting – spacing – digging of pits – filling of pits – application of manures – season of planting – irrigation – manuring – pruning and training – intercultivation – intercropping – flowering – bahar treatment – cropping – fruit drop – causes and control – harvesting – maturity indices – yield	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
5.	Production technology of **Grape** – origin – importance – climate – soils – varieties – commercial classification of grapes – table, wine, sweet juice and raisin grapes – their characteristics and example of varieties - different methods of propagation – different rootstocks used- planting – land preparation- system of planting –spacing – digging of pits – filling of pits – application of	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

	manures – season of planting –training – different methods of training – head, arbour, kniffin, and telephone trellies system – advantages and disadvantages of each system- pruning – summer pruning and winter pruning – points to be considered while pruning and main principles for successful pruning – irrigation – manuring – intercultivation – fruit thinning – use of growth regulators in increasing fruit set, berry size, cluster size and maturity – harvesting - maturity indices – yield.				
6.	Production technology of **Guava** –origin – importance – climate – soils – varieties – propagation – different methods of propagation – commercial method of propagation – planting – land preparation – system of planting –spacing – digging of pits – filling of pits – application of manures – season of planting – flowering – seasons of flowering – crop regulation – irrigation – manuring – training – pruning for encouraging new shoots and for sanitation – pollarding, bending intercultivation and intercropping – harvesting – maturity indices – yield.	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
7.	Production technology of	Interactive	Chalk Board/	1	1 and 2

	Papaya and Pomegranate – origin – importance – climate – soils – varieties –sex expression – climate – soils – propagation – raising of seedlings – planting –land preparation – system of planting – spacing – digging of pits – filling of pits – season of planting – irrigation – manuring – intercultivation and intercropping – flowering and fruiting – harvesting – maturity indices – yield – papain – uses and its extraction. **Pomegranate-** origin – importance – climate – soils – varieties –climate – soils – propagation – methods of propagation – commercial method of propagation – planting – land preparation – system of planting – spacing – digging of pits – filling of pits – application of manures – season of planting – irrigation – manuring – cropping – harvesting – maturity indices – yield – physiological disorder – fruit cracking and its control.	Lecture	PPT		
8.	Production technology **of Apple, Pear and Peach** – origin – importance – climate- soils – varieties – propagation – methods of propagation –rootstocks – planting – land preparation – system of planting – spacing – digging of pits – filling of	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

	pits – application of manures – season of planting – spacing – digging of pits – filling of pits – application of manures - season of planting – planting of pollenizers – training – system of training adopted – pruning – pruning for sanitation and production of new spurs – irrigation – manuring – intercultivation and inter cropping – harvesting – maturity indices – yield.				
9.	Production technology of **Custard apple –** origin – importance – different species annonaceous fruits – sithaphal – climate-soil-varieties – propagation – different methods of propagation – raising of seedlings – commercial method of propagation – planting – land preparation – system of planting – spacing – digging – of pits – application of manures to pits – season of planting – training and pruning – irrigation – manuring – intercultivation and intercropping – flowering – factors affecting fruit set- fruiting- harvesting – maturity indices – yield.	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
10.	Production technology of **Ber and Phlasa -**origin – importance – climate – soils – varieties – propagation-method of propagation – raising of seedlings and rootstocks uses - planting – land preparation –system of	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

	planting – spacing – digging of pits – filling of pits – application of manures to pits - Season of planting – training – method of training – pruning for sanitation and bearing – time of pruning – irrigation – manuring – intercultivation and intercropping – flowering and fruiting – harvesting – maturity indices – yield.				
11.	Production technology of **Pineapple and Litchi – Pineapple –** origin – importance – climate – soils – varieties – propagation **–**propagation material – commercial method of propagation – planting – land preparation – systems of planting – spacing – diggings of pits – filling of pit – application of manures – season of planting – irrigation – manuring – intercultivation – induction of flowering **–** harvesting – maturity indices – yield. **Litchi** – Origin - importance – climate – soils – varieties – propagation – methods of propagation – commercial method of propagation – planting – land preparation – system of planting –spacing – digging of pits – filling of pits – application of manures – season of planting – training and pruning – system of training adopted – regular	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

	pruning for sanitation and heavy pruning of old trees – irrigation – manuring – intercultivation and intercropping – harvesting – maturity indices – yield.				
12	Production technology of **Sapota and Jackfruit –** Origin - importance – climate – soils – varieties- - propagation – methods of propagation – commercial method of propagation- different root stock s used – planting - land preparation – system of planting –spacing – digging of pits – filling of pits – application of manures – season of planting –irrigation – manuring – intercultivation and intercropping –flowering and cropping – harvesting – maturity indices – yield.	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
13	Production technology of **Coconut -** botanical name – family – origin – economic part- importance – botany – varieties –tall, dwarf and hybrids – climate – soil – planting – manuring – irrigation –intercultivation – harvesting – and yield	Interactive Lecture	Chalk Board/ PPT	1	3
14	Production technology of **Arecanut** – botanical name – family – origin – importance- botany – varieties – climate-soil- raising of planting material – preparation of land – planting- manuring – irrigation – intercultivation – cover cropping - intercropping –	Interactive Lecture	Chalk Board/ PPT	1	3

	harvesting – yield and processing				
15	Production technology of **Cashewnut**- botanical name – family – origin – introduction – importance – botany – climate –soil – varieties and propagation - preparation of land – planting – irrigation – manuring – intercultivation – intercropping – training and pruning- cropping – harvesting – yield- processing	Interactive Lecture	Chalk Board/ PPT	1	3
16	Production technology of **Oilpalmand Cocoa** – botanical name – family – origin-economic part – importance – botany – varieties –climate – soil – propagation and plating – irrigation – intercultivation – harvesting – yield – processing cacao – botanical name – family – origin – importance – botany – varieties – forester, criollo and other types – climate – soil – propagation – preparation of land – planting – irrigation – weeding – mulching – pruning – intercropping – cover cropping – manuring – harvesting – yield – processing - uses	Interactive Lecture	Chalk Board/ PPT	1	3

S .No	**Practical class outlines**
1.	Description and Identification of fruits
2	Description and Identification of Plantation crops
3	Visit to commercial orchard
4	Identification and description of varieties of mango
5	Identification and description of varieties of guava and papaya

6	Identification and description of varieties of sapota, banana, citrus and pomegranate
7	Identification and description of varieties of coconut, arecanut and cashewnut
8	Propagation methods of fruits crops
9	Propagation methods of plantation crops
10	Important pests of and diseases of fruits
11	Important pests of and diseases of Plantation crops
12	Seed propagation-Scarification and stratification of seed
13.	Physiological disorders of fruit crops
14.	Physiological disorders of plantation crops
15.	Visit to fruit research stations
16.	Preparation of plant bio regulators and their use

REFERENCES

Sl.No.	Book title & Author	Publisher
1.	Fruits-Tropical and sub-tropical - Bose T.K. and Mitra.S.K,1990	NayaPrakashan,Calcutta
2.	Text book on Pomology-Vol.I to IV-Chattopadhya,N.1997,	Kalyani Publishers, Ludhiana
3	Introduction to spices, plantation crops, medicinal and aromatic plants	Oxford and IBM Publishing Co.Pvt. Ltd., New Delhi.

Course No : Hort-382
Course Title :**Post harvest management and value addition of fruits and vegetables**
Credit Hours : 2(1+1)

S.No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
1.	Importance of post harvest technology of horticultural crops – meaning and importance of post harvest technology – causes of post harvest losses.	Interactive Lecture	Chalk Board/ PPT	1	1
2	Pre harvest factors affecting the quality and post harvest shelf life of fruits and vegetables – environmental factors (temperature, light, rain, wind and humidity) – mineral nutrients (Ca, Mg, Zn, B and Cu) – growth regulators (auxins, gibberellins, cytokinins, ethylene and growth retardants)- rootstock, irrigation, pruning, thinning, girdling, varieties, pests ad diseases, pesticides, maturity ad mechanical injury	Interactive Lecture	Chalk Board/ PPT	1	1 and 3
3.	Ripening – definition – types of fruits based on ripening – changes occurring during ripening – maturation of seed/change in seed colour, water content, carbohydrates, organic acids, proteins, texture, taste, aroma, abscission, development of surface wax, respiration rate, chemical changes and enzymes – factors affecting ripening of fruits and vegetables – temperature CO_2 , O_2 radiation, air humidity, volatiles, growth regulators – chemicals used for hastening and delaying ripening of fruits and vegetables.	Interactive Lecture	Chalk Board/ PPT	1	1,3 and 4

4.	Factors responsible for deterioration of harvested fruits and vegetables – respiration, transpiration, ethylene, mechanical damages, pests and diseases	Interactive Lecture	Chalk Board/ PPT	1	1 and 3
5.	Harvesting and post harvesting of fruits and vegetables – methods of harvesting (hand and mechanical) – their advantages and disadvantages – curing – degreening – precooling – washing and drying – sorting and grading – disinfestations – post harvest treatments and waxing.	Interactive Lecture	Chalk Board/ PPT	1	1

6.	Methods of storage – low temperature storage (cellar refrigeration and freezing) – controlled atmospheric storage – hypobaric storage – irradiation and low cost storage structure – zero energy cool chamber – storage in pits – storage in wind breaks –*in situ* – storage I barrens – storage I cellars – clamp storage.	Interactive Lecture	Chalk Board/ PPT	1	3
7.	Packaging – definition – purpose of packaging – methods of packaging – packaging materials – different materials for fresh fruits and vegetables – specific packaging for export of mango, banana, grapes, kinnow, sweet orange and mandarin; cushioning materials – introduction – purpose of using cushioning material – characteristics of cushioning materials various kinds of cushioning materials.	Interactive Lecture	Chalk Board/ PPT	1	7
8.	Value addition concept - Importance and scope of preservation of fruits and vegetables in India -	Interactive Lecture	Chalk Board/ PPT	1	6

9.	Principles and methods of preservation – principles – methods – asepsis- preservation by high temperature, low temperature, drying, filteration, chemicals, salt, sugar, oil, acid fermentation, carbonation, antibiotics and irradiation.	Interactive Lecture	Chalk Board/ PPT	1	6
10.	Preservation by canning and bottling – selection of fruits and vegetables –sorting and grading – washing – peeling (hand peeling, mechanical peeling by heat, lye peeling and flame peeling)- cutting and blanching and their advantages and disadvantages – can filling – syruping or bringing – lidding or clinching – exhausting – sealing – processing – labeling, packing – storing – flowchart for canning and bottling – containers for canning and bottling – tin containers, glass containers, lacquers, acid resistant, sulphur resistant, other containers, plywood container, string opening, composite containers and self heating can	Interactive Lecture	Chalk Board/ PPT	1	6
11.	Spoilage of canned food – swell, hydrogen, springer, flipper, leakage, breather and bursting – discolouration of canned foods – metallic contamination – ferric tennate, iron sulphide and copper sulphide combined with hydrogen – biological causes – enzymes ad chemical reaction – Maillard reaction – spoilage due to physical and chemical changes – microbial spoilage.	Interactive Lecture	Chalk Board/ PPT	1	6
12.	Drying and dehydration of fruits and vegetables – definition – factors affecting rate of drying – advantages of dehydration over sundrying and other methods – principles of drying and	Interactive Lecture	Chalk Board/ PPT	1	6

	dehydration – flow chart for drying/dehydration of fruits and vegetables – blanching – sulphuring and spoilage of dried product – freezing of fruits and vegetables – methods of freezing – sharp freezing, quick freezing, direct immersion, indirect immersion , air blast freezing, cryogenic freezing, dehydro-freezing and freeze drying				
13.	Intermediate moisture food, Jam Jelly and Marmalade – Concepts standards	Interactive Lecture	Chalk Board/ PPT	1	6
14.	Intermediate moisture food preserve candy	Interactive Lecture	Chalk Board/ PPT	1	6
15.	Pickles – methods of pickling preservation with salt, vinegar, oil and spices – problems in pickle making – preserve – candy ad crystallized fruits and vegetables – glazed fruits and vegetables – chutneys and sauces / ketchups – flowchart for ketchup- flowchart for sauce	Interactive Lecture	Chalk Board/ PPT	1	6
16.	Fruit juices, squashes an d cordials – preparation – selection of fruit, washing, extraction of juice, deaeration, straining, filteration and clarification and preservation – preservatives ad colours permitted and prohibited in India.	Interactive Lecture	Chalk Board/ PPT	1	6

S.No.	Practical class outlines
1	Visit to Rythu bazaar for vegetable harvesting indices
2	Application of different types of packaging containers for shelf life extension
3	Effect of temperature on shelf life and quality of produce
4	Demonstration of chilling and freezing injury in fruits and vegetables
5	Extraction and preservation of pulp and juices
6	Preparation of Jam
7	Jelly
8	RTS, Nectar and Squash
9	Preparation of osmotically dried products, fruit bar and candy
10	Preparation of tomato products
11	Quality evaluation of products – Physico chemical
12	Quality evaluation of products – sensory evaluation
13	Visit to processing unit or industry
14	Studies on physiological loss of weight
15	Analysis of TSS, Acidity in different fruits
16	Analysis of Ascorbic acid in different fruits

REFERENCES

Sl.No.	Book title & Author	Publisher
1.	Preservation of Fruits and Vegetables – Giridharilal, G.S., Siddappa and Tondon, G.L.2007.	ICAR, New Delhi
2.	Post harvest Biology and Handling- Hard, N.F, and Salunkhe, D.K. 1980	AVI Publishing Co., Westport.
3.	Handling, Transportation and Storage of Fruits and vegetables (Vol.2) – Lloyd Ryoll, A.M.S. and Pentzer W.T.M.S.1982.	AVI Publishing Tables Co.Inc., Connecticut.
4.	Post Harvest Physiology and Storage of Tropical and Subtropical Fruits – Mitra, S.K.2005.	CABI Publishers, Kolkatta.
5.	Hand Book of Fruit Science and Technology- Salunkhe,D.K. and Kadam,S.S.1995	Marcel Dekker Incorporated, New York
6.	Fruit and Vegetable Preservation:Principles and Practices.- Srivastava, R.P. and Sanjeev Kumar.2002.	International Book Distribution Company, Lucknow.
7.	Packaging of Fruits and Vegetables in India – Venkatarathnam, L.1988.	Agri-Horticultural Society, Hyderabad.

AGRICULTURAL ECONOMICS

1	Course No.	AECO -141
2	Course Title	Fundamentals of Agricultural Economics
3	Credit Hours	2 (2+0)
4	Semester/year	First Year First / Second Semester
5	General Objective	To impart knowledge on the Fundamentals of Agricultural Economics
6	Specific objective	Basic Concepts in Economics. Mechanism of market forces i.e., Demand and Supply. Macroeconomic concepts like national income and its measurement, public revenue and public expenditure, economic planning.

Lecture Outlines (Theory)

Sl.No.	No. of Hours	Topic / Lesson	Teaching Method	Teaching Aids
1	1 hr	Economics: Meaning, subject matter, scope and definitions of economics, divisions of economics- Traditional and Modern approach of Economics	Lecture & Discussion	Chalk board & Power Point Presentation
2	1 hr	Consumption , production , exchange and distribution, micro and macro economics, positive and normative analysis- Deductive and Inductive methods of investigation	Lecture & Discussion	Chalk board & Power Point Presentation
3	1 hr	Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.	Lecture & Discussion	Chalk board & Power point Presentation
4	1 hr	Basic concepts: Goods and services, classification of goods, characteristics of goods and services, desire, want, demand, utility, Cardinal and Ordinal utility, Characteristics of utility - Forms of utility. Cost and price, wealth, capital, income and welfare, Classification of wealth	Lecture & Discussion	Chalk board & Power Point Presentation
5	1 hr	Agricultural Economics: meaning, definition, characteristics of agriculture, importance and its role in economic development.	Lecture & Discussion	Chalk board & Power Point Presentation
6	1 hr	Cardinal approach / utility theory, Law of Diminishing Marginal Utility – statement, assumptions of law, explanation, limitations, importance	Lecture & Discussion	Chalk board & Power Point Presentation
7	1 hr	Law of Equi-marginal Utility – meaning, assumptions, explanation, practical importance, limitations	Lecture & Discussion	Chalk board & Power Point Presentation
8	1 hr	Consumer's Surplus – meaning, assumptions, explanation, difficulties in measuring Consumer's Surplus, importance. Ordinal Approach-Consumer's equilibrium, indifference curves- indifference map , properties of IDC and Budget line- MRTS and price	Lecture & Discussion	Chalk board & Power Point Presentation

		ratio		
9	1 hr	Demand – meaning, definition, types of demand - income demand, price demand, cross demand. Demand schedule , demand curve. Law of demand – exceptions ,contraction and extension, increase and decrease in demand, determinants of demand	Lecture & Discussion	Chalk board & Power Point Presentation
10	1 hr	Elasticity of demand – Definition, elastic and inelastic demand, kinds of elasticity of demand, perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic, unitary elastic demand. Types of elasticity of demand , Price elasticity, income elasticity and cross elasticity of demand, factors affecting demand , practical importance of elasticity of demand	Lecture & Discussion	Chalk board & Power Point Presentation
11	1 hr	Production: meaning, process, creation of utility, factors of production, input-output relationship.	Lecture & Discussion	Chalk board & Power Point Presentation
12	1 hr	Laws of Returns: Law of Variable Proportions and Law of Returns to Scale	Lecture & Discussion	Chalk board & Power Point Presentation
13	1 hr	Cost: Cost concepts, short run and long run cost curves	Lecture & Discussion	Chalk board & Power Point Presentation
14	1 hr	Supply – meaning, definition, law of supply, exceptions, supply schedule, supply curve. Increase and decrease in supply, contraction and extension of supply, factors affecting supply.	Lecture & Discussion	Chalk board & Power Point Presentation
15	1 hr	Elasticity of supply, kinds of elasticity of supply – perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic and unitary elastic - factors affecting elasticity of supply.	Lecture & Discussion	Chalk board & Power Point Presentation
16	1 hr	Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets.	Lecture & Discussion	Chalk board & Power Point Presentation
17	1 hr	Price determination under perfect competition;	Lecture & Discussion	Chalk board & Power Point Presentation
18	1 hr	Short run and long run equilibrium of firm and industry, shut down point, normal & super normal profits, break even points.	Lecture & Discussion	Chalk board & Power Point Presentation
19	1 hr	Distribution theory: meaning, factor market and pricing of factors of production.	Lecture & Discussion	Chalk board & Power Point Presentation
20	1 hr	Concepts of rent, wage, interest and profit.	Lecture & Discussion	Chalk board & Power Point Presentation

21	1 hr	National income: Meaning and importance, circular flow, concepts of national income accounting- Gross Domestic Product, Gross National Product, Net National Product, Net Domestic Product- National Income at Factor Cost, Personal Income, Disposable Income	Lecture & Discussion	Chalk board & Power Point Presentation
22	1 hr	Methods / Approaches of measurement of National Income – product method, income method and expenditure method, difficulties in measurement.	Lecture & Discussion	Chalk board & Power Point Presentation
23	1 hr	Population: Importance, Malthusian and Optimum population theories.	Lecture & Discussion	Chalk board & Power Point Presentation
24	1 hr	Natural and socio-economic determinants, current policies and programmes on population control.	Lecture & Discussion	Chalk board & Power Point Presentation
25	1 hr	Money: Barter system of exchange and its problems, evolution, meaning and functions of money.	Lecture & Discussion	Chalk board & Power Point Presentation
26	1 hr	Classification of money, Advantages of paper money, money supply.	Lecture & Discussion	Chalk board & Power Point Presentation
27	1 hr	Inflation- types of inflation, measurement, General Price Index, WPI and CPI	Lecture & Discussion	Chalk board & Power Point Presentation
28	1 hr	Causes and control of inflation, Central Bank- functions and important policies	Lecture & Discussion	Chalk board & Power Point Presentation
29	1 hr	Public revenue, role and functions, sources, public expenditure	Lecture & Discussion	Chalk board & Power Point Presentation
30	1 hr	Tax: meaning, direct and indirect taxes, agricultural taxation, Methods of taxation, VAT, GST	Lecture & Discussion	Chalk board & Power Point Presentation
31	1 hr	Economic systems: Concepts of economy and its functions	Lecture & Discussion	Chalk board & Power Point Presentation
32	1 hr	Important features of capitalistic, socialistic and mixed economies, elements of economic planning, NITI AYOG role and functions	Lecture & Discussion	Chalk board & Power Point Presentation

Reference Books

1. Dewett, K.K. and Chand, A.2009 Modern Economic Theory S.Chand and Co., New Delhi
2. Dewett, K.K. and Varma, J.D. 1986 Elementary Economics S.Chand and Co., New Delhi.
3. Jhingan, M.L.1990 Advanced Economic Theory Vikas Publishing House, New Delhi

4. Subba Reddy, S, Raghu Ram, P., Sastry, T.V.N. and Bhavani Devi, I. 2016 Agricultural Economics Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi

Course No : AECO 241
Course Title : **Farm Management, Production and Resource Economics**
Credit Hours : 3(2+1)

