

GREEN BOOK - 2012



ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
Rajendranagar, Hyderabad - 500 030

GREEN BOOK - 2012

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DETAILED LECTURE OUTLINES

B.Sc.(Ag.) Degree

2012



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FOREWORD

Higher agricultural education system in Andhra Pradesh has provided technically qualified human resource that played the fundamental role in transformation of agriculture. With time, the problems confronted by agriculture changed, necessitating quality human resource trained in contemporary and cutting edge technologies. The state food grain production is projected to 21.8 in 2012-13 as against 18.26 million tonnes in 2011-12. Formal agricultural education is needed for the training of skilled professionals to support in achieving these changes and targets. At the same time global standards and enhanced competitiveness have to be maintained while producing these graduates. Above all, the future graduates need to be professionals who possess confidence and competence to analyse an agricultural problem and be able to suggest solutions to alleviate it. Also, whether the intent is to serve the farming community, to get employment with the private sector or to launch a self-managed professional venture, the future graduates must be taught in new subject areas and exposed more and more to learning by practice in real life situation of field.

Therefore, efforts are made by the university to attune agricultural education curriculum and its delivery to overarch the present day needs of farmers and future demands of job markets with quality agricultural graduates. So, new courses in B.Sc (Ag) on Skill Practice (18 modules) are introduced in both semesters of the first year from the academic year 2012-13. In addition, AGRI– 206, 207, 306 and 307 on Commercial Crop Production are also introduced in B.Sc (Ag) second and third years. These courses are unique in the agricultural education in the country. With these new additions the total credit load has gone up to 170, the highest in any SAU, in the country.

Further, to empower the agricultural graduates with knowledge and skills in industrial agriculture to get absorbed in the fast expanding agro-industry and to inject entrepreneurial spirit to set up an agri-enterprise independently the composite "RAWEP-AELP-INTERNSHIP" recommended by the ICAR is also introduced from the academic year 2012-13.

The GREEN BOOK-2012 is embedded with these new additions. This book helps the teachers in uniform and systematic coverage of updated syllabus, setting standard question papers across all the agricultural colleges of the university.

I congratulate the team of editors and supporting staff in bringing out this most useful book for the benefit of teachers and students.

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YEAR WISE AND SEMESTER WISE DISTRIBUTION OF CREDITS AMONG DIFFERENT DEPARTMENTS

S. No.	Department	First Year		Second Year		Third Year		Total Credit Hours (upto Third Year)		
		I	II	I	II	I	II	Theory	Practical	Total
1.	Agronomy	<u>101</u> 2+1	<u>102</u> 1+1	<u>201</u> 2+1 <u>202</u> 1+1	<u>203</u> 2+1	<u>301</u> 2+1	<u>302</u> 1+1 <u>303</u> 1+1	12	8	20
2.	Genetics and plant Breeding	<u>111</u> 2+1		<u>211</u> 2+1	<u>212</u> 2+1	<u>311</u> 2+1	<u>312</u> 2+1	10	5	15
3.	Soil Science and Agricultural Chemistry		<u>121</u> 2+1	<u>221</u> 2+1		<u>321</u> 2+1		6	3	9
4.	Entomology	<u>131</u> 2+1			<u>231</u> 2+1	<u>331</u> 3+1	<u>332</u> 0+1 <u>333</u> 1+1	8	5	13
5.	Agricultural Economics	<u>141</u> 2+0	<u>142</u> 1+1		<u>241</u> 1+1	<u>341</u> 1+1	<u>342</u> 1+1	6	4	10
6.	Agricultural Engineering		<u>151</u> 2+1	<u>251</u> 1+1	<u>252</u> 1+1	<u>351</u> 1+1		5	4	9
7.	Plant Physiology		<u>161</u> 2+1	<u>261</u> 1+1				3	2	5
8.	Plant Pathology	<u>171</u> 2+1		<u>271</u> 1+1		<u>371</u> 2+1	<u>372</u> 1+1	6	4	10
9.	Horticulture	<u>181</u> 2+1		<u>281</u> 2+1	<u>282</u> 2+1		<u>382</u> 1+1	7	4	11
10.	Agricultural Extension	<u>191</u> 1+1		<u>291</u> 1+1	<u>292</u> 1+1		<u>391</u> 1+1	4	4	8
11.	Biochemistry		<u>101</u> 2+1					2	1	3
12.	Agricultural Microbiology				<u>201</u> 2+1			2	1	3
13.	Environmental Science and Technology						<u>301</u> 1+1	1	1	2
14.	Statistics and Computer Applications		<u>101</u> 1+1			<u>301</u> 1+1		2	2	4
15.	English		<u>101</u> 1+1					1	1	2
16.	Commercial Agricultural Courses			<u>206</u> 0+1	<u>207</u> 0+1	<u>306</u> 0+1	<u>307</u> 0+1	0	4	4
17.	Skill Practice Courses	<u>101</u> 0+1	<u>102</u> 0+1					0	2	2
18.	Non-credit Courses of Co-curricular Activities		<u>100</u> 0+1		<u>200</u> 0+1			0	2	2
	Total	20 (13+7)	22 (12+10)	23 (13+10)	23 (13+10)	23 (14+9)	21 (10+11)	75	57	132
Fourth year – I and II Semesters – Composite Rural Agricultural Work Experience Programme (RAWEP), Agricultural Experiential Learning Programme (AELP) and Internship								0	38	38
Grand Total								75	95	170