THEORY

Lec. No	Topic
1.	Farm Management – Meaning – Definitions – Scope – Objectives - Relationship with other sciences
2.	Farm – Meaning – Definition – its types and characteristics – Factors determining size of farms
3.	Economic principles applied to farm management – Principle of variable proportions – Determination of optimum input and optimum output
4.	Minimum loss principle (Cost Principle) - Principle of factor substitution
5.	Principle of product substitution - Law of Equi-marginal returns – Opportunity cost principle
6.	Principle of comparative advantage – Time comparison principle
7.	Types of farming – Specialization, Diversification, Mixed farming, Dry farming and Ranching – Factors influencing types of farming
8.	Types of farm business organizations – Peasant farming, Co-operative farming, Capitalistic farming, Collective farming and State farming
9.	Meaning and concept of cost –Types of costs – Cost concepts – Farm income measures – Gross income, farm business income, family labour income, net farm income and farm investment income
10.	Farm business analysis – Meaning and concept of farm income and profitability – Technical and economic efficiency measures
11.	Farm records and accounts – Importance – Types of farm records to be maintained on farm
12.	Farm inventory – Methods of valuation– Net selling price, cost less depreciation, market price, cost method, replacement cost less depreciation and income capitalization methods
13.	Balance sheet or Networth statement – Assets, liabilities and networth – Ratio measures
14.	Income statement or profit and loss statement – Receipts, expenses and net income –Ratio measures
15.	Depreciation – Methods of computation – Straight line, diminishing balance, sum of the years digits and annual revaluation methods
16.	Farm planning – Meaning – Need for farm planning – Types of farm plans – Simple farm plan and whole farm plan – Characteristics of a good farm plan – Basic steps in farm planning
17.	Farm budgeting – Meaning – Types of farm budgets – Enterprise budgeting – Partial budgeting and whole farm budgeting.
18.	Linear programming – Meaning – Assumptions – Advantages and limitations
19.	Risk and uncertainty in agriculture – Nature and sources of risks – Production and technical risks – Price or marketing risk – Financial risk – Methods of reducing risk
20.	Agricultural Production Economics – Definition – Nature – Scope and subject

	matter of Agricultural Production Economics – Objectives of Production Economics – Basic production problems
21.	Law of returns - Law of increasing returns – Law of constant returns – Law of decreasing returns
22.	Factor-product relationship – Production function and its types – Elasticity of production - Three stages of production function
23.	Factor-factor relationship – Isoquant and their characteristics – MRTS – Types of factor substitution
24.	Iso-cost lines – Characteristics – Methods of determining least-cost combination of resources – Expansion path – Isoclines – Ridge lines
25.	Product-product relationship – Production possibility curve – Marginal rate of product substitution – Types of enterprise relationships – Joint products – Complementary – Supplementary – Competitive and Antagonistic products
26.	Iso-revenue line and characteristics – Methods of determining optimum combination of products – Expansion path – Ridge lines
27.	Resource productivity – Returns to scale
28.	Resource economics – Definition, subject matter and scope - Differences between NRE and agricultural economics
29.	Natural resources classification and characteristics – Resource depletion and causes for the same
30.	Positive and negative externalities in agriculture
31.	Inefficiency and welfare loss, solutions
32.	Important issues in economics and management of common property resources of land, water, pasture, forest resources, etc

PRACTICALS

1. Understanding basic concepts and terms in Farm Management, Production and Resource economics.
2. Determination of optimum input and output
3. Determination of least cost combination of inputs
4. Determination of profitable combination of products
5. Application of principle of equi-marginal returns
6. Seven types of costs and their computation
7. Farm cost concepts and their imputation procedure
8. Depreciation methods
9. Farm holding survey
10. Livestock – Farm survey
11. Estimation of cost of cultivation and farm income measures of major crops
12. Farm inventory analysis
13. Farm financial analysis – Preparation and analysis of balance sheet
14. Preparation and analysis of profit and loss statement
15. Preparation of farm plans
16. Preparation of enterprise budget and partial budget

REFERENCES

1. Economics of Agricultural Production and Resource Use: Heady, Earl O, Prentice Hall of India, Private Limited, New Delhi, 1964
2. Introduction to Agricultural Economic Analysis: BISHOP, C.E., & TOUSSAINT, W.D., NEWYORK, John Wiley and Sons, Inc., London, 1958
3. Fundamentals of Farm Business Management: S.S. Johl, J.R. Kapur, Kalyani Publishers, New Delhi
4. Agricultural Economics: Subba Reddy S., Raghuram P., NeelakantaSastry T.V., Bhavani Devi I., Oxford and IBH Publishing Company, Private Limited, New Delhi, 2006
5. Introduction to Farm Management: Sankhayan, P.L., Tata – Mc Graw – Hill Publishing Company Limited, New Delhi, 1983
6. Environmental Economics: R. N. Bhattacharya, Oxford India Publication
7. Hand Book of Environmental Economics: K. Chopra and VikramDayal, Oxford India Publication
8. Natural Resource Economics: Theory and Applications in India: Kerr, John M, Marothia D.K., Katar Singh, Ramasamy C & Bentley W.R., Oxford & IBH Publishing Company, Private Limited, New Delhi, 1997

Course No : AECO 242

Course Title : **Agricultural Finance and Co-operation**
Credit Hours : 2 (1+1)

THEORY

Lec. No	Topic
1.	Definition of agricultural finance – Nature – Scope – Meaning – Significance – Micro & macro finance
2.	Credit needs and its role in Indian agriculture. Agriculture credit – Meaning and definition of credit – Classification of credit based on time, purpose, security, source, liquidity, activity orientation, approach, and contact with farmer.
3.	Credit analysis – Economic feasibility tests – Returns to investment, Repayment capacity and Risk bearing ability (3Rs)
4.	Five Cs of credit – Character, Capacity, Capital, Condition and Common sense and Seven Ps of credit – Principle of productive purpose, Principle of personality, Principle of productivity, Principle of phased disbursement, Principle of proper utilization, Principle of payment and Principle of protection
5.	Methods and mechanics of processing a agriculture loan application
6.	Repayment plans: Lump sum repayment /straight-end repayment, Amortized decreasing repayment, Amortized even repayment, Variable or quasi variable repayment plan, Future repayment plan and Optional repayment plan
7.	Sources of agricultural finance – Institutional and non-institutional sources. Recent trends in agricultural finance –Social control and Nationalization of Banks
8.	Lead Bank Scheme – Origin – Objectives – Functions and progress; Regional Rural Banks (RRBs) – Origin – Objectives – Functions and progress – RRBs in Telangana
9.	Crop Loan System: Objectives – Salient features – Scale of finance and unit cost – Micro financing including KCC.
10.	Banking schemes for agricultural finance. Financial inclusion– Jan –Dhan scheme and other recent schems.
11.	Crop Insurance – Meaning and its advantages – Progress of crop insurance scheme in India – CCIS – National Agricultural Insurance Scheme (NAIS) –Modified NAIS – Weather Based Crop Insurance Scheme (WBCIS) – Livestock insurance – PM Fasal Bima Yojana. Advantages of crop insurance – Limitations in application and estimation of crop yields.
12.	Higher Financing Agencies – Reserve Bank of India (RBI) – Origin – Objectives and functions – Role of RBI in agricultural development and finance; National Bank for Agricultural and Rural Development (NABARD) – Origin, functions, activities and its role in agricultural development;
13.	International Bank for Reconstruction and Development (IBRD) – International Monetary Fund (IMF) – International Development Agency (IDA) – Asian Development Bank (ADB) – Insurance and Credit Guarantee Corporation
14.	Co-operation – Meaning – Objectives – Principles of Co-operation – Significance of co-operatives in Indian Agriculture.
15.	Brief history of cooperative development in India – Cooperative movement during pre – Independence period – Progress of cooperative movement during post-independence period

16.	Classification of co-operative credit institutions – Primary Agricultural Cooperative Credit Societies (PACS) – Farmers Service Societies (FSS) – Multi-Purpose Cooperative Credit Societies (MPCS) and Large-Sized Adivasi Multipurpose Cooperative Societies (LAMPS) – Marketing, consumer, Processing and Farming co-operatives. – Reorganization of Rural Credit Delivery System and concept of single window system – Andhra Pradesh mutually aided Co-operative Societies Act,1995, (Telangana Adaptation Order 2016)

PRACTICALS

1. Understanding basic concepts and terms in agricultural finance & co-operation
2. Working out the various repayment plans
3. Study of commercial banks/ RRB
4. Study of NABARD
5. Study of PACS/ DCCB
6. Study of SHGs
7. Estimation of scale of finance
8. Estimation of indemnity
9. Estimation of credit limits under Kisan Credit Card
10. Study of FSS
11. Study of Dairy co-operatives/ any other co-operative institution
12. Appraisal of loan proposal-A case study
13. Techno-Economic parameters for preparation of projects
14. Preparation of bankable projects for various agricultural and value added products
15. Study of Farmers Producers Association / Companies

REFERENCES

1. Ghosal, S.N., Agricultural Financing in India, Asia Publishing House, Bombay, 1966
2. Johl, S.S. and C.V. Moore., Essentials of Farm Financial Management, Today and Tommorow's Printers and Publishers, New Delhi, 1970
3. Mamoria, C.B. and R.D. Saksena., Co-operation in India, Kitab Mahal, Allahabad, 1973
4. Mukhi, H R. Cooperation in India and Abroad. New Heights Publishers, New Delhi, 1983
5. Muniraj, R., Farm Finance for Development, Oxford & IBH Publishing Company Private Ltd., New Delhi, 1987
6. Subba Reddy, S. and P.Raghuram., Agricultural Finance and Management, Oxford & IBH Publishing Company Private Ltd., New Delhi, 2005
7. Subba Reddy, S., P.Raghuram., P. Sastry, T.V.N. and Bhavani Devi I. Agricultural Economics., Oxford & IBH Publishing Company Private Ltd., New Delhi, 2010

Course No : AECO - 341
Course Title : **Agricultural Marketing, Trade and Prices**
Credit Hours : 3(2+1)

THEORY

Lec. No	Topic
1	Market and Marketing – Meaning – Definitions – Components of market – Market structure – Meaning – Components – Market conduct – Market performance
2	Agricultural Marketing – Meaning – Definition – Scope – Subject matter – Importance of agricultural marketing in economic development.
3	Classification of markets – On the basis of location, area of coverage, time span, volume of transaction, nature of transaction, number of commodities, degree of competition, nature of commodities, stage of marketing, extent of public intervention, type of population served, accrual of marketing margins
4	Demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products.
5	Producers surplus – Meaning and its types. Marketable surplus – Marketed surplus. Factors affecting marketable surplus of agri-commodities.
6.	Marketing mix, importance and its various components.
7	Market segmentation, market targeting and product positioning
8	Product life cycle (PLC) Meaning and stages in PLC. Characteristics of PLC.
9	Pricing considerations and approaches – Cost based and competition based pricing.
10	Market promotion – Advertising, personal selling, sales promotion and publicity – Meaning and components.
11	Marketing process and functions: Marketing process – Concentration, dispersion and equalization.
12	Marketing functions – Meaning – Exchange functions – Buying and selling.
13	Physical functions – Storage, transport and processing.
14	Facilitating functions – Packaging, branding, grading, quality control and labeling.
15	Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing.
16	Meaning and definition of marketing channel. Number of channel levels – Marketing channels for different farm products.
17	Market integration – Definition – Types of market integration – Horizontal, vertical and conglomeration.
18	Marketing efficiency – Meaning – Definitions– Technical or physical or operational efficiency – Pricing or allocative efficiency
19	Marketing cost – Margins – Price spread – Factors affecting the costs of marketing – Reasons for higher marketing costs of agricultural commodities – Ways of reducing marketing costs for farm products.
20	Role of Govt. in agricultural marketing – Regulated markets – Definition– Important and Features of regulated markets, functions, progress and defects

21	Public sector institutions – Warehousing – Meaning- warehousing in India – Central Warehousing Corporation(CWC) – Working of warehouses – Advantages – State Warehousing Corporations (SWC) – Food Corporation of India(FCI) – Objectives – Functions
22	Public sector institutions – FCI& DMI – Objectives – Functions
23	Cooperative marketing – Meaning – Structure – Functions of cooperative marketing societies
24	National Agricultural Cooperative Marketing Federation (NAFED) and State Agricultural Cooperative Marketing Federations (MARKFED) – State Trading-objectives – Types of state trading.
25	Risks in agriculture marketing – Nature and types of risk
26	Speculation & hedging; an overview of futures trading.
27	Characteristics of agricultural product prices – Agricultural price stabilization – Need for agricultural price policy – Commission for Agricultural cost and Prices (CACP) – Administered prices – Minimum Support Price, Procurement Price and Issue Price
28	Trade: Concept of International Trade and its need – Definition – Differences between international and inter – Regional trade– free trade vs. protection
29& 30	Theories of absolute and comparative advantage.
31	Present status and prospects of international trade in agri-commodities; WTO – Evolution – Role and functions
32	Agreement on Agriculture (AoA) and its implications on Indian agriculture;Trade Related Intellectual Property Rights(TRIPS)

PRACTICALS

1. Understanding basic concepts and terms used in agricultural marketing, trade and prices
2. Plotting and analysis the demand and supply curves
3. Calculation of various types of Elasticities
4. Analysing relationship between market arrivals and prices of some selected commodities
5. Computation of marketable and marketed surplus of important agricultural commodities
6. Study of price behaviour over time for some selected agricultural commodities;
7. Visit to a local market to study various marketing functions performed by different agencies.
8. Visit to regulated market
9. Identification of marketing channels for selected agricultural commodity
10. Collection of data regarding marketing costs, margins and price spread and its analysis
11. Presentation of the results analysis is in the class.
12. Visit to market institution – (NAFED) to study then organization and its functions
13. Visit to SWC to study the organization and its functions
14. Visit to CWC to study the organization and its functions.
15. Visit to Cooperative Marketing society to study the organization and its functions
16. Application of principles of comparative advantage for international trade

REFERENCES

1. Acharya S.S and Agarwal NL, 2006, Agricultural Marketing in India. Oxford & IBH Publishing Co.Pvt.Ltd. New Delhi
2. Kahlon, A.S and Tyagi.D S, 1983 Agricultural Price Policy in India. Allied Publishers Pvt. Ltd., New Delhi.
3. Kulkarni, K R.1964, Agricultural Marketing in India. The Co-operators Books Depot, Mumbai.
4. Mamoria, C.B. and Joshi. R L.1995, Principles and Practices of Marketing in India, Kitab Mahal, Allahabad
5. Mamoria, C.B., 1973., Agricultural Problems in India, Kitab Mahal, Allahabad
6. Subba Reddy, S., P.Raghu Ram., P. Sastry, T.V.N. and Bhavani Devi I. 2010. Agricultural Economics., Oxford & IBH Publishing Company Private Ltd., New Delhi, 2010

Department : School of Agribusiness Management,
College of Agriculture,
Rajendranagar.
Course Title : Human Values and Ethics (non-gradial)
Course No : ABM 101
Credits : 1 (1+0)

1. Human values – definition – concepts – culture and values – socialization – evaluation of human values – types of values.

2. Ethics – introduction – origin of ethics – meaning – types of ethics – ethical issues – ethical conflict – national differences in ethics – ethical behaviours, ethics vs. morals and values.

3. Virtues – civic virtues – civic knowledge – self restraint – self assertion – self reliance – respect for others – living peacefully – caring, sharing, honesty, courage, valuing time, cooperation, commitment, empathy, self confidence.

4. Goals in life – steps in goal setting – SMART Goals, mission for life – linking mission to goal setting – vision of life – driving one self to success – self esteem and self confidence.

5. Art of self improvement – self exploration – self awareness – putting capabilities to use – SWOT analysis.

6. Personality development – definition – elements and stages of personality development. Attitudes of attachment and detachment.

7. Interpersonal skills – delegation, humour, trust, expectations, values, status, compatibility and their role in building team work – resolving conflicts.

8. Ethical decision making – role of moral philosophies in decision making – difficulties in decision making – ethical reasoning – levels of decision making.

9. Ethics in media and technology – impact on youth, cyber ethics and etiquette, mobile phones, social networking – correct and judicious use.

10. Positive spirit – anatomy of the self – the mind – the intellect – the sub conscious mind – consciousness - the cyclic process within the self – states of awareness – innate and acquired qualities of the self – power to act.

11. Spirituality – concepts, nature and identity of god – form or image – attributes – relationship – purpose and benefits – power and acts – meditation – transmitter and receiver – morality and religion.

12. Positive thinking – assertiveness – coping with life stresses – peer pressure – suicidal tendencies – addiction – substance abuse.

13. Professional ethics – code of professional ethics in agricultural research – organizational ethics – violation of code of ethics – causes and consequences – whistle blowing.

14. Gender issues and gender sensitivity at work place – legal provisions.

15. Managing emotions – anger, frustration, helplessness etc, emotional intelligence – meaning and role in leading a balanced life.

16. Case study on ethics & values.

REFERENCES

1. Professional Ethics and Human Values – R. S. Naagarazan, New Age International Publishers -2006.
2. Values and Ethics in Business and Profession – Samita Manna and Suparna Chakraborthi, PHI Learning Pvt Ltd, New Delhi 2010.

Reading List

1. Scientific Values and Professional Ethics in Agricultural Research – Jagannadham Challa, Principal Scientist, HRD, NAARM, Rajendranagar, Hyderabad – 500 030.
2. Ethical Issues in Agricultural Research, Technology and Intellectual Property Rights – Anil K. Gupta, Indian Institute of Management, Ahmadabad 380 015, anilg@iimahd.ernet.in, www.iimahd.ernet.in ~ anilg, www.sristi.org , www.nifindia.org.
3. Human Values and Professional Ethics – R R Gour, R. Sangal and G.P.Bhagaria, Excel books, New Delhi, 2012.

AGRICULTURAL EXTENSION

Course No. : AEXT 191

Course Title : Rural Sociology and Educational Psychology

Credit hours : 2 (2+0)

General Objectives

At the end of the semester, the students will be able to

1. To impart knowledge to the students on sociological and psychological aspects of rural people and to acquaint with some important features of rural society

Specific Objectives

At the end of this semester, the students will be able to

1. Understand concept of rural sociology, its importance in agricultural extension, characteristics of Indian rural society.
2. Understand social groups, social stratification, culture, leadership and training
3. Understand concept of educational psychology, intelligence, personality, motivation, teaching and learning

S. No.	Lesson	Time required	Teaching method	Teaching aid(s)
1	**Sociology and Rural sociology, Extension Education & Agricultural Extension :** Meaning, Definitions, Branches of Sociology	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
2	Scope & significance of rural sociology in agricultural extension and their interrelationship	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
3	**Rural society:** definition & characteristics of Indian rural society.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
4	Differences and relationships between rural and urban societies	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
5	**Social Groups:** Meaning and classification	1hrs	interactive lecture	Chalk board, Computer aided instructions (CAI
6	**Rural Social Groups**: DWACRA, RMG and CIG	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI
7	**Role of Social Groups in Agricultural Extension**	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI

8	**Social Stratification**: Meaning , forms - class system and caste system and the influence of social stratification on extension	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI
9	**Culture**: Meaning & definition. Types of culture, different cultural concepts and. their role in agricultural extension	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI
10	**Social Institutions**: Meaning, types & their role in agricultural extension.	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI
11	**Social change & development:** Meaning and definition	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
12	**Social ecology:** Meaning and definition	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
13	**Rural development:** Concept , meaning, definition and problems	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
14	**Extension efforts in pre-independence Era**: Srinikethan, Marthandam, Firka Development and Gurgaon	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
15	**Extension efforts in post-independence Era:** Etawah pilot project, Nilokheri experiment Extension system in India- Four lines of extension	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
16	**Community development :** Meaning, definition, concept, principles and philosophy	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
17	**Extension programmes of GOI:** IADP, IAAP, HYVP	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
18	**Frontline extension programmes of ICAR:** IVLP, ORP & ND	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
19	**Psychology and Educational Psychology:** Meaning, scope and importance in agricultural extension	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
20	**Behaviour:** meaning, definition & types. Cognitive, effective and psychomotor domain and its effect on agricultural extension work	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI

21	**Rural Leadership:** concept, theories, meaning &definition, Classification/types of leaders in rural context	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
22	Roles of a leader and different methods of selection of lay & professional leaders	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
23	**Training:** Definition andtypes of training to professional and lay leaders.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
24	**Personality:** Meaning, Definition , Types, Factors and importance in Agricultural Extension	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
25	**Motivation:** Meaning, Types of motives, importance of motivation in agricultural extension	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
26	Demotivators, Techniques of Motivation	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
27	Theories of motivation	1hr	Interactive Lecture	Chalk board, Computer aided instructions (CAI
28	**Intelligence:** Meaning, types, factors and importance in agricultural extension	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
29	**Learning and Teaching:** Meaning & definition of learning, teaching, learning experience, & learning situation.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI
30	Elements of learning situation & their characteristics.	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI
31.	Principles of learning and their implications in teaching	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI
32.	Steps in extension teaching,	1hr	interactive lecture	Chalk board, Computer aided instructions (CAI

REFERENCES

S.No.	Title and authors
1.	Adivi Reddy, A. 2001. Extension Education. Sri Lakshmi Press, Bapatla.
2.	Chitamber, J.B. 1997. Introductory Rural Sociology. Wiley Eastern Limited, New Delhi.

3.	Daivadeenam, P. 2002. Educational Psychology in Agriculture. Agrotech Publishing Academy, Udaipur.
4.	Mangal, S.K. 2000. Educational Psychology. Prakash Brothers, Ludhiana.
5.	Ray, G.L. 2006. Extension Communication and Management. Naya Prakashan, Kolkata.
6.	Vidyabhushan and Sach Dev, D.R. 1998. An Introduction to Sociology. Kitab Mahal Agencies, Allahabad

Course No : AEXT 291
Course Title : **Fundamentals of Agricultural Extension Education**
Credit Hours : 3 (2+1)

4. Course Objectives

GENERAL

1. To improve the knowledge level of the students on concepts, Principles of Extension Education ,various extension teaching methods and information sources.
2. To acquaint the students with Agricultural journalism, Innovation Decision Process and capacity building of various stake holders.

B. SPECIFIC

I. THEORY

At the end of the semester the students will be able to

- Understand the concepts, Principles of Extension Education & Models and barriers in communication.
- Define extension teaching method, enlist functions and classify the extension teaching methods.
- Explain the procedure involved in carrying out individual, group and mass contact methods and enlist the factors influencing selection and combination of extension teaching methods.
- identify and understand various information sources for effective transfer of technology .
- understand the scope and importance of agricultural journalism and state the sources of news and types.
- Define the adoption and diffusion processes, explain models of adoption processes and innovation decision process.
- Gain understanding on training, types of training to farmers, farm women and rural youth for their capacity building.
- Know the importance, objectives and functions of different transfer of technology centers.

II Practical

At the end of this semester, the students will be able to gain

- Skill to communicate effectively in transfer of technology.

- Skill in organization of group discussion and method demonstration in transfer of technology.
- First hand experience on activities of extension units.
- Skills in writing scripts for mass media along with the preparation of agricultural information materials.
- Skill in selection and preparation of projected and non projected visual aids .
- Skill in handling of public address equipment, video camera and LCD Projector.

5. COURSE CONTENT

A. THEORY

S.No.	Lesson	Time	Teaching Method	Teaching Aids
1	**Extension education:** Meaning, definition, types, scope & process.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
2	Objectives & principles of extension education	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
3	**Extension programme planning**: meaning of programme planning & principles	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
4	Steps in programme development	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
5	**Extension administration:** Meaning, concept, principles & functions	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
6	**Monitoring & evaluation of extension programmes:** Monitoring- definition & concept Evaluation- definition & types	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
7	Differences between monitoring & evaluation & importance of evaluation in agricultural extension	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
8	**Communication:** Meaning, definition & elements of communication & their Characteristics. .	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
9	**Models:** Aristotle, Shannon & weaver, Schramm, Paul Leagans, Westley, Macclean & Litterer	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
10	Concepts of Communication: Empathy, redundancy, fidelity, frame of reference, entropy. Barriers to communication	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)

11	**Extension teaching methods:** Definition, functions, classification according to use & form- individual. Group & mass contact methods	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
12	Media mix, selection & combination of extension teaching methods	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
13	**Agricultural journalism :** Meaning, Scope, importance, characteristics of news, factors determining news value, types and sources of news	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
14	**Diffusion and adoption of innovation:** Definition & meaning of diffusion & adoption, **adoption process:** 5 stage & 7 stage models	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
15	Classification of adopter categories & their characteristics	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
16	Concept of adoption, over adoption, rate of adoption. Innovation: meaning & attributes of innovation	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
17	**Innovation decision process:** Meaning, definition & stages	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
18	Factors influencing rate of adoption process	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
19	**Transfer of technology**: Concept & models with examples	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
20	**Reforms in Agricultural Extension: ATMA, SREP**	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
21	**Gap Analysis**	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
22 & 23	**New trends in agricultural extension**: Privatization of extension, meaning, factors influencing privatization of extension, merits & problems, strategies with examples	2 hrs	Interactive lecture	Chalk board, Computer aided instructions (CAI)
24	Cyber extension meaning, features, successful models	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
25	**Kisan call centers, farmers call**	1hr	Interactive	Chalk board,

	centers: Meaning. Objectives, operational mechanism		lecture	Computer aided instructions (CAI)
26	**Market led extension**: Meaning, enhanced roles of agriculture extension personnel in light of market led extension, Difference between TOT & market led extension.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
27	**Indigenous Technical Knowledge:** Meaning, Definition, Methods of Documentation of ITKs	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
28	**Farmers led extension:** Meaning, Examples.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
29	**Expert system in agriculture**: Meaning, components, examples	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
30	**Capacity building of extension personnel and farmers:** training meaning, **types of training:** pre service, in-service, orientation, induction, refresher training	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
31	**Training to farmers &farm women**: time, duration & venue, short term, midterm & long term. FTC, KVK , DAATC: mandate & objectives	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
32	**PRA: Meaning, techniques and importance in Agricultural Extension**	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)

B. PRACTICALS

S.No	Practical	Time Required	Teaching Method
1	To get acquainted with university extension system/visit to the DAATCC/KVK centres of Agricultural University	2 ½ hrs	Work shop
2& 3	Organization of group discussions	2 ½ hrs each	-Do-
4	Handling and use of Audio-Visual Aids	2 ½ hrs	Workshop
5	Preparation of extension literature-Leaflet, Booklet, folder, pamphlet	2 ½ hrs	-do-

6&7	Presentation skills - exercise	2 ½ hrs each	-do-
7&8	Microteaching exercise	2 ½ hrs each	-do-
9	A visit to the village to understand the problems being encountered by the villagers/problems through PRA exercise	2 ½ hrs	-do-
10	To study organization and functioning of DRDA and other development departments at district level	2 ½ hrs	-Do-
11	Visit to NGO and learning from their experience in rural development	2 ½ hrs	-Do-
12	Understanding PRA techniques and their application in village development planning	2 ½ hrs	-do-
13	Exposure to mass media: visit to community radio and television studio for understanding the process of programme production	2 ½ hrs	-do-
14	Planning and writing of scripts for radio	2 ½ hrs	-do-
15&16	Planning and writing of scripts for print and electronic media	2 ½ hrs each	-do-

REFERENCES

1. Extension Education . Adivi Reddy,A .1987. Sree Lakshmi Press, Bapatla.
2. Extension Communication and management. Ray, G. L.1991. Naya Prakashan, Kolkata.
3. Communication. Rayudu, C. S. 1997. Himalaya Publishing House, Hyderabad.
4. Text book on Agricultural communication : Process and methods. Sandhu, A. S. 1993. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
5. Fundamentals of Extension Education and management in Extension. Jalihal, K. A. and Veerabhadraiah, V. 2007 . Concept Publishing Co. New Delhi.
6. Communication of Innovations. Rogers, E. M. and Floyd F. Shoemaker. 1971 Free Press, A division of Macmillan Publishing Co.
7. Diffusion of innovations. Rogers, E. M. 1995. Free Press, New York.
8. Education and Communication for Development. Dahama, O. P. and Bhatnagar, O. P. 1980. Oxford and IBH Publishing Co., New Delhi.
9. Audio Visual Aids in Teaching, Training and Extension. Yella Reddy, N. 1998. Haritha Publishing House Hyderabad.
10. Mass Communication and Journalism in India. Mehta, D. S. 1979. Allied Publishers Ltd. New Delhi.
11. Essentials of educational technology, teaching learning innovations in education. Aggarwal, J. C.
    1995. Vikas publishing house Pvt. Ltd. New Delhi.

12. Theory and practice of journalism. Ahuja, B. N. 1979. Surjeeth publication, Delhi.
13. Producing Agricultural information materials extension bulletin. Somasundaram, T. 1972. Kansas State University , USA and APAU, Rajendranagar.
14. Website of MANAGE- *www.manage.gov.in*

Course No : AEXT 292
Course Title : **Communication Skills & Personality Development**
Credit Hours : 2 (1+1)

4. Course Objectives

C. GENERAL

To improve the knowledge level of the students on various communication skills & personality development

D. **SPECIFIC**

I. THEORY

At the end of the semester the students will be able to

1. Understand the meaning & Concepts of communication skills- hard and soft skills.
2. Identify and understand various Non verbal communication skills.
3. Gain understanding on the skills of learning and presentation.
4. Know the importance of Personality Development and identify the different personality traits.
5. Understand the different dimensions of Personality Development like Attitude, Team work, management of Conflicts , stress & Time etc.

II PRACTICAL

At the end of this semester, the students will be able to gain

1. Effective Presentation skills
2. Skill in organization and participation in group discussions.
3. Firsthand experience on reading and comprehension skills.
4. Understanding of importance and insight into creativity skills.

5. Course Content

A. THEORY

S.NO	Lesson	Time required	Teaching Method	Teaching Aids
1	**Communication:** Meaning & process of communication. **Forms of communication:** verbal & non-verbal -meaning.	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
2	**Communication skills**: Meaning, hard & soft skills – over view	1hr	Interactive lecture	Chalk board, Computer aided

				instructions (CAI)
3	**Verbal & non- verbal communication:** Verbal: oral &written skills Non- verbal communication skills: Concept, meaning, forms & functions, importance of non- verbal communication in communication	1hr	Interactive lecture	Chalk board, (CAI)
4	**Listening skill-** meaning, concept, types of listening, barriers in listening & **Note Taking**	1 hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
5	**Oral presentation skills**: impromptu presentation & extempore presentation	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
6	**Effective Public Speaking**	1hr	Interactive lecture	Chalk board, Computer aided instructions (CAI)
7	**Group discussion**: Procedure, principles, purpose, advantages & disadvantages	1hr	Interactive lecture	Chalk board, (CAI)
8	**Small group discussion techniques**: Panel. Symposium, buzz session, syndicate, conference, seminars, workshop, debate and lecture	1hr	Interactive lecture	Chalk board, (CAI)
9	Writing of technical articles , field diary & lab record, indexing, footnote &bibliographic procedures	1hr	Interactive lecture	Chalk board, (CAI)
10	**Personality development** : Meaning, definition & overview of personality traits	1hr	Interactive lecture	Chalk board, (CAI)
11	**Questioning skills**	1hr	Interactive lecture	Chalk board, (CAI)
12	**Attitude:** Meaning, functions of attitude, developing positive attitude	1hr	Interactive lecture	Chalk board, (CAI)
13	**Team building**: working in teams	1hr	Interactive lecture	Chalk board, (CAI)
14	**Time management**: Importance & role in personality development & time management techniques	1hr	Interactive lecture	Chalk board, (CAI)
15	**Conflict management**: Meaning. Concept, causes of conflict & managing conflicts	1hr	Interactive lecture	Chalk board, (CAI)
16	**Stress management** : Meaning, definition, management of stress	1hr	Interactive lecture	Chalk board, (CAI)

PRACTICALS

S.NO	PRACTICAL	TIME REQUIRED	TEACHING METHOD
1	Simulation exercise for non- verbal communication & students feedback	2 ½ hrs	Simulation exercise
2	Listening & note taking & student feed back	2 ½ hrs	Practical exercise
3	Exercise on reading & comprehension & students feedback	2 ½ hrs	Practical exercise
4	Exercise on impromptu presentation & students feedback	2 ½ hrs	Presentation by the students
5&6	Group discussion – Practical exercises	2 ½ hrs each	Participatory exercises
7	Exercise on writing of technical articles& students feedback	2 ½ hrs	Presentations
8	Identification of personality types- role play & psychological tests & students feedback	2 ½ hrs	Role Play
9	Attitude-Role play- analysis of attitude & student feedback	2 ½ hrs	Role Play
10	Working in learners- management games	2 ½ hrs	Simulation games
11	Simulation exercise on time management	2 ½ hrs	Simulation games
12	Simulation exercise on conflict management	2 ½ hrs	Simulation games
13,14 &15	Interview Skills – Mock interviews	2 ½ hrs each	Mock interview
16	Simulation exercise on creativity	2 ½ hrs	Simulation game

REFERENCES

1. Communication Skills. Sanjay Kumar. 2011. Oxford Publication. ISBN 9780198069324.
2. Extension Communication and Management- Ray G L 1991 Naya Prakasham, Kolkata.
3. Communication of Innovations- Rogers EM and Floyd F Shoemaker 1971 Free Press, a division of Macmillan Publishing Co
4. Education and communication for development Dahama O P and Bhatnagar O P 1980 Oxford and IBH publishing Co., Delhi

5. Communication Rayudu C S 1997 Himalaya publishing house, Hyderabad
6. Personality Development and Soft skills. Barun K. Mitra. 2011. Oxford Publication. ISBN 13 0198066217.
7. Soft Skills for Professional Excellence – Personality Development – Vol I and II, CRTD Publications, Hyderabad.
8. A Youngsters' guide to personality development. S.P. Sharma 2013 V &S Publishers Delhi

Course No. : AEXT 391
Course Title **:** **Entrepreneurship Development & Business Communication**
Credit Hours : 2(1+1)

Objectives

By the end of the course the students will be able to

THEORY

- Describe the concepts of entrepreneur, entrepreneurship, agricultural entrepreneurship, characteristics of entrepreneur, achievement motivation & entrepreneurship, business management skills.
- Gain knowledge and skills in project formulation, project report preparation and evaluation of projects.
- Explain Entrepreneurship Development programmes, Govt. policies, schemes and incentives for promotion of entrepreneurship, supply chain management and total quality management
- Develop business communication skills- reading, writing, listening and presentation skills.

PRACTICALS

- Study successful enterprises, entrepreneurs and develop project proposal through field visits.
- Experience various functions and develop the managerial skills through simulated exercises.
- Prepare and present project reports.

THEORY

S. No.	Time	Topic/Lesson	Teaching Methods	Teaching Aids
1	1 hr	Concept of Entrepreneur, Entrepreneurship, Agri-Entrepreneurship, concept, need, scope and opportunities of Rural and Agri Enterprises	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
2	1 hr	Entrepreneurial Characteristics	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
3	1 hr	Impact of economic reforms in agribusiness and agri enterprise and over view of Agri Business in the	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt

		Country		
4	1 hr	Entrepreneurship Development Programmes (EDPs)-objectives, phases, Government policies and programmes and schemes	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
5	1 hr	EDP Process-Stages	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
6	1 hr	Developing organizational skills (controlling, supervision, monitoring and evaluation)	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
7	1 hr	Achievement Motivation, Problem solving skills	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
8	1 hr	Managing an enterprise, SWOT analysis, Time Management.	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
9	1 hr	Business written communication skills and Negotiation Skills	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
10	1 hr	Managerial skills (planning, budgeting, coordination, decision making) for Entrepreneurship Development	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
11	1 hr	Financing an Enterprise and Venture Capital	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
12	1 hr	Institutional Support to entrepreneurs	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
13	1 hr	Business Leadership Skills (communication, direction and motivation skills)	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
14	1 hr	Project- meaning, importance, project formulation, project report components and preparation.	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
15	1 hr	Supply Chain Management-Meaning, definition, process, advantages and disadvantages	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt
16	1 hr	Total quality Management: Meaning, definition, process and advantages	Lecture & Discussion	Chalkboard, Whiteboard & Power point PPt

PRACTICAL

S. No.	Time	Topic/Lesson	Teaching Methods	Teaching Aids
1.	2 ½	Simulation exercise on assessing	Group	Chalkboard, Whiteboard

	hrs	entrepreneurial traits	exercise	& Power point PPt
2.	2 ½ hrs	Practical exercise on problem solving skills	Simulation exercise	Chalkboard, Whiteboard & Power point PPt
3.	2 ½ hrs	Practical exercise on managerial skills	Simulation exercise	Chalkboard, Whiteboard & Power point PPt
4.	2 ½ hrs	Achievement motivation, goal setting	Individual &Group exercise	Chalkboard, OHP, & Whiteboard
5.	2 ½ hrs	Identification and selection of business ideas	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
6.	2 ½ hrs	Practical exercise on decision making	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
7.	2 ½ hrs	Planning ,Preparation of business plan and proposal writing.	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
8.	2 ½ hrs	Monitoring and supervision of entrepreneurial activities	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
9.	2 ½ hrs	Practical exercise on Creativity	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
10.	2 ½ hrs	Presentation of business proposal	Individual exercise	Chalkboard, Whiteboard & Power point PPt
11.	2 ½ hrs	Practical exercises on time Management / time Audit	Simulation exercise	Chalkboard, Whiteboard & Power point PPt
12.	2 ½ hrs	SWOT analysis of selected enterprise.	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
13.	2 ½ hrs	Leadership Skills: organization skills	Individual &Group exercise	Chalkboard, Whiteboard & Power point PPt
14.	2 ½ hrs	Visit to entrepreneurship Development Institute	Visit	Chalkboard, Whiteboard & Power point PPt
15.	2 ½ hrs	Business Communication and Negotiation	Simulation exercise	Chalkboard, Whiteboard & Power point PPt
16.	2 ½ hrs	Field Visit to Successful Enterprise- Study of Characteristics of Successful Entrepreneurs - Case Study.	Visit	Chalkboard, Whiteboard & Power point PPt

REFERENCE BOOKS

S. No.	Author's Name	Publishing Year	Book Name
1.	Anil Kumar S, Poornima S C, Mini K Abraham and Jayashree K	2003	Entrepreneurship development, *New Age international Publishers, New Delhi-110002*
2	Dipak De , Basavaprabhu Jirli	2008	Dynamics of entrepreneurship development in Agriculture-Basics to advances, Ganga Kaveri Publishing house, Varanasi.
2	Gupta C. B.	2001	Management Theory & Practice, *Sultan Chand &Sons.*
3	Indu Grover	2008	Handbook on Empowerment & Entrepreneurship, *Agrotech Public Academy*
	Jasmir Singh Saini	1996	Entrepreneurship Development Programmes and Practices, Deep Deep Publications , New Delhi.
4	Khanka S. S.	1999	Entrepreneurial Development, *S. Chand & Co.*
5	Mary Coulter		Entrepreneurship in Action 2nd edition, Prentice Hall of India, New Delhi
6	Mohanty S K	2009	Fundamentals of Entrepreneurship, Prentice Hall of India, New Delhi
7	Singh D.	1995	Effective Managerial Leadership, *Deep & Deep Publ.*
8.	Vasanta Desai	2000	Dynamics of entrepreneurial development & Management
9	Vasanta Desai	1997	Small Scale Industries & Entrepreneurship, *Himalaya Publ. House.*
10.	EEI, ANGRAU, R'nagar, Hyderabad	2004	Reading Material of Personality development Training porgramme
11	Sagar Mondal & G L Ray	2009	Text book of Entrepreneurship and Rural development
12	R Prasad	2003	Entrepreneurship- Concepts and Cases ICFAI publications

BIO-CHEMISTRY

1. Course No. : BICM 101

2. Course Title :**Fundamentals of Plant Biochemistry and Biotechnology 3(2+1)**

3. Credit Hours : 3 (2+1)

4. General Objective : To impart knowledge on the fundamentals of biochemistry and biotechnology

5. Specific Objectives

a) Theory

By the end of the course, the students will be able to

i. understand the concepts of biochemistry and biotechnology

ii. understand the biochemical reactions occurring in living cells

b) Practical

By the end of the practical exercises, the students will be able to

i. differentiate between qualitative identification and quantitative estimations

ii. understand the separation of biomolecules using various biochemical techniques

iii. understand the basic techniques of biotechnology

S.No	Lecture details
1.	Introduction – importance of biochemistry – scope of biochemistry
2.	Properties of Water- ionization, cohesive, universal solvent, colligative properties, electrolyte and physical properties
3.	pH and Buffer – Phosphate and carbonate-bicarbonate buffer
4.	Carbohydrate: Importance and classification. Structures of Monosaccharides
5.	Reducing and oxidizing properties of Monosaccharides, Mutarotation;
6.	Structure of Disaccharides and Polysaccharides
7.	Lipid: Importance and classification
8.	Structures and properties of fatty acids; storage lipids and membrane lipids
9.	Proteins: – amino acids – classification – protein and non protein amino acids, essential and non essential amino acids – classification based on their hydrophobicity of R(side chain) groups
10.	Reactions of amino acids - Ninhydrin reaction and peptide bond formation-– titration and zwitterions nature of amino acids

11.	Structure of proteins – primary, secondary, tertiary and quaternary structures and forces involved in stabilizing protein- Ramachandran plot
12.	Enzymes: General properties; Classification; Mechanism of action; Michaelis&Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes.
13.	Enzymes – characteristics of enzymes – chemical nature, speed, specificity, active site and Mechanism of action – activation energy and change in free energy of enzyme catalyzed reaction.
14.	Measurement of enzyme activity – factors affecting enzyme activity – Line Weaver Burk equation & plots – allosteric enzymes
15.	Classification of enzymes - coenzymes
16.	Nucleic acids –importance – structure of nitrogen bases – nucleosides and nucleotides – Adenosine triphosphate (ATP), Guanosine triphosphate (GTP), Cytidine triphosphate (CTP), Thymidine triphosphate (TTP) and Uridine triphosphate (UTP)
17.	Types of DNA -A, B & Z DNA -secondary structure of DNA- Tertiary structure-- packing of DNA into chromosomes
18.	RNA: Types and Secondary and Tertiary structure
19.	Metabolism – anabolism – catabolism – stages of respiration – over all metabolic view of carbohydrates, proteins and lipids
20.	Glycolysis and Tricarboxylic Acid (TCA) cycle- metabolic energy generation in the above cycles
21.	Oxidative phosphorylation and substrate level phosphorylation – electron transport chain in mitochondria
22.	Metabolism of lipids – anabolism of saturated fatty acids, unsaturated fatty acids and triacylglycerols
23.	Catabolism of lipids – triacylglycerols – α , β and ω oxidation of fatty acids in brief and b oxidation in detail – glyoxylate acid cycle
24	Concepts and applications of plant biotechnology: Scope, organ culture,
25.	embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications
26.	Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance
27.	Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation
28.	Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods
29.	Transgenics and its importance in crop improvement
30.	PCR techniques and its applications; RFLP
31.	RAPD, SSR Assisted Breeding in crop improvement
32.	Biotechnology regulations

S.No	Name of the practical
1.	Preparation of solution
2.	Preparation of buffers and pH
3.	Qualitative tests of carbohydrates and amino acids
4.	Quantitative estimation of glucose

5.	Quantitative estimation of proteins
6.	Titration methods for estimation of amino acids
7	Titration methods for estimation of lipids
8	Effect of pH, temperature and substrate concentration on enzyme action and plots
9	Separation of amino acids and Monosaccharides by Paper chromatography
10	Separation of amino acids and lipids by TLC
11	Sterilization techniques. Composition of various tissue culture media
12	Preparation of stock solutions for MS nutrient medium.
13	Callus induction from various explants. Micro-propagation, hardening and acclimatization.
14	Demonstration on isolation of DNA
15	Demonstration of paper electrophoresis techniques
16	Demonstration of DNA finger printing.