DEPARTMENT WISE DISTRIBUTION OF COURSES

Course No.	Department and Title of the course	Credits
Agronomy		
AGRO 101	Principles of Agronomy and Agricultural Meteorology	3 (2+1)
AGRO 102	Dryland Farming and Watershed Management	2 (1+1)
AGRO 201	Water Management	3 (2+1)
AGRO 202	Weed Management	2 (1+1)
AGRO 203	Crop Production-I	3 (2+1)
AGRO 301	Crop Production-II	3 (2+1)
AGRO 302	Principles and Practices of Social Forestry	2 (1+1)
AGRO 303	Farming Systems and Sustainable Agriculture	2 (1+1)
	Total	20 (12+8)
Genetics and Plant Breeding		
GPBR 111	Principles of Genetics	3 (2+1)
GPBR 211	Principles of Plant Breeding	3 (2+1)
GPBR 212	Principles of Plant Biotechnology	3 (2+1)
GPBR 311	Breeding of Field and Horticultural Crops	3 (2+1)
GPBR 312	Principles of Seed Technology	3 (2+1)
	Total	15 (10+5)
Soil Science and Agricultural Chemistry		
SSAC 121	Introduction to Soil Science	3 (2+1)
SSAC 221	Soil Chemistry, Soil Fertility and Nutrient Management	3 (2+1)
SSAC 321	Manures, Fertilizers and Agro-chemicals	3 (2+1)
	Total	9 (6+3)
Entomology		
ENTO 131	Insect Morphology and Systematics	3 (2+1)
ENTO 231	Insect Ecology and Integrated Pest Management	3 (2+1)
ENTO 331	Pests of Crops and Their Management	4 (3+1)
ENTO 332	Sericulture, Apiculture and Lac Culture	1 (0+1)
ENTO 333	Field Diagnosis in Agriculture	2 (1+1)
	Total	13 (8+5)

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Course No.	Department and Title of the course	Credits
Agricultural Economics		
AECO 141	Principles of Agricultural Economics	2 (2+0)
AECO 142	Agricultural Finance and Co-operation	2 (1+1)
AECO 241	Farm Management and Production Economics	2 (1+1)
AECO 341	Agricultural Marketing	2 (1+1)
AECO 342	Agribusiness Management	2 (1+1)
	Total	10 (6+4)
Agricultural Engineering		
AENG 151	Fundamentals of Soil and Water Conservation Engineering	3 (2+1)
AENG 251	Farm Power and Machinery	2 (1+1)
AENG 252	Greenhouses and Post Harvest Technology	2 (1+1)
AENG 351	Renewable Energy Sources	2 (1+1)
	Total	9 (5+4)
Plant Physiology		
PPHY 161	Crop Physiology	3 (2+1)
PPHY 261	Ecophysiology	2 (1+1)
	Total	5 (3+2)
Plant Pathology		
PATH 171	Introduction to Plant Pathogens	3 (2+1)
PATH 271	Principles of Plant Pathology	2 (1+1)
PATH 371	Diseases of Field Crops and Their Management	3 (2+1)
PATH 372	Diseases of Horticultural Crops and Their Management	2 (1+1)
	Total	10 (6+4)
Horticulture		
HORT 181	Principles of Horticulture and Production Technology of Fruit Crops	3 (2+1)
HORT 281	Production Technology of Vegetables and Flowers	3 (2+1)
HORT 282	Production Technology of Spices, Aromatic, Medicinal and Plantation Crops	3 (2+1)
HORT 382	Post Harvest Management and Value Addition of Fruits and Vegetables	2 (1+1)
	Total	11 (7+4)

Contd...on Page iv

Course No.	Department and Title of the course	Credits
Agricultural Extension		
AEXT 191	Dimensions of Agricultural Extension	2 (1+1)
AEXT 291	Fundamentals of Rural Sociology and Educational Psychology	2 (1+1)
AEXT 292	Extension Methodologies for Transfer of Agricultural Technology	2 (1+1)
AEXT 391	Entrepreneurship Development and Communication Skills	2 (1+1)
	Total	8 (4+4)
Biochemistry		
BICM 101	Biochemistry	3 (2+1)
Agricultural Microbiology		
AMBE 201	Agricultural Microbiology	3 (2+1)
Environmental Science and Technology		
EVST 301	Environmental Science	2 (1+1)
Statistics and Computer Applications		
STCA 101	Statistics	2 (1+1)
STCA 301	Introduction to Computer Applications	2 (1+1)
	Total	4 (2+2)
English		
ENGL 101	Comprehension and Communication Skills in English	2 (1+1)
Commercial Agricultural Courses		
AGRI 206	Commercial Crop Production – I	1 (0+1)
AGRI 207	Commercial Crop Production – II	1 (0+1)
AGRI 306	Commercial Crop Production – III	1 (0+1)
AGRI 307	Commercial Crop Production – IV	1 (0+1)
	Total	4 (0+4)
Skill Practice Courses		
SKPR 101	Skill Practice Courses (9) – I	1 (0+1)
SKPR 102	Skill Practice Courses (9) – II	1 (0+1)
	Total	2 (0+2)
Non-credit Courses of Co-curricular Activities		
COCA 100	Physical Education	1 (0+1)
COCA 200	NSS / NCC	1 (0+1)
	Total	2 (0+2)

YEAR WISE AND SEMESTER WISE DISTRIBUTION OF COURSES

Course No.	Title of the Course	Credit Hours (T+P)
FIRST YEAR		
First Semester		
AGRO 101	Principles of Agronomy and Agricultural Meteorology	3 (2+1)
GPBR 111	Principles of Genetics	3 (2+1)
ENTO 131	Insect Morphology and Systematics	3 (2+1)
AECO 141	Principles of Agricultural Economics	2 (2+0)
PATH 171	Introduction to Plant Pathogens	3 (2+1)
HORT 181	Principles of Horticulture and Production Technology of Fruit Crops	3 (2+1)
AEXT 191	Dimensions of Agricultural Extension	2 (1+1)
SKPR 101	Skill Practice Courses (9) – I	1(0+1)
	Total	20 (13+7)
Second Semester		
BICM 101	Biochemistry	3 (2+1)
ENGL 101	Comprehension and Communication Skills in English	2 (1+1)
STCA 101	Statistics	2 (1+1)
AGRO 102	Dryland Farming and Watershed Management	2 (1+1)
SSAC 121	Introduction to Soil Science	3 (2+1)
AECO 142	Agricultural Finance and Co-operation	2 (1+1)
AENG 151	Fundamentals of Soil and Water Conservation Engineering	3 (2+1)
PPHY 161	Crop Physiology	3 (2+1)
COCA 100	Physical Education	1 (0+1)
SKPR 102	Skill Practice Courses (9) – II	1(0+1)
	Total	22 (12+10)
SECOND YEAR		
First Semester		
AGRO 201	Water Management	3 (2+1)
AGRO 202	Weed Management	2 (1+1)
GPBR 211	Principles of Plant Breeding	3 (2+1)