References

Buchanan, B.B., Gruissem, W. and Jones, R.L. 2002.Biochemistry and Molecular Biology of Plants. John Wiley and Sons, UK.

Conn, E.E., Stumpf, P.K., Bruening, G. and Doi, R.H. 1995. Outlines of Biochemistry. John Wiley and Sons Inc., Singapore.

Lehninger, A.L., Nelson, D.A. and Cox, M.M. 2005. Principles of Biochemistry.CBS Publishers and Distributors, New Delhi.

H.S. Chawla (2003), Introduction to plant biotechnology Oxford & IBH Publishing Co. New Delhi

B.D. Singh, (2006), Plant Biotechnology. Kalyani Publishers

K.S.Bilgrami and A.K.Pandey (1992) Introduction to Biotechnology CBS Pub. New Delhi

P.K.Gupta (1994) Elements of Biotechnology Rastogi and Co., Educational Publishers, Meerut

Stryer, L. 2005. Biochemistry. W.H. Freeman and Company, New York.

Voet, D. and Voet, J.G. 2004.Biochemistry. John Wiley and Sons Inc., USA. 180

U. Satyanarayana and U. Chakrapani , Biochemistry. A division of Reed Elsevier India. Pvt. Ltd 4th edition.

S.N.Gupta, Biochemistry.Rastogi publication Meerut – New Delhi

Rameshwar, A. 2006.Practical Biochemistry.Kalyani Publishers, Ludhiana.

Sadasivam, S. and Manickam, A. 1996.Biochemical Methods for Agricultural Sciences. New Age International Publisher, New Delhi.

MICROBIOLOGY

Course No. : AMBE-201
Credits : 2(1+1)
Course Title : Agricultural Microbiology

1.	Introduction. Microbial world, spontaneous generation theory, germ theory of disease, protection against infection	1 hr
2.	Microscopy, Magnification, Resolution power type of microorganisms	1 hr
3.	Review of Bacterial cell structure, Prokaryotic and Eukaryotic microbes	2 hr
4.	Growth of microorganisms: Cell division, growth cycle of bacteria	1 hr
5.	Chemoautotrophy	1 hr
6.	Photo autotrophy	1 hr
7.	Bacterial genetics: Variation, Adaptation and Mutation	1 hr
8-9.	Genetic recombination- transformation, conjugation and transduction, plasmids, transposon, Operon concept	2 hr
10.	Genetic code, Regulation of gene expression, Induction and repression, positive regulation	1 hr
11.	Role of microbes in soil fertility and crop production: Carbon cycle	1 hr
12.	Nitrogen, Phosphorus and Sulphur cycles	1 hr
13.	Biological nitrogen fixation- symbiotic, associative and asymbiotic, Azolla, blue green algae and mycorrhiza, Rhizosphere and phyllosphere.	1 hr
14.	Microbes in human welfare: silage production, Biofertilizers,	1 hr
15.	Biopesticides,	1 hr
16.	Biofuel production and biodegradation.	1 hr

Practical

1. Introduction to microbiology laboratory and its equipments;
2. Microscope- parts, principles of microscopy, resolving power and numerical aperture.
3. Methods of sterilization,

4. Nutritional media and their preparations.
5. Enumeration of microbial population in soil by bacteria,
6. Enumeration of microbial population in soil by fungi,
7. Enumeration of microbial population in soil by actinomycetes.
8. Methods of isolation and purification of microbial cultures.
9. Isolation of *Rhizobium* from legume root nodule.
10. Isolation of *Azotobacter* from soil.
11. Isolation of *Azospirillum* from roots.
12. Isolation of aerobic spore forming bacteria by Enrichment technique using Streak plate method
13. Staining and microscopic examination of microbes.
14. Enumeration of bacteria by Stain slide method
15. Enumeration of bacteria by Most Probable Number method
16. Enumeration of bacteria by Pour plate method
17. Enumeration of bacteria by Spread plate method

References

1. Microbiology: Pelczar, jr. M.J.E.C.S.Chan and Krieg. N.R, 1996.Mc graw hill publishers, New york
2. Microbiology: Prescott, Lm; Harley, J P. and Klein, D.A. (5ed) 2002. Mc graw hill Publishers, New york
3. Biology of Microorganisms: Madigan M Martinko J M and Parker J (10 ed.) 2003 Prentice Hall of India Pvt Ltd., New Delhi.
4. Agricultural Microbiology: Rangaswami G Bhagyaraj D J (2nd ed) 2001 Prentice hall of India Pvt Ltd., New Delhi
5. General Microbiology: Jamaluddin M, Malvidya N and Sharma A. 2006. Scientific publishers, Washington.
6. Introduction to Soil & Agricultural Microbiology: Prabhakaram. G. 2004. Himalaya publication house, mumbai
7. General Microbiology: Sullia, S.B, and Shantaram, 1998, Oxford and IBH Publising Company, private limited, New Delhi.

Manual for practicals

1. Agricultural Microbiology by Dr. R. Subhash Reddy,
Dept. of. Agril. Microbiology and Bioenergy, College of Agriculture, R' Nagar

ENGLISH

1.	Course No.	:	ENGL 101
2.	Course titles	:	**COMREHENSION AND COMMUNICATION SKILLS IN ENGLISH**
3.	Credit hours	:	2 (1+1)
4.	General objective:		To develop the comprehension and communication skills of I year B.Sc (Ag.) Students in English

A) Theory Lecture Outlines

1. War Minus Shooting, A lesson from the Text Book, "The Sporting Spirit" by George Orwell. Comprehension pertaining to the Textual Grammar i.e., Fill in the blanks, Matching and vocabulary
2. War Minus Shooting, A lesson from Text Book, "The Sporting Spirit" Reading Comprehension and answering the questions related to the text
3. Synonyms, List of synonyms, Choose the correct synonyms, exercises – practice and implementation
   Antonyms, fill in the blanks, choose the correct Antonyms, exercises Practice and Implementation
4. Verbal Ability, A list of Words often confused and misused – Practice and Implementation
5. A Dilemma – A lesson from the Text Book, Layman looks at Scienceby Raymond Fosdick Comprehension pertaining to the Textual Grammar i.e., Fill in the blanks, Matching, Vocabulary and Reading Comprehension
6. A Dilemma – A layman looks at Science, Reading Comprehension and answering the questions
7. Homonyms, Homonyms are distinct words with quite different meanings-use the following words in two ways, more words at a glance and exercises related to GRE & TOEFL
8. Homophones, A list of homophones, Fill in the blanks, Underline the correct word and exercises related to GRE & TOEFL
9. You and Your English, A lesson from the Text Book, Spoken English and Broken English by G.B. Shaw, answering the questions related to the Text. Fill in the blanks, Matching, Vocabulary and Reading Comprehension
10. You and Your English, Reading Comprehension and answering the questions
11. Functional Grammar, Tenses, Active voice and Passive voice, Degrees of comparison and types of sentences, Direct and Indirect speech and Agreement of verb with subject
12. Functional Grammar, Articles, Prepositions, Parts of Speech and Agreement of verb with subject
13. Business correspondence, Principles of letter writing, Courtesy and

Consideration, Directness and Conciseness, Avoid Verbosity and participial Endings, Clarity and Precision, Negative and round about, Structure and layout of letters , Planning a letter, Quotations, Orders, Tenders, Sales letters, Claim and Adjustment Letters, Job application letters, Social correspondence Personal Correspondence and CV

14. The Style**,** Importance of Professional Writing, Choice of words and phrases, Cliches, Jargons, Foreign words and phrases
15. Precis Writing, Summarizing,The essential features of a good précis, Important points while making a précis, Some Don'ts, Make a précis of the following paragraph and suggest suitable title. Figurative language
16. Interview, The Screening Interview, The informational Interview, The Directive Style, The Meandering Style, The Stress Interview, The Behavioural Interview, The Audition, The Tag-Team Interview, The Mealtime Interview, The Follow-up Interview, Fermi Interview, Preparing for the Interview, Body Language and Interview, Types of Interviews Questions. Idiomatic language

B) Practical Class Outlines

1. Effective Listening – Developing Listening Skills – Honing Listening skills
2. Listening to Short talks and Lectures from the cassettes of EFLUniversity
3. Spoken English, Vowels, consonants, monophthongs, diphtongs, triphthongs
4. Stress, intonation, phonetic transcription
5. Seminars, Conferences, preparation and demonstration
6. Oral Presentation by students, Articulation and delivery – Evaluation sheet for oral presentation
7. Communication skills – Verbal communication, written communication
8. Telephonic conversation
9. Reading Skills, Skimming, Scanning, Extensive reading, Intensive reading examples
10. Meeting, purpose, procedure, participation, physical arrangements
11. Presentation of reports by using power point & L.C.D
12. Interviews – Mock interviews
13. Debate and Group discussion
14. Using a dictionary effectively
15. Vocabulary
16. Pronunciation practice

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STATISTICS AND MATHEMATICS

1. Course No. **: SMCA 101**

2. Course Title **: ELEMENTARY MATHEMATICS**

3. Credit hours **: 2 (1+1)**

General Objectives:

To impart knowledge to the students on elementary mathematics topics required and useful in the study of agricultural courses .

Specific Objectives: At the end of this semester, the students will be able to

1. Understand concepts of geometry of straight lines, circles
2. Understand concepts on calculus and matrices and their applications

Sl. No.	Lesson	Time	Teaching method	Teaching Aid(s)
1	Straight lines : Distance formula, section formula (internal and external division)	1hr	Interactive lecture	Chalk board
2	Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes,	1hr	Interactive lecture	Chalk board
3	Problems on distance between the lines, Change of axes	1hr	Interactive lecture	Chalk board
4	Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line	1hr	Interactive lecture	Chalk board
5	Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two st. lines	1hrs	interactive lecture	Chalk board
6	Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral	1hr	interactive lecture	Chalk board
7	Problems on Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between	1hr	interactive lecture	Chalk board

	two lines, Area of triangle and quadrilateral			
8	Introduction to – Circle, Equation of circle with centre and radius, General equation of a circle, Equation of circle passing through three given points and tangent of the circle	1hr	interactive lecture	Chalk board
9	Differential Calculus : Definition of function, limit and continuity	1hr	interactive lecture	Chalk board
10	Problems on limits and continuity	1hr	interactive lecture	Chalk board
11	Simple problems on continuity, Differentiation of x^n , e^x , sin x & cos x from first principle	1hr	Interactive lecture	Chalk board
12	Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions	1hr	Interactive lecture	Chalk board
13	Simple problem based Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions	1hr	Interactive lecture	Chalk board
14	Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method	1hr	Interactive lecture	Chalk board
15	simple problems based on Logarithmic differentiation and differentiation by substitution method	1hr	Interactive lecture	Chalk board
16	Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form y=f (x)	1hr	Interactive lecture	Chalk board
17	Simple problems based on Differentiation of Inverse Trigonometric functions, Maxima and Minima of the functions of the form y=f (x)	1hr	Interactive lecture	Chalk board
18	Partial differentiation, homogeneous functions	1hr	Interactive lecture	Chalk board
19	Examples and problems on partial differentiation	1hr	Interactive lecture	Chalk board
20	Euler's theorem and its application	1hr	Interactive lecture	Chalk board
21	Integral Calculus : Integration of simple functions	1hr	Interactive lecture	Chalk board
22	Integration of Product of two functions, Integration by substitution method	1hr	Interactive lecture	Chalk board
23	Problems on Integration of Product of two functions, Integration by substitution method	1hr	Interactive lecture	Chalk board
24	Definite Integral, Area under simple well-known curves	1hr	Interactive lecture	Chalk board
25	simple problems based on Definite Integral, Area under	1hr	Interactive	Chalk

	simple well-known curves		lecture	board
26	Matrices and Determinants: Definition of Matrices, Addition, Subtraction	1hr	Interactive lecture	Chalk board
27	Problems on Addition, Subtraction and Determinants of Matrices	1hr	Interactive Lecture	Chalk board
28	Multiplication, Transpose of matrices	1hr	Interactive lecture	Chalk board
29	Problems on Multiplication, Transpose of matrices	1hr	Interactive lecture	Chalk board
30	Inverse up to 3rd order matrix	1hr	interactive lecture	Chalk board
31.	Problems on Inverse of matrices up to 3rd order	1hr	interactive lecture	Chalk board
32.	Properties of determinants up to 3rd order and their evaluation	1hr	interactive lecture	Chalk board

REFERENCES

S.No.	Title and authors
1.	Text Book of Matrix, A. K. Sharma, Discovery Publishing House 2004
2.	Essential Engineering Mathematics, Michael Batte, Ventus Publishing ApS (e-book)
3.	Elements of the differential and integral calculus, William Anthony Granville, Percey F Smith and William Raymond Longley
4.	Differential calculus for beginners, Joseph Edwards, Macmillan Publishing, 1896

MVSL DN Raju and Dr. K .V. Ramana – Engineering Mathematics-1
MVSL DN Raju and Dr. K .V. Ramana – Engineering Mathematics-2

Mathematics -2B " Coordinate Geometry and Calculus" Intermediate Telugu Academy.

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Course No. : SMCA 201
Course Title : **STATISTICAL METHODS**
Credit hours : 2 (1+1)

General Objectives

1. To impart knowledge to the students on Statistical methods required and useful in the study of agricultural courses.

Specific Objectives

At the end of this semester, the students will be able to

4. Understand concepts of Descriptive statistics and Testing of hypothesis and their applications
5. Understand concepts on Correlation , Regression and ANOVA and their applications

Sl. No.	Lesson	Time	Teaching method	Teaching Aid(s)
1	Introduction to Statistics, Definition, Advantages & Limitations, Applications in Agriculture, Data -Types of data – Quantitative and Qualitative Variables- Discrete and Continuous Variables	1hr	Interactive lecture	Chalk board and Computer aided instructions (CAI)
2	Graphical Representation of Data--Qualitative data: Bar Graphs, Multiple Bar Graphs, Pie Graphs—Quantitative data: dot plots, Histograms, Line graphs	1hr	Interactive lecture	Chalk board and CAI
3	Measures of Central Tendency: Definition, Different Measures, Characteristics of a Satisfactory Average .Definition and Calculation of Arithmetic Mean, Median and Mode for Grouped and Ungrouped data- Merits and Demerits of AM, Median and Mode	1hr	Interactive lecture	Chalk board and CAI
4	Measures of Dispersion: Definition. Different Measures (relative and absolute) Standard Deviation, Variance and Coefficient of Variation	1hr	Interactive lecture	Chalk board and CAI
5	Introduction to Probability—Events, Sample Space, Definition of Probability, Addition and Multiplication Theorem (without proof), Simple Problems Based on Probability	1hrs	interactive lecture	Chalk board and CAI
6	Binomial Distribution, Poisson Distribution. Normal Distribution- Density function, curve and its properties including area under the curve. Problems Based on Normal Distribution	1hr	interactive lecture	Chalk board and CAI
7	Introduction to Sampling: Definitions of Statistical Population, Sample, Random Sampling, Parameter, Statistic. Sampling distribution, Concept of Standard Error of Mean. Formulae of SD for Large and Small Samples	1hr	interactive lecture	Chalk board and CAI
8	Tests of Significance: Introduction to Statistical Test of Significance, Null Hypotheses, Types of Errors, Level of	1hr	interactive lecture	Chalk board and CAI

	Significance and Degrees of freedom, Steps involved in Testing of a Hypotheses			
9	Large sample tests: Introduction to Standard Normal Distribution, Test for Population Means- Z-test, One sample and Two Samples with Population SD known and Unknown. Assumptions, Conditions, Null Hypotheses, Test Statistic Table values and Inference (Conclusion about Null Hypotheses)	1hr	interactive lecture	Chalk board and Chalk board and CAI
10	Small sample tests: Introduction to t- distribution, Test for Population Means- one sample t-test, Two sample t-test and Paired t-test. Assumptions, Conditions, Null Hypotheses, Test Statistic, degrees of freedom and Inference (Conclusion about Null Hypotheses)	1hr	interactive lecture	Chalk board and CAI
11	Introduction to Chi-square distribution, r x c Contingency Table, Chi-square test in 2x2 Contingency table, Yates Correction for Continuity, Assumptions, Conditions, Null Hypotheses, Test Statistic, Degrees of freedom and Inference (Conclusion about Null Hypotheses). F-test for Two Population variances and properties Assumptions, Conditions, Null Hypotheses, Test Statistic, Degrees of freedom and Inference (Conclusion about Null Hypotheses)	1hr	Interactive lecture	Chalk board and CAI
12	Introduction to Correlation: Definition, Scatter Diagram, Types of correlation, Properties, , Calculation of correlation coefficient and Test of Significance for correlation coefficient, Null Hypotheses, Test Statistic, Degrees of freedom and Inference (Conclusion about Null Hypotheses)	1hr	Interactive lecture	Chalk board and CAI
13	Regression: Definition, Fitting of two lines Y on X and X on Y, Properties, inter relation between correlation and regression	1hr	Interactive lecture	Chalk board and CAI
14	Introduction to Analysis of Variance, Assumptions in ANOVA- Analysis of One Way Classification. Introduction to Experimental Designs- Need, Basic principles in Experimental Designs, Completely Randomized Design Layout and Analysis	1hr	Interactive lecture	Chalk board and CAI
15	Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement. Estimates of population mean and standard error, confidence limits	1hr	Interactive lecture	Chalk board and CAI
16	Use of Random Number Tables for selection of Simple Random Sample	1hr	Interactive lecture	Chalk board and CAI

REFERENCES

S.No.	Title and authors
1.	Statistics for Agricultural Sciences-Second Edition,2007 - G. Nageswara Rao BS Publications, Hyderabad
2.	A Text Book of Agricultural Statistics- R. Rangaswamy(1995), New Age International Publishing Limited, Hyderabad
3.	**Hand Book of Agricultural Statistics**, Chandel SRS, Achal Prakashan Mandir publications, New Delhi.
4	Statistical Methods -George W. Snedecor, William G. Cochran, IOWA State Univ. Press/AMES

PRACTICALS

Sl. No.	Practical
1	Construction of frequency distribution tables for ungrouped data by using inclusive and exclusive methods. -And Calculation of Quartile, Deciles and percentiles.
2	-Preparation of Histogram,Ogives. Preparation of various graphs and charts
3	Computation of A.M, Median and Mode for grouped and un-grouped data by direct and deviation methods
4	Problems on calculating Skewness and Kurtosis, S.D and CV% for grouped data
5	Problems on Probability
6	Problems on Binomial , Poisson and Normal distributions
7	Normal Curve and its properties, identification of normality through data i.e. , $\mu \pm \sigma$ criterion.
8	Problems on Z- test for one Sample, two sample with Population SD known and unknown .
9	Student's t-test for single sample, two sample and paired t- test, F-test (Test for homogeneity of variances).
10	Chi-square test and Yates Correction in 2x2 contingency table and Chi-square test in mxn contingency table
11	Computation of the Correlation Coefficient and its Testing
12	Fitting of Simple Linear Regression equations (y on x , and x on y) and its testing
13	Analysis of Variance One Way Classification. Analysis of CRD with equal and unequal replications
14	Analysis of RBD
15	Analysis of LSD.
16	Selection of random sample using random numbers. Estimate of population mean , standard error, and confidence limits in SRS.