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Course No.	Title of the Course	Credit Hours (T+P)
SSAC 221	Soil Chemistry, Soil Fertility and Nutrient Management	3 (2+1)
AENG 251	Farm Power and Machinery	2 (1+1)
PPHY 261	Ecophysiology	2 (1+1)
PATH 271	Principles of Plant Pathology	2 (1+1)
HORT 281	Production Technology of Vegetables and Flowers	3 (2+1)
AEXT 291	Fundamentals of Rural Sociology and Educational Psychology	2 (1+1)
AGRI 206	Commercial Crop Production – I	1 (0+1)

Total 23 (13+10)

Second Semester

AMBE 201	Agricultural Microbiology	3 (2+1)
AGRO 203	Crop Production-I	3 (2+1)
GPBR 212	Principles of Plant Biotechnology	3 (2+1)
ENTO 231	Insect Ecology and Integrated Pest Management	3 (2+1)
AECO 241	Farm Management and Production Economics	2 (1+1)
AENG 252	Greenhouses and Post Harvest Technology	2 (1+1)
HORT 282	Production Technology of Spices, Aromatic, Medicinal and Plantation Crops	3 (2+1)
AEXT 292	Extension Methodologies for Transfer of Agricultural Technology	2 (1+1)
AGRI 207	Commercial Crop Production – II	1 (0+1)
COCA 200	NSS / NCC	1 (0+1)

Total 23 (13+10)

THIRD YEAR

First Semester

AGRO 301	Crop Production-II	3 (2+1)
STCA 301	Introduction to Computer Applications	2 (1+1)
GPBR 311	Breeding of Field and Horticultural Crops	3 (2+1)
SSAC 321	Manures, Fertilizers and Agro-chemicals	3 (2+1)
ENTO 331	Pests of Crops and Their Management	4 (3+1)
AECO 341	Agricultural Marketing	2 (1+1)

Contd...on Page vii

Course No.	Title of the Course	Credit Hours (T+P)
AENG 351	Renewable Energy Sources	2 (1+1)
PATH 371	Diseases of Field Crops and Their Management	3 (2+1)
AGRI 306	Commercial Crop Production – III	1 (0+1)
	Total	23 (14+9)
Second Semester		
EVST 301	Environmental Science	2 (1+1)
AGRO 302	Principles and Practices of Social Forestry	2 (1+1)
AGRO 303	Farming Systems and Sustainable Agriculture	2 (1+1)
GPBR 312	Principles of Seed Technology	3 (2+1)
ENTO 332	Sericulture, Apiculture and Lac Culture	1 (0+1)
ENTO 333	Field Diagnosis in Agriculture	2 (1+1)
AECO 342	Agribusiness Management	2 (1+1)
PATH 372	Diseases of Horticultural Crops and Their Management	2 (1+1)
HORT 382	Post Harvest Management and Value Addition of Fruits and Vegetables	2 (1+1)
AEXT 391	Entrepreneurship Development and Communication Skills	2 (1+1)
AGRI 307	Commercial Crop Production – IV	1 (0+1)
	Total	21 (10+11)
FOURTH YEAR		
First and Second Semesters		
	Composite Rural Agricultural Work Experience Programme (RAWEP), Agricultural Experiential Learning Programme (AELP) and Internship	38 (0+38)
		Grand Total 170 (75+95)

DEPARTMENT OF AGRONOMY

1. Course No. : AGRO 101
2. Course Title : **Principles of Agronomy and Agricultural Meteorology**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on principles of agronomy and agricultural meteorology
5. Specific Objectives

a) Theory

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

- i. understand the concepts of agronomy and agricultural meteorology
- ii. know about the situation of agriculture in various agro-climatic zones of India and Andhra Pradesh
- iii. discuss the risks and uncertainties and ways to manage the same for better crop production

b) Practical

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

- i. identify different manures, fertilizers, green manure plants etc.
- ii. participate in all agricultural operations like ploughing, puddling, sowing, application of fertilizers, harvesting etc.

A) Theory Lecture Outlines

1. Definition of agriculture – meaning and scope of agronomy
2. History and development of agriculture in ancient India – agriculture in civilization era
3. National and International Agricultural Research Institutes in India
4. Agro-climatic zones of India – soils, land use pattern, major sources of irrigation and ground water potential
5. Agro-climatic zones of Andhra Pradesh – soils, land use pattern, major sources of irrigation and ground water potential

6. Tillage and tilth – objectives of tillage – characteristics of ideal seed bed – effect of tillage on soil properties – pore space, texture, structure, bulk density and colour of the soil
7. Types of tillage – preparatory tillage – factors affecting preparatory cultivation, after cultivation, puddling
8. Sowing – methods of sowing – time and depth of sowing for major agricultural crops – cereals, pulses and oilseeds
9. Crop stand establishment – factors affecting optimum stand establishment
10. 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
11. Soil fertility – soil fertility and soil productivity – fertility losses – maintenance of soil fertility – soil organic matter
12. Weed control – definition of weed – losses and uses of weeds – weed influence on crop production – methods of weed control
13. Irrigation management – importance of irrigation – objectives of irrigation – methods of irrigation – drainage and its advantages
14. Cropping systems – monocropping – definition and principles of crop rotation – mixed cropping – intercropping – relay cropping – multistoried cropping – sole cropping and sequence cropping
15. Harvest maturity symptoms and harvesting of major agricultural crops – rice, maize, groundnut, sugarcane and pulses – maturity indices, method of harvesting, threshing and winnowing – harvest index
16. Agricultural meteorology – introduction – definitions of meteorology, climatology and agricultural meteorology – scope and practical utility of agricultural meteorology
17. Composition and structure of atmosphere – definitions of weather and climate – aspects involved in weather and climate
18. Solar radiation – definition, introduction of electromagnetic spectrum and functions of light, solar constant, net radiation, black body radiation, emissivity, absorptivity, reflectivity, transmissivity and albedo
19. Physiological response of different bands of incident radiation – factors affecting distribution of solar radiation within the plant canopy

20. Air temperature – introduction – temperature and heat definitions – isotherms – horizontal and vertical temperature variations in the atmosphere – cardinal temperatures – importance of air temperature
21. Low air temperature and plant injury – high air temperature and plant injury – soil temperature – factors affecting soil temperature
22. Definitions of atmospheric pressure, cyclones – anticyclones – pressure patterns – wind – effects of wind on crops – mountain and valley winds – land and sea breezes
23. Atmospheric humidity and its expression – saturation – effects of humidity on crops
24. Evaporation and transpiration – definitions – factors affecting rate of evaporation and transpiration
25. Rainfall – importance of rainfall on crops – types of rainfall – monsoon – definition – origin and distribution of south west monsoon
26. Origin and distribution of north east monsoon – economic importance and influence of monsoon rains on farm operation
27. Clouds – cloud formation – cloud classification and characteristics – World Meteorological Organization (WMO)
28. Drought – definition – types of drought – effect of drought on crops – management of drought
29. Precipitation and condensation – definition, different forms of precipitations and condensations – cloud seeding (artificial rain making)
30. Weather disasters and management – rainfall, heat and cold waves, windstorms, hail storms, thunderstorms, dust storms, tornadoes and defective insolation
31. Weather forecasting – applications and utility for agriculture – synoptic charts, reports and symbols
32. Remote sensing – definition – introduction – applications in agriculture