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Course No. : SMCA 301
Course Title **: Agri Informatics**

Credit hours : 2 (1+1)

GENERAL OBJECTIVES

1. To impart knowledge to the students on basic Informatics required and useful in the study of agricultural .

SPECIFIC OBJECTIVES

At the end of this semester, the students will be able to

1. Understand concepts of computers, OS, Office applications
2. Understand concepts on basics of Programming, WWW, and IT applications in agriculture

Sl. No.	Lesson	Time	Teaching method	Teaching Aid(s)
1	Introduction to Computers, Definition, Advantages & Limitations	1hr	Interactive lecture	Computer aided Instructions (CAI)
2	Anatomy of Computers – Components of Computers and its functions - Overview of Input devices of Computer Memory concepts, Units of memory.	1hr	Interactive lecture	Computer aided instructions
3	Operating System: Definition and Types of operating systems.	1hr	Interactive lecture	Computer aided instructions
4	MSWORD: Creating, Editing, Formatting a document and Saving a document	1hr	Interactive lecture	Computer aided instructions
5	MSWORD – Features of File, Edit and Format menus	1hrs	Interactive lecture	Computer aided instructions
6	MSEXCEL: Data Presentation, Data presentation, interpretation and graph creation.	1hr	Interactive lecture	Computer aided instructions
7	MSEXCEL: Statistical analysis, mathematical expressions with MSEXCEL	1hr	Interactive lecture	Computer aided instructions
8	MSACCESS: Database, concepts and types..	1hr	Interactive lecture	Computer aided instructions
9	MS ACCESS: Uses of DBMS in Agriculture; creating database.	1hr	interactive lecture	Computer aided instructions
10	Internet - World Wide Web (WWW): Concepts and components.	1hr	interactive lecture	Computer aided instructions
11	Programming Languages: Introduction to different computer programming languages.	1hr	Interactive lecture	Computer aided instructions
12	Programming Languages: Concepts and standard input/output operations.	1hr	Interactive lecture	Computer aided instructions
13	e-Agriculture, concepts and applications, Use of ICT in Agriculture	1hr	Interactive lecture	Computer aided instructions
14	IT application: Computer-controlled devices (automated systems) for Agri-input management.	1hr	Interactive lecture	Computer aided instructions
15	Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc;	1hr	Interactive lecture	Computer aided instructions

16	Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions.	1hr	Interactive lecture	Computer aided instructions

REFERENCES

S.No.	Title and authors
1.	Satish Jain, M Geetha, Kratika,(2012) Computer Course Windows 7 With Ms Office 2010, Bpb Publications
2.	Anupama Jain and Avneet Mehra (2012), Computer Fundamental MS Office: Including Internet & Web Technology 2010
3.	Meera SN 2008 ICTs in agricultural extension: Tactical to practical
	Willem Zip 1994 Improving the transfer and use of agricultural information: A guide to information technology.
4.	Programming in Ansi C Paperback – 8 May 2012, by E Balagurusamy (Author)

PRACTICALS

SL	Topic
1	Study of Computer Components and accessories– Booting of Computer and its Shut Down
2	Practice of some fundamental DOS commands – TIME, DATE, DIR,MD, CD, RD, DEL, TREE, COPY, VOL and LABEL
3	Introduction of different operating systems such as windows, Unix, Linux;
4	Practicing WINDOWS Operating System – Use of Mouse, Title Bar, Minimise, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars, Creating Folders, COPY and PASTE functions and File Management.
5	MSWORD – creating, editing and presenting a scientific Document.
6	MS POWER POINT – creating, editing and presenting a scientific Document.
7	MSEXCEL: Creating a spreadsheet, writing expressions, Entering formula expression through the formula tool bar and use of inbuilt statistical, mathematical functions
8.	MSEXCEL: creating graphs, analysis of scientific data-Data analysis-t-test, Regression, ANOVA
9	MSACCESS: Creating Database, preparing queries and reports.
10	MSACCESS: Demonstration of Agri-information system.
11	Introduction to World Wide Web (WWW) and its components
12	Introduction of programming languages.
13	HTML: Creation of scientific website,
14	Internet: Presentation and management agricultural information through web;
15	Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost;
16	Introduction of Geospatial Technology for generating valuable information for Agriculture.

REFERENCES

S.No	Title/Author
1	Batnakar S and Schware R 2000 Information and communication technology in development - Cases from India.
2	Meera SN 2008 ICTs in agricultural extension: Tactical to practical.
3	Willem Zip 1994 Improving the transfer and use of agricultural information: A guide to information technology.
4	Parmar, A., Mathur, N., Prasanna, U.D. and Prasanna, V.B. 2000. Working with WINDOWS:
56	A Hands on Tutorial. Tata McGraw-Hill Publishing Co., New Delhi.
7	Viescas. 2005. Microsoft Office Access 2003-Inside Out. PHI Publishers, New Delhi.
8	Vikas Gupta. 2002. Comdex Computer Course Kit. Dreamtech Press, New Delhi.
9	Winston. 2000. Microsoft Excel Data Analysis and Business Modeling. PHI Publishers, New Delhi
10	let us C, Yashwant kanetkar
11	Pro HTML5 and CSS3 Design Patterns Paperback – 2012 by Dionysios Synodinos (Author), Michael Bowers (Author), Victor Sumner (Author)
12	Programming in Ansi C Paperback – 8 May 2012, by E Balagurusamy (Author)
13	Office Home & Student 2016 for Mac
14	Microsoft Office 365 - Personal
15	Computer Fundamentals Architecture And Organization 5/E
16	Computer Fundamentals Paperback – 2010, by Anita Goel (Author)
17	Learning Computers for Smarter Life - Class 4, Author: Manuj Bajaj, Anil Ahlawat
18	Fundamentals of Computers Hardcover – 2010, by Nishit Mathur (Author)

ENVIRONMENTAL SCIENCE

Course No : EVST 301

Course Title : **Environmental Studies and Disaster Management**
Credit Hours : 3(2+1)

GENERAL OBJECTIVE

To impart knowledge on different environmental issues and to create a pro-environmental attitude besides knowing about strategies of disaster management.

SPECIFIC OBJECTIVES

A) THEORY

By the end of the course, the student

i. gets knowledge on the importance of environmental studies
ii. understands the natural resources and his role in conservation of them
iii. acquaints with different types of pollution and their control measures
iv. understands about disaster management strategies.

B) PRACTICAL

By the end of the practical exercises, the students would

- Gain analytical skills in assessing different sources of pollution.

THEORY LECTURE OUTLINES

Lec.No.	THEORY
1	Definition - scope and importance - Multidisciplinary nature of environmental studies
2	Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems -Forest resources: Use and over-exploitation – deforestation - case studies- Timber extraction
3	Mining- dams and their effects on Environment.
4	b) Water resources: Use and over-utilization of surface and ground water- floods- drought-conflicts over water- dams-benefits and problems.
5	c) Mineral resources: Use and exploitation - environmental effects of extracting and using mineral resources - case studies.
6	d) Food resources: World food problems - changes caused by agriculture and overgrazing - effects of modern agriculture - fertilizer-pesticide problems - water logging& salinity - case studies.
7	e) Energy resources: Growing energy needs - renewable and non-renewable energy sources - use of alternate energy sources - Case studies.
8	f) Land resources: Land as a resource - land degradation - soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
9	**.** 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.
10	Introduction – types - characteristic features - structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds- streams- lakes- rivers- oceans- estuaries)
11	Biodiversity and its conservation: Introduction – definition – genetic - species -ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use- productive use- social- ethical- aesthetic and option values.
12	Biodiversity at global- National and local levels- India as a mega-diversity nation. Hot-sports of biodiversity -Threats to biodiversity: habitat loss- poaching of wildlife- man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
13	**.** Environmental Pollution: definition, cause, effects and control measures of Air pollution
14	Causes- effects and control measures of Water pollution
15	Causes- effects and control measures of Soil pollution
16	Causes- effects and control measures of Marine pollution - Thermal pollution
17	Causes- effects and control measures of Noise pollution - Nuclear hazards
18	Solid Waste Management: causes - effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.
19	Social Issues and the Environment: Unsustainable to Sustainable development - Urban problems related to energy- Water conservation - rain water harvesting - watershed management.
20 & 21	Environmental ethics: Issues and possible solutions - climate change- global –warming- acid rain- ozone layer depletion- nuclear accidents and holocaust.
22	Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act.
23	Forest Conservation Act and Biodiversity act - Issues involved in enforcement of environmental legislation. Public awareness.
24	Human Population and the Environment: population growth - variation among nations - population explosion - Family Welfare Programme. Human Rights. Environment and human health: Value Education.
25	Women and Child Welfare. HIV/AIDS Role of Information Technology in Environment and human health.
26	Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods- drought- cyclone- earthquakes- landslides- avalanches- volcanic eruptions- Heat and cold waves.
27	Climatic change: global warming- Sea level rise- ozone depletion.
28 & 29	Man Made Disasters- Nuclear disasters- chemical disasters- biological disasters- building fire- coal fire- forest fire- oil fire- air pollution- water pollution- deforestation- industrial waste water pollution- road accidents- rail accidents- air accidents- sea accidents.
30	Disaster Management- Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction.
31	Concept of disaster management- national disaster management framework; financial arrangements.
32	Disaster response: Role of NGOs- community –based organizations and media. Central- state- district and local administration; Armed forces - Police and other organizations in disaster response.

B) Practical Class Outlines

1. Collection, processing and storage of effluent samples
2. Case study on water pollution in terms of estimating Chemical oxygen demand
3. Case study on water pollution in terms of estimating BOD and DO
4. Case study on water pollution in terms of estimating total dissolved solids
5. Case study on water pollution in terms of estimating temporary hardness
6. Case study on water pollution in terms of estimating turbidity
7. Preparation of sludge / soil for analysis of heavy metals
8. Estimation of heavy metals in soil by Atomic Absorption Spectrophotometer (AAS).
9. Determination of sound level by using Sound Level Meter – Noise pollution case study
10. Estimation of respirable & non-respirable dust in air by using dust sampler- Air pollution Case Study.
11. Visit to local area to document environmental assets
12. Visit to local polluted Site Observations and Remedial Measures
13. Estimation of species abundance of plants
14. visit to land fill site to study solid waste management approaches
15. Visit to a pond eco system
16. Case study on disaster management (Floods/Cyclones)

REFERENCES

1. Bharucha, E. 2005. *Textbook of Environmental Studies for Under Graduate Courses*. University Grants Commission, University Press. Hyderabad.
2. Gupta, P.K. 2004. *Methods in Environmental Analysis – Water, Soil and Air*. Agrobios (India), Jodhpur.
3. Kaul, S.N. and Ashutosh Gautham. 2002. *Water and Waste Water Analysis*. Daya Publishing house, New Delhi.
4. Manoharachari, C. and Jaya Ram Reddy 2004. *Principles of Environmental Studies*. B S Publication, Hyderabad.
5. Sharma, J.P. 2003. *Introduction to Environmental Science*. Lakshmi Publications, Guntur.
6. Ahulwaria, V.K. 2013. Environmental Studies: basic concepts, New Delhi: TERI
7. Divya Agarwal and Manoj K. Agarwal, 2014Text Book of Environmental Science, Daya Publishing house, New Delhi.
8. Anjaneyulu, Y. 2005 Introduction to Environmental Science BS Publications, Hyderabad.
9. Anji Reddy M. 2010, Text book of Environmental Science & Technology BS Publications, Hyderabad.

AGRICULTURAL ENGINEERING

Course No : AENG 151

Course Title : Introductory Soil and Water Conservation Engineering

Credit Hours : 2(1+1)

Degree : B.Sc (Ag)

Lecture Outline

1. Surveying – definition and objectives of survey, primary divisions of surveying , definition of geodetic and plane surveys, linear measurements (MKS), measurement of distances.

2. Levelling-definition, description of dumpy level and Levelling staff, terminology connected with Levelling. Height of instrument, Bench mark and its types, change point.

3. Contour survey-definition, characteristics and uses of contours.

4. Irrigation-definition, classification of irrigation projects based on CCA and expenditure, benefits of irrigation, ill effects of irrigation, flow irrigation and lift irrigation.

5. Water lifting devices-classification of pumps, centrifugal pump, principle of operation, Installation procedure.

6. Deep well pump- submersible pumps, Installation and working principle of pump - Troubles and remedies.

7. Water conveyance systems-open channel, definitions of wetted perimeter, hydraulic radius, hydraulic slope, area of cross section and free board. Manning's formula.

8. Earthern channels-Advantages and disadvantages of earthern channels, channel lining materials, Advantages of lining the channels. Underground pipeline over earthern channels, disadvantages.

9. Measurement of irrigation water-importance, methods of measuring water-volumetric and area-velocity method. Direct discharge methods-water meter, weirs, and orifices, parshall flume-Installation of these devices, conditions for weir installation

10. Soil and water conservation-definition and scope, soil erosion-definition, types, Geological and accelerated soil erosion, causes and ill effects of soil erosion.

11. Accelerated soil erosion-water and wind erosion definitions, rain drop (splash) erosion, sheet erosion, rill erosion, Gully erosion, stream bank erosion and their stage of occurrence.

12. Study on soil estimation methods : USLE, MUSLE, EI and Cosecton wheel method

13. Erosion control measures-Engineering measure. Study of engineering measures like contour bunds, graded bunds, broad based terracing and bench terracing.

14. Wind erosion definition, mechanics of wind erosion and types of soil movement
15. Principles of wind erosion and its controls methods
16. Water harvesting techniques: Definition and types

Practicals

1. Acquaintance with survey equipment
2. Acquaintance with leveling instruments and levelling procedure
3. Contour field survey
4. Preparation of contour maps using contour field survey data
5. Study of components of centrifugal pump
6. Power estimation on centrifugal pump
7. Capacity calculation of open channel
8. Discharge calculation of different water measuring devices
9. Identification of different forms of water erosion
10. Estimation of soil loss by USLE method
11. Exercise on soil erosion control by contour and graded bunds
12. Exercise on broad base and bench terracing
13. Exercise on shelterbelts and wind breaks.
14. Study on onfarm water harvesting methods
15. Visit to water harvesting structures like farm pond
16. Visit to nearby watershed to study soil conservation structures

Reference Books

1. Surveying and Leveling Vol.1 by Kanetkar T P and Kulkarni S V 1981. Vidyarthi Griha Praksam, Pune.
2. Land and water Management Engineering by Murthy V V N 1982, Kalyani publishers, New Delhi.
3. Irrigation Theory and practice by Michael A M 1989. Vikas Publishing House Pvt. Ltd, New Delhi.

4. Principles of Agricultural Engineering – Vol II. By Michael AM and Ojha TP 1993. Jain Brothers, New Delhi.
5. Introduction to soil and water conservation Engineering by B.C.MAL 2005, Kalyani publishers, New Delhi.

Course No : AENG-251
Course Title : **Farm Machinery and Power**
Credit Hours : 2(1+1)

General Objective

To impart knowledge to the students on the significance, use and maintenance of farm power and improved farm equipment through various media including demonstrations

Specific Objectives

A) THEORY

By the end of the course, the students will be able to

i). Identify the present mechanization gaps and future needs for improved equipment for agro-socio-economics of the agro-climatic regions of the state.

ii). Students will be have technical knowledge on tractor for various operation and their components.

B) PRACTICAL

By the end of the practical exercises, the students will be able to

i) Gain skills on farm power management and use of equipment

THEORY

1. Status of farm power in India - farm mechanization for enhancing productivity - sources of farm power – advantages and disadvantages.
2. Internal combustion (IC) engines – working principle – four stroke and two stroke cycle engines – difference between the two types- components of IC engine.
3. Working principle of IC engines using diesel and petrol as fuels – special features of diesel engine – difference between petrol and diesel engines
4. Terminology associated with engine power - indicated power, break power, friction power and drawbar power - stroke-bore ratio, swept volume, clearance volume, compression ratio and piston displacement-thermal and mechanical efficiencies- numerical problems on engine power in both Metric and SI units.
5. Familiarization with various systems of tractor – air and fuel supply system, cooling system.
6. Familiarization with various systems of tractor – ignition system – lubrication system.
7. Familiarization with various systems of tractor – Power Transmission from engine to rear wheels – role of different units in speed reduction and transmission of power.
8. Tractors – classification – factors to be considered while purchasing a tractor. Cost analysis of owning and operating tractor and implements
9. Tillage – primary and secondary tillage- mould board plough- constructional features - components of MB plough and their functions – limitations of MB plough

10. Standard disc plough – advantages and disadvantages – constructional features and operational adjustments.
11. Determining drawbar power based on draft of implement and speed of tractor- transmission and tractic efficiencies - determination of theoretical and effective field capacities, field efficiency- numerical problems on drawbar power and field capacity in Metric and SI units.
12. Secondary tillage implements – harrows – different types – classification of disc harrows, cultivators – rigid tine and spring tine types.
13. Methods of sowing-sowing implements-seed drills and planters-seed metering mechanism – calibration of seed drill and numerical problems on the subject.
14. Objectives of spraying and dusting – constructional features of knapsack sprayer and hand compression sprayer – dusters – hand operated rotary duster – care and maintenance of sprayers and dusters.
15. Tractor - mounted equipment for land management – bund former, ridger and terraces blade
16. Equipment for manual and power harvesting- sickle and harvester combines - methods of harvesting fruits crops in hill areas.

PRACTICAL

1. Study of various components of IC engine.
2. Study of two stroke and four stroke cycle engines.
3. Familiarization with air cleaning and fuel supply system
4. Familiarization with lubrication system of tractor
5. Familiarization with ignition system of tractor
6. Familiarization with cooling system of tractor.
7. Familiarization with power transmission system of tractor.
8. Familiarization with primary tillage implements – MB plough – to study MB plough in operation.
9. Familiarization with primary tillage implements – disc plough – to study disc plough in operation.
10. Familiarization with secondary tillage implements study of harrows and cultivators
11. Learning tractor driving
12. Learning tractor driving
13. Familiarization with sowing implements - study of seed-cum-fertilizer drill- calibration of seed drill.
14. Familiarization with various sprayers and dusters.
15. Familiarization with harvesting implements – study of mower.
16. Practical examination.

References

- Jagadiswar Sahay. 1992. ***Elements of Agricultural Engineering***. Agro Book Agency, Patna
- Jain, S.C. 2003. ***Farm Machinery – An Approach*****.** Standard Publishers and Distributors, New Delhi
- Kepner, R.A., Roy Bainer and Barger, E.L. 1987. ***Principles of Farm Machinery***. CBS Publishers & Distributors, Delhi
- Klenin, N.I., Popov, I.F. and Sakun, V.A. 1985. ***Agricultural Machines***, Amerind Publishing Co. Pvt. Ltd., New Delhi.
- Michael, .M. and Ojha, T.P. 2008 ***Principles of Agricultural Engineering* (*Vol. I)***. Jain Brothers, New Delhi.

- Nakra, C.P. 1986. ***Farm Machinery and Equipment.*** Dhanpat Rai and Sons, New Delhi.

Course No : AENG: 252
Course Title **: Protected Cultivation and Secondary Agriculture**
Credit Hours: Credits: 2(1+1)

OBJECTIVE

To impart knowledge on constructional and operational details of greenhouses will lead the students to grow crops with profits and also to use the greenhouses for offseason usage and also to manage them commercially. The course will provide knowledge on drying of crops, numerical on moisture measurement and material handling of different agricultural produce.

LECTURE OUTLINES

1. Introduction to green houses-history, definition, greenhouse effect, advantages of green houses.
2. Brief description of types of green houses-green houses based on shape, utility, construction and covering materials and cost, shade nets.
3. Plant response to greenhouse environments: light, temperature, relative humidity, ventilation and carbon dioxide and environmental requirement of agriculture and horticulture crops inside green houses.
4. Equipment required for controlling green house environment – summer cooling and winter cooling, natural ventilation, forced ventilation and computers.
5. Planning of green house facility-site selection and orientation, structural design and covering materials.
6. Materials for construction of green houses- wood, galvanized iron and glass. Polyethylene film, poly vinyl chloride film, tefzel T^2 film, fiberglass reinforced plastic, rigid panel and acrylic and polycarbonate rigid panel.
7. Design criteria and constructional details of greenhouses - construction of pipe framed greenhouses, material requirement, preparation of materials and procedure of erection
8. Greenhouse heating and distribution systems - greenhouse utilization -off-season drying of agricultural produce. Economic analysis of greenhouse production-capital requirement, economics of production and conditions influencing returns.
9. Irrigation system used in greenhouses-rules of watering, hand watering, perimeter watering, overhead sprinklers, boom watering and drip irrigation.
10. Importance engineering properties such as physical thermal and aero & hydrodynamic properties of cereals, pulses and oilseeds.
11. Drying – definitions - principles – familiar with psychrometry chart – numerical on phychrometry chart
12. Moisture content measurement – methods of drying – classification – thin layer dryer, deep bed drying – numerical and moisture content measurement.
13. Mechanical drying – different types dryer – continuous flow dryers – mixing and non-mixing type dryers.

14. Importance of material handling devices – belt conveyor – capacity and power requirement
15. Screw conveyors – capacity and power requirement
16. Bucket elevator – capacity and power requirement – pneumatic conveyor

PRACTICALS

1. Study of different types of green houses based on shape
2. Study of different types of green houses based on construction
3. Study of materials for construction of Green houses
4. Study of construction of pipe framed green house
5. Calculation of ventilation rates in active summer cooling system
6. Calculation of rate of air exchange in active winter cooling system
7. Field visit to green house
8. Study of threshers– their components, operation and adjustments
9. Tutorial on use of Psychrometry chart
10. Measurement of moisture content by direct method
11. Measurement of moisture content by indirect method
12. Performance evaluation of sack dryer and Rotary dryer
13. Performance evaluation of continuous flow non-mixing column driers
14. Performance evaluation of continuous flow baffle dryer and mixing type dryer (L.S.U)
15. Study of material handling devices
16. Field visit to material handling unit

REFERENCES

1	Post harvest Technology of Cereals and pulses	:	Chakraborthy A and De D S 1981. Oxford& IBH Publishing Co., New Delhi
2	Green house technology	:	G N Tiwari and R K Goyal
3	Green house	:	K Radha manohar and C Igadinathane
4	The complete Book of Greenhouse Gardening	:	Cavendish M 1974. Marshal Cavendish Books, London
5	Greenhouse Management for Flowers and plant Production	:	Kennard S Nelson B A 1977. International Printers and Publishers Inc., Illinois
6	A Growth Chamber - Manual Environmental control for plants	:	Langhans R W (Ed.) 1978. Contock Publishing Associates, Cornell University Press, lthaca and London.
7	Solar Energy and its Utilisation	:	Rai G D 1995. Khanna Publishers, New Delhi

Course No: AENG – 351
Course Title : **Renewable Energy and Green Technology**
Credit Hours: 2 (1+1)

OBJECTIVE

Concepts of utilization of non-conventional energy resources such as gasifiers, solar and wind, etc. with theoretical background will be taught to effectively utilize the energy for agricultural operations and agricultural processing activities

THEORY

1. Introduction – renewable energy sources – classification – advantages and disadvantages
2. Biomass – importance of biomass – classification of energy production – principles of combustion – pyrolysis and gasification
3. Biogas – principles of biogas production – advantages and disadvantages – utilization
4. Biogas plants – classification – types of biogas plants – constructional details of biogas plants
5. Types of gasifiers – producer gas and its utilization
6. Briquettes – briquetting machinery – types and uses of briquettes – shredders
7. Solar energy – application of solar energy – methods of heat transfer – conduction, convection and radiation
8. Solar appliances – flat plate collectors – focusing plate collectors – solar air heater
9. Solar space heating and cooling – solar energy gadgets – solar cookers – solar water heating systems
10. Solar grain dryers – solar refrigeration system – solar ponds
11. Solar photovoltaic system – solar lantern – solar streetlights – solar fencing – solar water pumping system
12. Wind energy – advantages – disadvantages – wind mills – types
13. Constructional details of windmills – applications of windmills
14. Bio fuels – characteristics of various bio fuels – different parameters and calorific values
15. Bio diesel production – applications – extraction from *Jatropha*
16. Ethanol from agricultural produce (sugar cane and corn)

PRACTICAL

1. Constructional details of KVIC and Janata type biogas plants
2. Constructional details of Dheen Bandu type biogas plants
3. Field visit to biogas plants
4. Constructional details of different types of gasifiers
5. To study the performance of gasifiers
6. To study the briquettes preparation from biomass
7. To study the efficiency of solar cooker
8. To study the performance of a solar still

9. To study the performance of a solar dryers
10. To study the working of solar photovoltaic pumping system
11. To study the performance evaluation of domestic solar water heater
12. To study the performance evaluation of solar lantern
13. To Study the performance evaluation of solar street light
14. To study the performance of different types of wind mills
15. Field visit to wind mills
16. To study the processing of bio diesel production from J*atropha*

REFERENCES

1	Biotechnology and other Alternate Technology	Chakravarthy A 1989. Oxford and IBH Publishing Co. Ltd., New Delhi
2	Renewable Energy Sources and Conversion Technology	Bansal N K 1990. Tata McGraw Hill Publishing Co. Ltd., New Delhi
3	Solar Energy Utilization	Rai G.D. 1984 Khanna Publishers, New Delhi
4	Solar Energy	Sukatme SP 1985. Tata McGraw Hill Publishing CO. Ltd., New Delhi
5	Non-Conventional Energy Sources	Rai, G.D. 1984 Khanna Publishers, New Delhi
6	Production of Biodiesel From Jatropha carcus Oil by Using Pilot Biodiesel Plant.	Ramesh, D. Samapathrajan, A and Venkatachalam, P. 2009 TNAU, Coimbatore

LIVESTOCK, POULTRY AND FISHERIES

Course No : LPFM- 201
Course Title : **Livestock, Poultry and Fisheries Management - II**
Credit Hours : 2(1+1)

THEORY

Introduction to animal husbandry. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of life stock and poultry. Management of calves, growing heifers and milch animals. Management of sheep's, goat and swine.

Important Indian and exotic breeds of cattle, Buffalo, sheep, goat and poultry. Digestion in livestock and poultry. Classification of feed stuff. Proximate principals of feed nutrients and there functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry.

Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

Identification and biology of commonly cultivated fresh water fishes. Collection of fish seed and hypophysation. Fish pond construction. Fish pond management. Fresh water aquaculture systems. Integrated fish farming systems. Fish byproducts and their utilization. Maintenance of aquarium.

PRACTICAL

External body parts of cattle, buffalo, sheep, Goat, swine and poultry. Handling and restraining of livestock. Identification methods of farm animals and poultry. Visit to IDF, IFF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records. Judging of cattle, buffalo and poultry. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. Clean milk production, milking methods. Hatchery operations incubation and hatching equipments. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production

LECTURE OUTLINE

THEORY

1. Role of Livestock and Poultry in National Agriculture. Development of Dairy Industry in India and in Telangana State
2. Different systems of Livestock production-Extensive, Semi-intensive, Intensive and Mixed.
3. Important breeds-Classification of Indigenous, Exotic Cattles, buffaloes, Sheep, Goat and Swine. Breed characteristics of Sindhi, Jersey, Holstein Friesian (HF), Murrah and Surthi.
4. Milking Management-Processing of Milk, Cooling, Pasteurization, Merits and Demerits. Preservatives and common adulterants of Milk.
5. Breeding-importance. Cross breeding, signs of Estrous cycle. Artificial Insemination Merits and Demerits.
6. Introduction-Advantages and disadvantages of Sheep and Goat farming under different systems of management. Important Sheep and Goat Breeds. Type of Housing and Equipments.
7. Breeding management-Breeding season-Fitness of purchase for first breeding –methods of detection of heat, Artificial Insemination. Care of the pregnant animals-Breeding stock.

8. Feeding management of Sheep and Goat. Feeding methods. Principles to be followed in feeding and watering –Feeder space, Water space. Management of stall fed conditions. Transportation of Sheep and Goat.
9. Disease management-Introduction of Livestock and Poultry diseases. Prevention and control of diseases. Deworming, Dipping and Spraying etc.,
10. Wool: Importance of wool-fiber structure-Fleece characters, Goat fiber-Marketing of Goat/sheep fibers/wool. Planning of sheep/Goat farms. Economics of sheep and Goat farms.
11. Introduction to Poultry-Classification of poultry-layers, broilers and dual purpose.
12. Systems of housing-deep litter and cage systems. Merits and Demerits.
13. Care and management of day old chicks, brooder management and management of layers and broilers. Poultry nutrition-poultry diseases and management.
14. Introduction to fish culture-Fishery resources of India and Telangana State.
15. Ecology of fish pond-water and soil quality, Food chain and food productivity.
16. Fresh water fish diseases-Bacterial, Viral, Fungal, Protozoan, Helminthes and crustacean diseases. Prevention and control measures.

SUGGESTED READING BOOKS

1. Handbook of animals' husbandry by ICAR, Reprint 2015?
2. Livestock production management by N S R Sastry and C K Thomas?
3. Fish and fisheries of India- Jhingran V. G.

PRACTICALS

1. Study and observe the different external body parts of Cattle, buffalo, Sheep, Goat, Swine, Fish and poultry.
2. Handling and Restraining of Livestock, Fishes and poultry.
3. Different identification methods of farm animals, Fishes and Poultry.
4. Visit to Livestock (IDF), Fish Farms (IFF) and poultry farms(IPF).
5. Identification of different breeds of livestock, Major cultivated fishes, poultry and familiarizing with routine farm operations and farm records.
6. Judging of Dairy cattle, buffaloes, Fishery and poultry.
7. Elimination and culling of livestock, Fishery and poultry.
8. Planning, layout and construction/preparation of livestock, Poultry farm houses and Fish ponds.
9. Computation of rations for livestock, Fishery and Poultry.
10. Formulation of concentrate mixtures, Fishery and Poultry.
11. Clean Milk production and different milking methods
12. Hatching equipments, Hatchery operations and Incubation.
13. Management of day old chicks, broilers and layers. Management of Fish stocking ponds.
14. Debeaking, Dusting and Vaccination.
15. Economics of Cattle, Buffalo, Sheep, Goat, Swine, Fishery and Poultry production.
16. Project preparation for external funding and commercial farms and Enterprises for Dairy milk and milk products-Marketing strategies for milk and milk products,Eggs,Fishes and Meat etc.,

CROP PHYSIOLOGY

Course No : CPHY 161
Course Title : Fundamentals of Crop Physiology
Credit Hours : 2(1+1)
Degree : B.Sc (Ag)

Theory lecture outlines

1. Introduction –definition of Crop physiology – Importance in agriculture and horticulture
2. Plant cell – Nucleus, Chloroplast, Mitochondria, Golgi apparatus, Cell wall, Plasma membrane, ER, Peroxisomes and Glyoxysomes – Structure and functions.
3. Crop water relations – Physiological importance of water to plants – Active and passive uptake of water – measurement of water status in plants– transpiration – definition – significance-structure of stomatal complex in monocots and dicots – role of stomata in transpiration.
4. Nutriophysiology – definition – essential elements – Criteria of essentiality of elements-classification of plat nutrients based on their biochemical role and physiological function - Physiology of nutrient uptake – active and passive uptake of nutrients.
5. Nutriophysiology – functions of N, P, K, Ca, Mg, Fe, Zn, Mn, B, Mo, Cl, Na and Si
6. Nutriophysiology – Deficiency and toxicity symptoms of plant nutrients.
7. Photosynthesis – energy synthesis – Cyclic and Non Cyclic Photophosphorylation – Carbon dioxide fixation – $_{C3}$ pathway.
8. Photosynthesis - Carbon dioxide fixation - C_4 and CAM pathways – methods of measuring Photosynthesis.
9. Photosynthesis – Photorespiration – factors affecting photosynthesis (Light, Carbon dioxide, Temperature, Water stress, Water logging, Salinity, Weeds/ Weedicides, etc).
10. Respiration and its significance – importance of Glycolysis, Tricarboxylic Acid Cycle (TCA), Pentose Phosphate Pathway and Electron transport chain.
11. Respiration – interrelationship of respiration and photosynthesis – growth respiration and maintenance respiration – alternate respiration – salt respiration – wound respiration – measurement of respiration.
12. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role of Auxins and Gibberellins.

13. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role of Cytokinins and Abscisic Acid (ABA).
14. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role and ill effects of Ethylene and Brassinosteroids- Novel plant growth regulators – commercial application of plant growth regulators in agriculture and horticulture.
15. Growth and development – definition – types of growth – determinate and indeterminate growth – monocarpic and polycarpic species with examples – Physiological aspects of growth and development of major crops.
16. Growth and development – measurement of growth – growth analysis –growth characteristics – definitions and mathematical formulae.

Practicals

1. Preparation of solutions
2. Imbibition of seed
3. Seed vigor and viability tests
4. Optimum conditions for seed germination
5. Measurement of leaf area by various methods
6. Growth analysis – calculation of growth parameters
7. Measurement of water status in roots, stems and leaves
8. Absorption spectrum of chloroplast pigments
9. Separation of chloroplast pigments by chromatography
10. Leaf anatomy of C3 and C4 plants
11. Stomatal frequency and Index
12. Effect of ABA on regulation of stomata
13. Plant growth regulators and their effect on seedling growth
14. Breaking of seed dormancy – chemical and mechanical methods
15. Development of nutrient deficiency symptoms in field crops
16. Tissue tests for mineral nutrients deficiency

ELECTIVE COURSES

AGRONOMY

1 Course No : ELEC-300

2 Course Title : **Weed Management**

3 Credit Hours : 3(2+1)

THEORY

Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use. Introduction to mode of action of herbicides and selectivity. Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application. Integration of herbicides with non chemical methods of weed management. Herbicide Resistance and its management.

PRACTICAL

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Herbicide and agro-chemicals study. Shift of weed flora study in long term experiments. Study of methods of herbicide application, spraying equipments. Calculations of herbicide doses and weed control efficiency and weed index.

OBJECTIVES

To impart knowledge on various aspects of weeds and different methods of weed management for sustainable and higher crop production.By the end of the course, the students will be

- Able to understand about weed biology and ecology and its usefulness in weed management.
- Able to develop the mastery of weed identification.
- Able to understand different methods of weed management including herbicides, their mode of action and selectivity and resistance for the effective weed control.
- Able to understand and develop technical knowhow on different herbicides and their usage, computation of herbicide doses and skills on herbicide application for better herbicidal effects and weed management.

THEORY

Lec. No.	Topic
1	Introduction - weed definition - harmful and beneficial effects of weeds
2	Classification of weeds – classification based on morphology – life cycle – habitat – origin – association – special features and soil pH with examples.

3	Propagation of weeds – sexual – asexual – vegetative reproduction
4	Dispersal of weed seeds and fruits – dispersal agents – wind and water – animal – man – manures –farm implements and silage – dispersal of vegetative propagules.
5	Weed Biology – characteristic features of weeds
6	Weed ecology – definition – persistence of weeds – climatic, edaphic and biotic factors
7	Crop -weed competition - principles – factors - critical period of crop-weed competition in some important crops -
8	Allelopathy and its application for weed management
9	Methods of weed management – preventive weed control measures
10	Physical / mechanical, cultural weed management practices
11	Chemical and biological methods of weed control – bioherbicides and their application in agriculture
12	Integrated weed management – concept and components
13	Herbicides – definition - advantages and limitations of herbicide usage in India
14	Classification of herbicides based on chemical nature - time and method of application
15	Classes of herbicides based on – selectivity – spectrum – translocation – residual nature – soil sterilants and fumigants
16	Types of formulations of herbicide – Soluble concentrate (SC), Soluble liquid (SL), Soluble powder (SP), Wettable powder (WP), Suspension/flowable concentrates, Water dispersible granules (WDG), Emulsifiable concentrate (EC), Micro-emulsifiable concentrate
17	Nomenclature of herbicides - commonly available herbicides in India
18	Adjuvants -definition, their use in herbicides application.
19	Mode of action of herbicides – important biochemical modes of action of herbicides interfering with photosynthetic reactions – respiration -enzymatic inhibition etc.
20	Selectivity of herbicides – fundamental principles of selectivity - differential rate of absorption - differences in morphology and growth habit of plants - rate of translocation.
21	Selectivity of herbicides - differential rate of deactivation of herbicides – metabolism - reverse metabolism – conjugation - protoplasmic resistance to the specific herbicide
22	Herbicide resistance & management – Definition – Types of resistance – Development of herbicide resistance in weeds and their management
23	Herbicide rotation, mixtures and relevance in agriculture
24	Compatibility of herbicides with agro-chemicals and their application
25	Herbicide residue management – Persistence & residue of herbicides – Management of herbicide residue in soil – cultural & mechanical – enhancing biodegradation – deactivation of herbicides
26	New developments in herbicides – micro-herbicides & nano-herbicides
27	Weed management in Cereals & Millets

28	Weed management in Pulses, Oilseeds, Sugarcane and Cotton
29	Weed management in Vegetables, Orchards & Non-cropped areas
30	Shift of weed flora in crops & cropping systems
31	Aquatic weeds and their management
32	Problematic weeds and their management

PRACTICALS

Lec. No.	Topic
1	Identification of weeds and study of losses due to weeds
2	Biology and survey of weeds in cropped area and other habitats
3	Techniques of weed preservation - Herbarium preparation
4	Determination of critical period of crop-weed competition under field condition and study of crop associated weeds
5	Estimation of weed population dynamics and efficacy of herbicides (WCE and WI)
6	Study of biology of important problematic weeds
7	Study of biology of parasitic and aquatic weeds
8	Shift of weed flora study in long term experiments
9	Study of commonly available herbicides in the market, their nomenclature and label information
10	Study of herbicide formulations and mixture of herbicides
11	Computation of herbicide doses
12	Study of herbicide application equipment and calibration
13	Herbicide application methods and precautionary measures
14	Herbicide phytotoxicity scoring under field conditions and its compatibility with agro chemicals
15	Field study of weed control in cropped & non-cropped areas
16	Herbicide residue analysis

References

- Das, T.K. 2011. *Weed Science – Basics and Applications*. Jain Publishers, New Delhi.
- Gupta, O.P. 2016. *Modern Weed Management*. Agro Bios (India), Jodhpur.
- Naidu, V.S.G.R. 2012. *Handbook on Weed Identification*. Directorate of Weed Science Research, Jabalpur.
- Rao, V.S. 2011. *Principles of Weed Science*. Oxford & IBH Publishing Co., New Delhi.
- Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. *All About Weed Control*. Kalyani Publishers, Ludhiana.
- Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Press, Madras.

GENETICS & PLANT BREEDING

Course No. : **ELEC - 210**

Course Title : **Micro Propagation technologies**

Credit Hours : 3 (1+2)

General Objective : To impart knowledge to the students on the various techniques of plant tissue cultureand their role in crop improvement

A)

THEORY LECTURE OUTLINES

Lec. No.	Topic Details
1.	History of plant tissue culture – terminology used in plant tissue culture
2.	Plant cell and tissueculture – steps in general tissue culture techniques – merits and limitations – Applications of plant tissue culture in crop improvement
3.	Laboratory set up; Growth room chambers and instruments Different techniques used for sterilization in plant tissue culture,
4.	Nutritional requirements of tissue culture – preparation and composition of Murashige and Skoog (MS) medium
5.	Types of media – solid and liquid media – advantages and limitations
6.	Totipotency– growth and differentiation in cultures Types of cultures – callus and suspension cultures
7.	Micropropagation – meristem culture – procedure – various approaches for shoot multiplication – Micropropagation –Problems – advantages and limitations
8.	Somaclonal variation – types – origin – advantages – limitations – achievements
9.	Anther / pollen culture – brief procedure – factors affecting androgenesis – Haploids – Applications of haploids in crop improvement – limitations – achievements
10	Embryo culture – purpose – methods of embryo culture – procedure – applications – achievements. Ovule culture – ovary culture; Purpose and Procedure
11	Endosperm culture – purpose – procedure – applications
12	Somatic embryogenesis – stages of somatic embryo development – general procedure – Factors affecting somatic embryogenesis – applications – limitations
14.	Artificial seed / synthetic seed production – desiccated systems and hydrated systems of synthetic seed production – advantages and limitations
15.	Protoplast culture – methods of protoplast isolation – Advantages
16	Somatic hybridization – Procedure, products of somatic hybridization – symmetric hybrids, asymmetric hybrids and cybrids – advantages and limitations of somatic hybridization

B) PRACTICALS LECTURE OUTLINES

Lec. No.	Topic Details
1.	Requirements for Plant Tissue Culture Laboratory
2.	Importance of equipments used in PTC lab.
3.	Techniques in plant tissue culture
4.	Problems and possible solutions in plant tissue culture work

5.	Media components and its importance
6.	Preparation of stock solutions for media preparation
7.	Preparation of liquid and solid Ms media
8.	Sterilization techniques in PTC
9.	Inoculation of various explants
10.	Aseptic manipulation of various explants carrot, tobacco, maize and wheat
11.	Aseptic inoculation of commercial crops. Banana, Pomegranate, Teak.
12.	Micro propagation of important crops, through axillary bud and apical shoot bud proliferation.
13.	Micro propagation and plant regeneration from leaf explants
14.	Micro propagation and plant regeneration through immature embryos of cereals.
15.	Callus induction – plant regeneration of anther culture
16.	Callus induction – plant regeneration of embryo and endosperm culture
17.	Hardening / acclimatization of regenerated plants
18.	Transfer of plants to soil / normal environment
19.	Production of synthetic seeds (Desiccated and hydrated systems)
20.	Isolation of protoplast from tobacco leaf
21.	Culturing of protoplast on CPW medium
22.	Demonstration of direct gene transfer technique (gene gun)
23.	Demonstration of leaf disc method (co-cultivation)
24.	Agrobacterium mediated transformation (indirect method)
25.	Implant technique for transformation
26.	DNA isolation by CTAB method
27.	Gel electrophoresis and quantification of DNA
28.	Confirmation by PCR (molecular method)
29.	Gus assay (Biochemical method)
30, 31 & 32	Visit to private tissue culture lab

REFERENCES

- Jha, T.B. and Ghosh, B. 2005. *Plant Tissue Culture*. University Press, Hyderabad.
- Razdan, M. K. 2002. *Introduction to Plant Tissue Culture*. Oxford and IBH Publishing Co., New Delhi.
- H.S. Chawla (2003). Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. New Delhi
- E.F. Springer, 2007. Plant propagation by tissue culture: Vol 1. The background. George

Course No. : ELEC 310

Course Title : **Commercial Plant Breeding**

Credit hours : 3(1+2)

THEORY

1. Modes of plant reproduction and classification of crops based on pollination
2. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production.
3. Genetic purity test of commercial hybrids
4. Advances in hybrid seed production of rice
5. Advances in hybrid seed production of maize
6. Advances in hybrid seed production of sorghum and pearl millet
7. Advances in hybrid seed production of castor, sunflower and Brassica
8. Advances in hybrid seed production of cotton and pigeon pea
9. Quality seed production of vegetable crops under open and protected environment
10. Alternative strategies for the development of the line and cultivars: Haploid inducer and tissue culture techniques
11. Alternative strategies for the development of the line and cultivars: Biotechnological tools
12. IPR issues in commercial plant breeding
13. DUS testing and registration of varieties under PPV & FR Act
14. Variety testing, release and notification systems in India
15. Principles and techniques of seed production, types of seeds, quality testing in self pollinated crops
16. Principles and techniques of seed production, types of seeds, quality testing in cross pollinated crops

PRACTICAL

1. Floral biology of self pollinated crops
2. Floral biology of cross pollinated crops
3. Selfing and crossing techniques in various crops
4. Techniques of seed production in self and cross pollinated crops using A/B/R system
5. Techniques of seed production in self and cross pollinated crops using two line system
6. Learning techniques in hybrid seed production using male-sterility in field crops
7. Understanding the difficulties in hybrid seed production
8. Tools and techniques for optimizing hybrid seed production
9. Concept of rouging in seed production plot
10. Concept of line and its multiplication and purification in hybrid seed production
11. Role of pollinators in hybrid seed production
12. Hybrid seed production techniques in sorghum
13. Hybrid seed production techniques in pearl millet
14. Hybrid seed production techniques in maize
15. Hybrid seed production techniques in rice
16. Hybrid seed production techniques in sunflower and rapeseed-mustard
17. Hybrid seed production techniques in castor
18. Hybrid seed production techniques in pigeon pea

19. Hybrid seed production techniques in cotton
20. Hybrid seed production techniques in vegetable crops
21. Sampling and analytical procedures for purity testing and detection of spurious seed
22. Seed drying structures in quality seed management
23. Seed storage structures in quality seed management
24. Screening techniques during seed processing viz., grading and packaging
25. Visit to public and private seed production plots
26. Visit to public and private seed production plots
27. Visit to public and private seed production plots
28. Visit to public and private seed production plots
29. Visit to public and private seed processing plants
30. Visit to public and private seed processing plants
31. Visit to public and private seed processing plants
32. Visit to public and private seed processing plants

SOIL SCIENCE & AGRICULTURAL CHEMISTRY

1	Course No.	**ELEC - 320**
2	Course Title	**AGROCHEMICALS**
3	Credits Hours Semester	3(2+1) VI
4	General Objectives	
5	Specific objective a) Theory	At the end of the course, the students will be able to: (i) Have an acquaintance with the methods involved in manufacture and properties of various inorganic fertilizers (ii) Have knowledge about different agro-chemicals, their properties and uses (iii) Understand the importance of fertilizers and pesticides, their uses and residual effects in soil
	b) Practicals	At the end of the course, the students will be able to: (i) To collect the representative samples of fertilizers and pesticides (ii) Analyze the fertilizers and pesticides for their nutrient contents / active ingredients and to detect the adulteration in fertilizers and pesticides (iii) The students will be familiarized with the use of instruments like flame photometers, spectrophotometers, colorimeters, digestion – cum – distillation units etc. for the purity analysis of pesticides and nutrient contents in the fertilizers (iv) The students shall be taken to various organizations dealing with fertilizers testing laboratory, biofertilizers laboratory and pesticide residue testing laboratory to get an insight into various aspects regarding their production and testing (v) The students will be able to calculate fertilizers requirement and pesticides doses to be used for different crops

LECTURE OUTLINES – THEORY

An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.

Herbicides-Major classes, properties and important herbicides. Fate of herbicides.
Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride.

Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb.

Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification of insecticides: inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses.

Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassiumchloride, potassium sulphate and potassium nitrate.

Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.

Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

THEORY LECTURE OUTLINES

Lecture No.	Topic
1.	Introduction to agrochemicals – classification, type and role of agrochemicals in agriculture - Introduction to insecticides and classification of insecticides based on chemical nature with examples
2.	Botanical insecticides – examples, advantages – disadvantages. Neem – chemicals in neem and insecticidal action of neem
3.	Natural pyrethrum – sources, extraction, chemistry and insecticidal action
4.	Nicotene and Rotenone – sources, chemistry and mode of action
5.	Organochlorine insecticides – structure, properties and insecticidal activity of BHC, DDT, endosulfan
6, 7, 8 & 9.	Organophosphorous insecticides – mode of action – classification with structures of acids and examples of their derivatives – structure-activity relationships of thiophosphoric acid derivative insecticides - structure and properties of DDVP, phosphamidon, chlorpyriphos, malathion, phorate, profenofos, methyl parathion, acephate, monocrotophos
10.	Carbamate insecticides – chemistry – mode of action – structure and properties of carbaryl, carbofuran
11.	Synthetic pyrethroids – examples, uses, advantages and disadvantages
12.	Neonicotinoids – chemistry and insecticidal action – properties and uses of neonicotinoid insecticides imidacloprid, acetamaprid.
13.	Herbicides – classification with examples – selectivity of herbicides –- Mode of action of herbicides with examples
14.	Structure and properties of important herbicides – Atrazine, butachlor, 2, 4-D, glyphosate - Fate of herbicides
15.	Fungicides – classification with examples. Inorganic fungicides – characteristics, preparation, mode of action and use of sulphur fungicides
16.	Characteristics, preparation, mode of action and use of copper fungicides – Bordeaux mixture and copper oxy chloride

17& 18.	Organic fungicides – Dithiocarbamates - mode of action – structure, preparation, properties and use of zineb, maneb, thiram and ziram
19.	Systemic fungicides – structure, characteristics and use of benomyl, carboxin, oxycarboxin, metalaxyl, carbendazim
20.	Insecticide Act and rules - Pesticides banned, withdrawn and restricted use
21 &22.	Plant growth regulators – examples and uses - Biorationals, biopesticides, reduced risk insecticides - Bio-insect repellents - Animal origin insecticides
23.	Fertilizers – classification with examples – their importance in agriculture. Nitrogenous fertilizers – Haber-Bosch process – feed stocks for ammonia synthesis
24.	Feed stocks and manufacturing process of ammonium sulphate, ammonium nitrate, calcium ammonium nitrate, ammonium chloride
25.	Feed stocks and manufacturing process of urea, slow release N-fertilizers
26.	Phosphatic fertilizers – Feed stocks and manufacturing process of SSP – Preparation of bone meal and basic slag
27.	Potassic fertilizers – natural sources – manufacturing of potassium chloride, potassium sulphate
28.	Complex fertilizers – manufacturing of ammonium phosphates, nitrophosphates, potassium nitrate and NPK complexes
29.	Mixed fertilizers – sources and compatibility – preparation of major, secondary and micronutrient mixtures
30.	Fertilizer control order- fertilizer logistics - fertilizer subsidy - fertilizer marketing
31.	Persistence of agrochemicals – fate and effect of their use on the environment, soil, human health and animal health
32.	Merits and demerits of use of chemicals in agriculture – management of agrochemicals for sustainable agriculture

PRACTICAL

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

PRACTICAL LECTURE OUTLINES

Lecture No.	**Experiment**
1.	Sampling of fertilizers and pesticides for analysis
2.	Pesticide application technology – pesticide application appliances
3.	Pesticide formulations - formulations of pesticides available in market
4.	Quick tests for identification of fertilizers – identification of cations
5.	Quick tests for identification of fertilizers – identification of anions
6.	Estimation of nitrogen content of urea
7.	Estimation of phosphorous content in SSP by colourimetry
8.	Estimation of potassium content of potassic fertilizers using flame photometer
9.	Determination of calcium content of fertilizers

10.	Standardization of sodium thiosulphate by iodimetry
11.	Determination of iodine content of test solution by iodometry
12.	Determination of purity of copper oxy chloride
13.	Determination of purity of sulphur fungicide
14.	Determination of purity of malathion
15.	Calculations of fertilizer application and preparation of fertilizer mixtures
16.	Calculation of doses of pesticides to be used

Reference Books

S. No.	Title	Authors and Year	Publishers
1	Manures and Fertilizers	Yawalkar K S Agarwal J P and Bokde, S. 1992.	Agri. Horticultural Publishing House, Nagpur
2	Fertilizers Guide	Tandon, HLS 1994.	Fertilisers Development Consultation Organization, New Delhi
3	Hand Book on Fertilizers Usage	Seetharaman S Biswas B C, Yadav D S and Maheswaru S 1996.	Oxford and IBH Publishing Company, New Delhi
4	Chemistry of insecticides and Fungicides	Sreeramulu US 1991.	Oxford and IBH Publishing Company, New Delhi
5	Fungicides in Plant Disease Control	Nene Y L and Thapliyal P N 1991. Oxford and IBH Publishing Company, New Delhi	
6	Principles of Weed Science	Rao V S 1992.	Oxford and IBH Publishing Company, New Delhi
7	The Pesticide Manual – A World Compendium	1995	British Crop Production Council, U.K.

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HORTICULTURE

Course No. : **ELEC– 280**

Course Title : **Protected Cultivation**

Credit Hours : 3 (1+2)

S.No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
1.	Protected cultivation – Importance and scope, status of protected cultivation In India and	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
2	Greenhouse / polyhouse designs, different types of protected structures based on soil and	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
3.	Different types of Cladding material involved in Green house/polyhouse	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
4	Greenhouse design	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
5.	Environmental control in polyhouses	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
6.	Artificial lights, Automation in polyhouses	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
7	Types of Growing media, Soil preparation and substrate management in polyhouses for growing crops	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
8	Types of benches and containers used in polyhouses	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
9	Irrigation and Fertigation management	Interactive Lecture	Chalk Board/	1	3 and 4
10	Use of polyhouses for Propagation and production of quality planting material	Interactive Lecture	Chalk Board/ PPT	1	3 and 4
11	Greenhouse cultivation of Rose, Soil, Climate, Varieties, Propagation and intercultural operations	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
12	Rose, harvesting, Post harvest management, Pests and Diseases	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

S.No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
13	Greenhouse cultivation of Carnation Soil, Climate, Varieties, Propagation and intercultural operations	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
14	Carnation, harvesting, Post harvest management, Pests and Diseases	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
15	Greenhouse cultivation of Chrysanthemum, Soil, Climate, Varieties, Propagation and intercultural operations	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
16	Chrysanthemum, harvesting, Post harvest management, Pests and Diseases	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
17	Greenhouse cultivation of pot plants Gerberas	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
18	Greenhouse cultivation of orchids, Soil, Climate, Varieties, Propagation and intercultural operations	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
19	Orchids, harvesting, Post harvest management, Pests and Diseases	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
20	Greenhouse cultivation of Anthurium	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
21	Greenhouse cultivation of Lillium	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
22	Greenhouse cultivation of Tulip	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
23	Greenhouse cultivation of Tomato, Soil, Climate, Varieties, Propagation and intercultural operations	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
24	Tomato, harvesting, Post harvest management, Pests and Diseases	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
25	Greenhouse cultivation of Bell pepper	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

S.No	Title of the Lecture	Teaching method	Teaching aid	Time required hour	Reference book(s)
26	Greenhouse cultivation of Cucumber	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
27	Greenhouse cultivation of Strawberry	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
28	Greenhouse cultivation of Pot plants and containers	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
29	Off-season production of flowers	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
30	Off-season production of Vegetables	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
31	Polyhouse cultivation of economically important medicinal plants like stevia etc	Interactive Lecture	Chalk Board/ PPT	1	1 and 2
32	Polyhouse cultivation of economically important aromatic plants like Davanam etc	Interactive Lecture	Chalk Board/ PPT	1	1 and 2

S.No	Practical class outlines
1.	Study of different structures of polyhouses
2	Raising of seedlings and saplings under protected conditions
3	Use of portrays in quality planting material production
4	Bed preparation in polyhouse
5	Planting of seedlings/saplings in polyhouse
6	Intercultural operations in flower crops
7	Intercultural operations in vegetable crops
8	Measurement of soil EC
9	Measurement of soil pH
10	Study of different growing media
11	Calculation and scheduling of Irrigation in polyhouse crops
12	Calculation and Fertigation for polyhouse crops
13.	Study of Fogging and Misting in polyhouses
14.	Growing media used for multiplication of greenhouse plant
15.	Visit to commercial polyhouses producing vegetable crops
16.	Visit to commercial polyhouses producing flower crops

REFERENCES

Sl.No.	Book title & Author	Publisher
1	Commercial Flowers, Bose, T.K. and Yadav, L.P.1992.	NayaPrakash, Calcutta
2	Floriculture in India-Randhawa, G.S. and Mukhopadhyaya, A.1994	Allied Publishers Pvt.Ltd., New Delhi.
3.	Radha Manohar, K. and lgathinathane, C.2000.Greenhouse Technology and Management	BS Publications, Hyderabad
4.	Kennard, S and Nelson, B.A.1977. Greenhouse management for Flowers and Plant Production.	International Printers and Publishers inc.lllinois

AGRICULTURAL EXTENSION

1. Course No :ELEC - 390
2. Course Title **: Agricultural Journalism**
3. Credit Hours : 3 (2+1)
4. Course Objectives :

E. GENERAL

To acquaint the students with the concepts of Journalism and how to write the agricultural news for print and electronic media for effective transfer of technology.

F. SPECIFIC

I. THEORY

At the end of the semester the students will be able to

- Describe the concepts of Journalism, agricultural journalism,& characteristics of agricultural news.
- Gain knowledge and skills in writing the Agricultural News stories and evaluation of them.
- Develop knowledge on print media and electronic media related to Agricultural Journalism.

II.PRACTICALS

- Study News stories ,success stories and develop skills in writing them for print and electronic media.
- Develop skill in evaluation and measurement of readability of written News stories etc.
- Develop skill in preparation of radio scripts and story boards.

4. Course Content

A. THEORY

S.No	Lesson	Time Required	Teaching Method	Teaching Aids
1	Journlism: Definition, meaning, functions & its role.	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
2	Different types of Journalism with examples	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
3	Agricultural Journalism-Nature, scope, importance of Agricultural Journlism in TOT	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
4	Journalist- definition, roles, responsibilities, Characteristics	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
5	Agricultural Journalist – definition, roles, responsibilities, Characteristics of Farm Journalist	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
6	Distinguishing features of farm	1 hr	Lecture	Chalk board & Power

	journalism-Different from other types of journalism		Cum Discussion	point presentation
7	News-Characterisitics of News, Types of News , sources of News	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
8	Agricultural News, Characteristics, the types and sources of Agricultural News	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
9	News papers and magazines as a communication media	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
10	Characterisitics, kinds and functions of news papers and magazines	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
11	Characteristics of news paper and magazine readers	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
12	Form, content, style and language of news papers and magazines	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
13	Parts of news papers and magazines	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
14	News story-Meaning, definition purpose, writing of news story, principles and parts	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
15	Agricultural story-Types-success story, feature story, news story	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
16	Feature story-Meaning, definition, purpose, writing of feature story, -principle-Parts	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
17	Writing news stories with different types of leads	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
18	Photo journalism, meaning, role and its importance in transfer of technology	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
19	Use of art works, graphs, charts, maps in Agricultural Journalism	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
20	Writing attractive captions	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
21& 22	Layout of Agricultural News	2 hr	Lecture Cum Discussion	Chalk board & Power point presentation
23&	Readability, meaning,	2 hrs	-do-	-do-

24	definition, concept and measurement			
25& 26	Writing of radio script for delivering of radio talk	2 hrs	-do-	-do-
27& 28	Writing of Story Board for Television and video programme		-do-	-do-
29	Role of social media in farm journalism	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
30	Editing of news story	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
31	Farm advertisement and role and its importance in Agricultural Journalism	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation
32	Proof Reading	1 hr	Lecture Cum Discussion	Chalk board & Power point presentation

B. PRACTICALS

S.NO	PRACTICAL	TIME REQUIRED	TEACHING METHOD
1	Exercise on collection of Agricultural information through interview	2 ½ hrs	Workshop
2	Exercise on coverage of agricultural events	2 ½ hrs	Workshop
3	Exercise on collecting information from agricultural research	2 ½ hrs	Workshop
4&5	Exercise on writing of news stories	2 ½ hrs each	Workshop
6	Exercise on writing of success stories	2 ½ hrs	Workshop
7	Selection for writing of Agricultural News story/Success Story	2 ½ hrs	Workshop
8	Exercise on Selection and preparation of Art Works for writing of Agriculture News Story/Success Story	2 ½ hrs	Workshop
9	Exercise on Editing of news story/Success story	2 ½ hrs	Workshop
10	Measuring readability of the written News Story/Success Story	2 ½ hrs	Workshop
11&12	Writing of Radio Scripts	2 ½ hrs each	Workshop
13&14	Planning and writing of Story Board	2 ½ hrs each	Workshop
15	Visit to Print Media Office	2 ½ hrs	Workshop
16	Visit to Electronic Media office	2 ½ hrs	Workshop

REFERENCES

- Agricultural Extension and Farm Journalism.A.K. Singh. 2014 .Agrobios, Jodhpur
- Editing Principles and Practices.Rabindranath.2013.Motilal Banarsidass Publishers (P) Ltd. New Delhi.
- Mass Communication and Journalism in India. Mehta, D. S. 1979. Allied Publishers Ltd. New Delhi.
- Mass Communication in Agricultural Extension. Dileep Kumar Dangi.2012.Astral International (P) Ltd. New Delhi
- Theory and practice of journalism. Ahuja, B. N. 1979. Surjeeth publication, Delhi

ENTOMOLOGYV AND MICRO-BIOLOGY

Course No. : ELEC - 230
Course Title : **Bio Pesticides and Bio Fertilizers**
Credits : 3(2+1)

THEORY

Lect. No.	Topic
BIO PESTICIDES	
1.	History and concept of Insect pathogens and Bio Pesticides.
2	Introduction, importance, scope and potential of Bio Pesticides
3	Definitions, concepts and classification of Bio Pesticides *viz.* pathogens, botanical pesticides, and bio rationals.
4	Microbial Bio Pesticides *viz* Viruses, Bacteria, Fungi etc.
5 & 6	Virulence, pathogenicity and symptoms of entomopathogenic organisms
7	Botanicals & other bio rational pesticides and their uses
8	Role of Bio Pesticides in Organic farming and eco friendly agriculture
9&10	Mass production and scaling up of production of different categories of Bio Pesticides.
11	Regulatory requirements of Govt. of India in mass production of Bio Pesticides
12	Methods of applications of Bio Pesticides
13	Precautionary approaches in application and usage of Bio Pesticides.
14	Standards and specifications of Bio Pesticides as per Govt. of India guidelines
15	Methods of quality control and Techniques of Bio Pesticides
16	Constraints & possible solutions in production and use of Bio Pesticides
BIO FERTILIZERS	
17	Different Agriculturally important beneficial Microorganisms. Introduction and scope of Biofertilizers.
18	Types and classification of Biofertilizers. Total Biofertilizer production in India and Telangana state.
19	Different Nitrogen Biofertilizers. Symbiotic & Non Symbiotic Nitrogen fixation.
20	Nodule formation, Competitiveness, Quantification of Nitrogen fixed.
21	Associative and Free living Nitrogen fixation. Cynobacterial Biofertilizers.
22	Phosphate solubulising Bacteria and Fungi. Mechanism and solubulization of Phosphorus
23	Phosphate mobilizing microorganisms. VAM in detail.
24	Potassium and Zinc Biofertilizers.
25	Plant Growth Promoting Biofertilizers (PGPR)
26	Production technology; Strain selection, Sterilization, Growth and Fermentation.
27	Mass scale production of different carrier and liquid based biofertilizers.
28	FCO specifications and quality control of biofertilizers.
29	Microbes beneficial for recycling of Organic wastes & Composting.
30	Bioremediators and its related Microbes.

31 &32	Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers – Storage, shelf life and marketing. Factors influencing the efficacy of Biofertilizers.

PRACTICALS

Prac.No.	Topic
	BIOPESTICIDES
1	Isolation and purification of important Bio Pesticides: Insect viruses and their production.
2	Isolation and purification of important Bio Pesticides:Bacterial organisms and their production.
3	Isolation and purification of important Bio Pesticides:Entomo Pathogenic Fungi (EPF) and their production.
4	Isolation and purification of important Bio Pesticides:Antagonistic organisms and their production.
5	Field visit to explore natural infections & epizootics along with study of symptomology under field conditions.
6	Identification of important botanicals.
7	Visit to Bio Pesticides production unit in nearby area.
8	Quality control protocols for Bio Pesticides.
	BIOFERTILIZERS
9	Isolation of Nitrogen fixing organisms Rhizobium, Azotobacter.
10	Isolation of Phosphate solubilising mobilizing microbes from soil sample.
11	Development & production of efficient Microbes. Preservation and pure cultures development.
12	Study of Nitrogen fixing Activity by ARA method.
13	Production of Indole Acetic Acid (IAA).
14	Production of Siderophores.
15	Preparation of different Carrier based Biofertilizers. Bacterial and Fungal.
16	Study the Quality parameters of Biofertilizers

REFERENCES FOR BIO PESTICIDES

- Leo, M.L. Nollet, Hamirsingh Rathore. **Bio Pesticide Handbook.** CRC Press Tayler & Francis group, Newyork. 1-29 pp.
- Md. Arshad Anwer. 2017. **Bio Pesticides and Bio Agents** e book CRC Press Taylor & Francis group Newyork. 1-365 pp.
- Dwijendra Singh.2014. **Advances in Plant Bio Pesticides**. Publisher Springer 1-401 pp.
- Ghayur Alam. 2000. **A Study of Bio Pesticides and Bio Fertilisers in Haryana, India.** International Institute for Environment and Development 3 Endsleigh Street London 1-24 pp.
- Vibrant Gujarath. 2017. **Setting up a Bio-Fertilizers and Bio-Pesticides Unit** Biotechnology Government of Gujarat. Gujarat State Biotechnology Mission. 1-23 pp.

- Salma Mazid, Ratul Ch. Rajkhowa, Jogen Ch. Kalita (2011). **A review on the use of Bio Pesticides in Insect Pest Management**. ***International Journal of Science and Advanced Technology***, Volume 1 No 7, 169-178 pp.
- Muhammad Nawaz, Juma Ibrahim Mabubu and Hongxia Hua. 2016. **Current status and advancement of Bio Pesticides: Microbial and Botanical Pesticides.*Journal of Entomology and Zoology Studies***, Volume 4(2): 241-246 pp.
- S. Ezhil Vendan. 2016. **Current Scenario of Bio pesticides and eco-friendly insect pestmanagementinIndia**. ***South Indian Journal of Biological Sciences*** 2(2); 268-271pp.
- Opender Koul.2011. **Microbial Bio Pesticides: Opportunities and Challenges.** CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources Vol 6, No. 56. 1-26 pp.
- Vaishali Kandpal 2014. **Bio Pesticides.*International Journal of Environmental Research and Development***. 4(2), 191-196 pp.
- Subrata Datta. 2012. **Bio Pesticides and Fertilizers: Novel Substitutes of their Chemical Alternates.*Journal of Environmental Research and Development,*** 6 (3A), 773-777 pp.

REFERENCES FOR BIO FERTILIZERS

1. Biofertilisers in Agriculture by N. S. Subba Rao.
2. Recent Trends in Biofertilisers by Pati Bikasir and Mandal Santi, M.
3. The complete technology book on Biofertiliser and Organic Farming (2nd revised edition) by Niir Board. 2012 published.
4. Hand book of Microbial Biofertilisers by Mahendra Rai. Published in 2006 by CRC Press.
5. Biofertiliser in Sustainable Agriculture by A. C. Guar. Published by ICAR.
6. Biofertilisers Technology by S. Kannaiyan, K. Kumar and Govindarajan published by Scientific Publishers (India) 2004.

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Course No. : ELEC - 350
Course Title : **Food Safety and Standards**
Credits : 3(2+1)

THEORY

8.	Food Safety – Definition, Importance, Scope – Its need and role in food safety	1 hr
9.	Factors affecting Food Safety and Quality of food	1 hr
10.	Hazards and Risks, Types of hazards – Biological hazards – different microbes- Bacterial hazards- Parasitic hazards Types of hazards – Chemical hazards – Naturally occurring hazards- Intentionally added chemicals – incidentally added chemicals Physical hazards – Glass – Metal – Bones – Management of hazards – Need, Pest and Rodent control	1 hr
11.	Control of parameters – Different parameters for certifying quality of food Physical and Chemical and packing material	1 hr
5&6	Food storage	2 hr
7	Product design	1 hr
8&9	Hygiene and Sanitation in Food Service Establishments- Introduction Personnel Hygiene	2 hr
10&11	Sources of contamination and their control- Water Analysis, Surface Sanitation	2 hr
12	Waste and byproduct disposal	1 hr
13	Food Safety Measures	1 hr
14.	Food Safety Management Tools- Basic concepts	1 hr
15.	Food Safety Management Tools - PRPs, GHPs, GMPs, SSOPs etc	1 hr
16.	Risk assessment and management during food preparation – HACCP – prerequisite programmes – HACCP principles flow diagrams and applications	1 hr
17.	ISO series.	1 hr
18	TQM - concept and need for quality	1 hr
19	Components of TQM, Kaizen	1 hr
20	Risk Analysis	1 hr
21	Accreditation and Auditing	1 hr
22	Food inclusion audit	1 hr
23	Food process operation audit - Food safety audits	1 hr
24	Food laws and Standards- FSSA. Global Scenario CAC.	1 hr
25	Food laws and Standards- Indian Food Regulatory Regime.	1 hr
26	Food traceability and food recalls	1 hr
27	Recent concerns- New and Emerging Pathogens.	1 hr
28	Packaging of food.	1 hr
29	Product labeling and Nutritional labeling.	1 hr

30	Genetically modified foods\ transgenic. Organic foods.	1 hr
31	Newer approaches to food safety. Recent Outbreaks.	1 hr
32	Indian and International standards for food products.	1 hr

PRACTICAL CLASS OUTLINES

1. Water quality analysis physico-chemical and microbiological.
2. Preparation of different types of media.
3. Microbiological Examination of different food samples- Cereal foods
4. Microbiological Examination of different food samples- Processed fruits and vegetable products.
5. Microbiological Examination of different food samples- Diary products
6. Microbiological Examination of different food samples- Meat and poultry products.
8. Assessment of surface sanitation by swab/rinse method.
9. Assessment of personal hygiene.
10. Biochemical tests for identification of bacteria.
11. Biochemical tests for identification of bacteria
12. Scheme for the detection of food borne pathogens.
13. Scheme for the detection of food borne pathogens.
14. Preparation of plans for Implementation of FSMS – HACCP.
15. Preparation of plans for Implementation of FSMS - ISO: 22000.
16. Practical Examination.

Suggested Reading

- Gerard J. Tortora, Berdell R. Funke, Christine L. Case. 2014. Microbiology: An Introduction, 12th Ed. Prentice-Hall, NY, USA.
- Johanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2013. Prescott's Microbiology, 9th Ed. McGraw-Hill Higher Education, NY, USA.
- Michael J. Pelczar Jr., E.C.S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi.

AGRICULTURAL ECONOMICS

Course No : ELEC - 340
Course Title : **Agribusiness Management**
Credit Hours : 3 (2+1)

THEORY

Lec. No	Topic
1.	Transformation of agriculture into agribusiness. Agribusiness – Definition, nature and scope.
2.	Various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy.
3.	The new agricultural policy in India – Scope and components
4.	Distinctive features of agribusiness management – Importance and need for agro-based industries – Classification of industries and types of agro - based industries.
5.	Institutional arrangement, procedures to set up agro – based industries – Constraints in establishing agro-based industries.
6.	Agri-value chain – Primary and support activities and their linkages – Constraints in agri-value chain.
7.	Business environment – Internal and external factors – Micro and macro variables.
8.	PEST and SWOT analysis of the businesses / organizations
9.	Definition of management – Functions of management – Role of managers – Skills required by managers.
10.	Definition of organization culture – Determinants of organization culture – Organization culture and climate – Creating a positive organizational culture.
11.	Definition of planning function – Meaning and definition of plan – Types of plans – Mission, objectives, strategies, policies, procedures, rules, programmes and budget.
12.	Steps in planning and implementation – Planning and controlling – Management control – Various types of controls.
13.	Organization – Definition –Objectives of an organization –Staffing function in organization – Needs and ways of staffing.
14.	Directing and motivation – Definition of leadership – Leadership styles based on use of authority. Motivation – Definition – Maslow's Hierarchy of Needs Theory of Motivation.
15.	Financial management –Introduction –Definition – Scope and importance
16.	Fixed capital management – Fixed capital –Determinants of fixed capital – Decision areas in fixed capital – Purchase or lease
17.	Estimation of working capital requirements – Working capital management – Concepts, need, determinants, sources, its objectives and importance.
18.	Sources of capital – Long term sources, short term sources of a business concern. Dividend decision – Factors influencing dividend decision
19.	Understanding financial statements –Income statement and its significance – Balance sheet its significance.
20.	Financial ratio analysis
21.	The importance and scope of marketing – Definition of marketing management – Core marketing concepts – Needs, wants and demands.
22.	Marketing philosophies – The production concept –The product concept – The selling

	concept – The marketing concept – The societal marketing concept – The 4P's of marketing mix.
23.	Identifying market segments and targets – Bases for segmenting consumer markets – Geographic, demographic, psychographic, behavioral – Market targeting and product positioning.
24.	Developing and establishing brand name – Various brand assets.
25.	Product life cycle – Marketing strategies in introduction stage, growth stage, maturity stage, decline stage – Consumer behaviour analysis.
26.	Product pricing by companies – Various methods, cost plus pricing, markup pricing, breakeven pricing, demand based pricing, geographical pricing, price discounts and allowances, promotional pricing and differentiated pricing.
27.	Product promotion – Advertisement, personal selling, sales promotion and publicity.
28.	Sales and distribution management – The importance of channels, hybrid channels and multi channel marketing, value networks – Causes of channel conflict –Managing channel conflict.
29.	Definition of project – Project management – Project characteristics – Importance – Objectives of project management.
30.	Project life cycle and its phases
31.	Project appraisal and evaluation techniques – Undiscounted measures – Capital budgeting – Payback period method – Average rate of return etc
32.	Project evaluation – Discounted measures – Time value of money, BC Ratio, Profitability Index, Net Present Value, Internal Rate of Return.

PRACTICALS

1. Case study on role and functions of Manager in a firm.
2. Study of leadership styles of popular business personalities.
3. Analysis of financial statements
4. Working out financial ratios
5. Case study on market segmentation and targeting.
6. Problems on various pricing methods.
7. SWOT & PEST analysis of any two business firms.
8. Business communications – Business letters, memos, notice, reports, press release etc.
9. Study of the latest govt. schemes for promoting agribusinesses.
10. Visit to agribusiness firm and study of their operations.
11. Project appraisal and evaluation - undiscounted measures.
12. Project appraisal and evaluation - discounted measures.
13. Developing a business plan.
14. Case study on Corporate Social Responsibility
15. Analysis of agribusiness advertisements and publicity items
16. Study of various levels of channels – Distribution function.

REFERENCES

1. Project Management – Rajeev M. Gupt – PHI Publications, New Delhi, 2011.
2. Marketing Management – Philip Kotler, Keller, Koshy, Jha – Pearson Publishing, New Delhi, 2013.
3. Organizational Behaviour – Robbins, Judge, Vohra – Pearson Publishing, New Delhi, 2012.
4. Essentials of Management – Koontz and Welhrich – Mc Graw Hill Publishing, 2010.
5. Principles of Management – T. Ramasamy – Himalaya Publishing House, 2007.
6. Management – SA Sherlekhar – Himalaya Publishing House, 2010
7. Accounting – S.N. Maheswari and S. K. MAheswari – Vikas Publishing House Pvt Ltd, 2006
8. Financial Management – I. M. Pandey – Vikas Publishing House Pvt Ltd, 2011

CROP PHYSIOLOGY

Course No : ELEC – 360

Course Title : **Applied Crop Physiology**
Credit Hours : 3 (2+1)

Lecture Number	Content
	A. Seed Physiology
1-2	**Importance of seed physiology in seed industry –** Influence of seed germination, seedling emergence on crop stand and seed production and yield potential: seed quality – seed size, content of carbohydrate, proteins, fats, amino acids. Mineral nutrients influencing seed quality maintenance; Post-harvest – threshing quality of seed, sun – drying, storage of seeds – influence of seed moisture, relative humidity.
3	Seed viability – Longevity; crop seeds varying in seed viability and longevity – Importance of seed viability – methods of identifying seed viability. Dormancy: Importance of seed dormancy in regulation of cropping systems – different methods of inducing and breaking dormancy.
4	Seed size, Cotyledonary size in relation to Crop growth and Productivity – seed size effect of photosynthesis and assimilate production – Effect of plant growth and development.
	B. Growth and Development
5	Significance of crop growth and development on crop productivity potential. Significance of AGR, RGR, NAR, LAI, LAD, CGR, SLW, SLA, HI on improving crop productivity
6 & 7	Methods and formulae of growth parameters (AGR, RGR, NAR, LAI, LAD, CGR, SLW, SLA, HI) for improving crop productivity Modern concepts in photosynthesis: Enhancement of photosynthesis by manipulation LAI, inhibition of photo respiration, increasing CO_2 fixation at high CO_2 levels. Inhibition of excess light intensity effects on photosynthesis, enhancing photosynthesis low light intensities.
8	Nutrient application- Methods and timing of nutrient application in relation to crop growth stages: Significance of split application of nutrients by foliar application, fertigation, mist and foam methods.
9	Photoperiodism for improving crop productivity in modern crop genotypes - Importance of photo induction cycles – primordial initiation and growth determining yield potential. Photo sensitivity and photo insensitivity in modern crop genotypes.
10	Light quality and intensity in improving crop productivity in modern genotypes –. Effect low light and excess light intensity on crop productivity – Light saturation point – it importance – levels in crop plants Cereals, Pulses and Oil seed crops.
11	Crop geometry for crop improvement. – Significance different spacings between plants and rows on crop growth, development and yield components. Radiation Use Efficiency and its implications Crop Productivity. Importance of RUE, differences in RUE among crop plants.

C. Nutrition	
12 &13	Macro and micro nutrients for improving crop productivity: Effect of Macro and micro nutrients on cop yields. Sufficiency-deficiency and toxicity effects on influencing crop yields – Differences in yields in different crops supplied with sufficient and deficient or toxic nutrients. Correction remedies: importance of correction of nutrient deficiencies. Remedies to correct deficiencies of macro and micro nutrients in different crops.
14	Foliar application of nutrients: Importance - nutrient economy efficiency of nutrient utilization for crop growth, development and yield.
15	Water Use Efficiency in cereals in relation to yield potential: Differences in WUE among crops. Significance in improving crop productivity. Plant characters to improve WUE.
16	Nitrogen Use Efficiency in improving crop yields: Differences in NUE among crops. Significance in improving crop productivity and grain yield. Plant characters to improve NUE in crop plants.
17	Water stress: effects on crop plant growth and development: Effects on germination, seedling emergence, tillering, LAI, flower induction. Productive potential: Effect on yield formation and yield components. Grain filling and yield. Crucial crop growth stages to water stress: Sensitive crop growth stages to stress in different crops (Cereals, Pulses, Oil seed crops)
18	Flooding stress: effects on crop plant growth and development: Effects on germination, seedling emergence, tillering, LAI, flower induction. Productive potential: Effect on yield formation and yield components. Grain filling and yield. Crucial crop growth stages: Sensitive crop growth stages to stress in different crops (Cereals, Pulses, Oil seed crops)
19	Salinity stress: effects on crop plant growth and development: Effects on germination, seedling emergence, tillering, LAI, flower induction. Productive potential: Effect on yield formation and yield components. Grain filling and yield. Crucial crop growth stages to salinity: Sensitive crop growth stages to stress in different crops (Cereals, Pulses, Oil seed crops)
20	Characteristics of tolerant crop genotypes to water stress, Cold, Flooding and salinity:- Plant morphological, anatomical, bio chemical, physiological and molecular features. Tolerant to water stress, Cold, flooding and salinity.
D. Phytohormones	
21	Phytohormones in crop growth regulation for improving crop production Physiological and morphological effects of auxins, Gibberellins, Cytokinins, Ethylene and Abscissic acid include: 1. Promotion of rooting and propagation 2. Initiation or termination of dormancy in seeds, buds and tubers 3. Induction or retardation of aging (Senescence) 4. Promotion or Delay of flowering 5. Control of fruit set and development 6. Enhancement or prevention of leaf or fruit drop 7. Control of plant or organ size

	8. Modification of sex expression 9. Chemical pruning 10. Increased resistance to pests and environmental stress of water, temperature and pollution 11. Prevention or delay of Post – Harvest spoilage 12. Regulation of plant and fruit composition 13. Influence on mineral upkate 14. Change of timing in crop development 15. Enhanced coloration of fruit 16. Enhancement of sugar production by sugarcane ripeners 17. Increasing flow & latex in commercial production of rubber tubers 18. Enhanced transplantation hardiness in rice 19. Modification of pattern of crop canopies and plant arche texture 20. Flavour, colour, shape, firmness, taste, juciness and etability. Improvement in fruit and vegetable crops
22 & 23	Case studies of Auxins - seed germination, crop growth, regulation and improving crop yields. Gibberellins - seed germination, crop growth, regulation and improving crop yields. Cytokinins - seed germination, crop growth, regulation and improving crop yields. Abscissicacid -seed germination, crop growth/regulation and improving crop yields
E. Plant Growth Regulators	
24 & 25	Plant growth regulators (Promoters and Retardants) in regulating seed germination, Crop growth and development and improving yield potential:- (Ex: Cycocel – Excess growth regulation, assimilate of translocation and yield in cotton, chillies etc crops. Planofix – Reduction in flower and fruit drop and increased yields cotton, chillies etc crops. Paclobutrazole – Increasing fruit crop productivity and quality fruits. Morphactins – Increasing production of vegetable crops by vegetative growth regulation. Brassinoloids – Improving cereal crop yields, stress tolerance. Improving protein yields etc in various agri crops
F. Case studies on	
26 & 27	1. Reducing excess vegetative growth in cotton, Pulses and Cereals etc. – by using manual, chemical growth regulation with examples of success stories. 2. Enhancing loading tolerance in cereals – Through 'Source & Sink' regulation by manual / chemical methods. 3. Preventing flower and fruit drop in cotton, chillies etc. – using phyto hormones, Planofix, NAA etc. 4. Induction of flowering in specific crops – by using phyto hormones/photo periodic induction followed by gene transfer methods through breeding programmes. 5. Enhancing ripening for improving quality of grain yield and catching market value – by staggered use of Abscissic acid, ethylene or Cytokinins in vegetables, flowers and grain production through regulation of fruit growth.

2. Herbicide Physiology	
28	Herbicides in improving crop yields, grain quality
29	Specificity of herbicides targeting plant physiological processes for effective weed killing - Atrazine (Traize group) – Electron tropping and causing chlorosis, photosynthesis inhibition leading killing of weeds. Glyphosate – Enhancing respiration to control weeds. 2,4-D – Blocking vascular transport and killing weeds. Inhibition of amino acid synthesis and killing weeds
30	Physiological basis of herbicide tolerance in crop plants – Specific to Physiological Processes 1. Apoplastic / Symplastic transport of herbicides 2. Leaf chlorosis, photosynthesis inhibition 3. Electron trapping for photosynthesis inhibition 4. Blocking amino acid synthesis 5. Enhancing respiration and exhausting carbohydrate reserves of weeds 6. Cell proliferation blocking xylem & phloem conductive tissues.
3. Modelling	
31	Elementary models for crop growth, Simulation of crop growth, Crop-weather interactions. Crop production under elevated levels of CO2, temperature and scarcity of rainfall
32	Modeling of potential production: physiological principles – CO2 assimilation at single leaf and canopy levels. Modeling of patterns of development and dry matter distribution in rice. Overview of rice model to calculate potential crop production – input data required to run the model and interpretation of results

PRACTICALS

1	Crop Plant Growth analysis (Objective: Prediction of primordial initiation stage, date of flowering in relation to measurement of growth parameter and assess productivity
2	Screening crop varieties/Species for photosensitivity (Objective: To identify crop varieties sensitive to photoperiod)
3	Assessment of effect of light intensity on productivity in Cereals and Pulse crops
4	Radiation Use Efficiency and quantification
5	Influence of seed size and cotyledonary area in relation to crop yield
6	Testing seed viability dynamics Vs seed germination of crop seeds
7	Effect of Phytohormones on improving germination of crop seeds
8	Studying development of macro nutrient toxicities, deficiencies and correction in crop plants
9	Crop modeling, Hands on experience with APSIM. Running CROPGRO models to study crop growth under different growth constraints and interpretation of model output
10	Study of Water Use Efficiency of crop plant species/varieties, High throughput techniques
11	Visit to Phenomics facility for quantification of crop growth. Sensitivity analysis of these models across years with changed weather data sets
12	Effect of Cytokinins in preventing flower and fruit drop in cotton, chillies etc.,
13	Estimation of water soluble sugars, protein in grains or fruits
14	Visits: Cereals/Pulse crop fields to diagnose and rectify nutrient and other physiological disorders
15	Visits to seed storage labs and establishments at seed farms