B) Practical Class Outlines

1. Study of tillage implements
2. Practice of ploughing
3. Practice of puddling
4. Study of seeding equipment – different methods of sowing

5. Study of manures, fertilizers and green manure crops / seeds
6. Study of inter-cultivation implements and practice
7. Practice of methods of fertilizer application
8. Participation in ongoing field operations
9. Visit to meteorological observatory – layout plan of standard meteorological observatory
10. Measurement of light intensity / radiation components
11. Recording of atmospheric and soil temperature
12. Recording of relative humidity
13. Measurement of wind speed, direction and measurement of atmospheric pressure
14. Recording of evaporation
15. Measurement of rainfall – different types of rain-gauges
16. Synoptic charts and weather reports, symbols etc.

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

1. Course No. : AGRO 102
2. Course Title : **Dryland Farming and Watershed Management**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on dryland agriculture and watershed management
5. Specific Objectives

a) Theory

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

- i. understand the importance of dryland farming, water harvesting and storage methods
- ii. analyze rainfall of the area, plan water storage methods, plan and identify crop and livestock systems to such areas
- iii. know the moisture and soil conservation methods for better production and protection of environment

b) Practical

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

- i. evolve methods to alleviate drought by following moisture conservation methods and mid season corrections
- ii. understand methods to harvest and store rainwater and recommend crops and cropping systems for rainfed areas

A) Theory Lecture Outlines

1. Dryland farming – introduction and definition – dimensions of the problem – area and production from drylands in India and Andhra Pradesh – dry climates and their classifications – moisture index – semi - arid and arid climates – objectives and activities of Central Research Institute for Dryland Agriculture (CRIDA) – its main and coordinating centers
2. Problems of crop production in drylands – climate – rainfall pattern – distribution – variabilities in rainfall – short rainy season – high intensity rainfall
3. Problems of crop production in drylands – soil characteristics – soil fertility status – soil moisture storage and retention capacity – heavy weed infestation and economic conditions of the farmer
4. Existing pattern of land use in low rainfall areas – drought – definition – types and occurrence of drought – management strategies for drought – dry sowing, pot watering, aquaseed drill, transplanting of seedlings raised in polythene bags, gap filling – thinning
5. Tillage for dryland crops – on season tillage – off-season tillage – primary tillage – secondary tillage – deep ploughing – year round tillage – sub soiling – setline cultivation – minimum tillage and zero tillage – seeding practices – soil crusts and their effect on crop growth and soils – its management

6. Soil erosion – definition – losses due to erosion – types of soil and wind erosion – nature and extent of wind and water erosion – factors effecting erosion – universal soil loss equation
7. Agronomic measures of soil conservation – choice of crop – crop geometry – tillage – contour cultivation – strip cropping – cover cropping – mulching – cropping systems and weed control
8. Fertilizer use in drylands – 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 – fertilizer use in relation to soil moisture status
9. Efficient crops and varieties – cropping systems in drylands – inter cropping – advantages – efficient inter cropping systems in different dry farming regions of Andhra Pradesh
10. Crop planning for normal monsoon – contingent crop planning for aberrant weather conditions in red and black soils under delayed onset of monsoon, normal monsoon followed by long dry spells and early withdrawal of monsoon
11. Evapotranspiration – measures to reduce evapotranspiration – weeding, use of mulches, chemicals, windbreaks and shelterbelts
12. Land use capability and classification – definition of watershed – objectives and principles of watershed development
13. Watershed management – area of operation of watershed in Andhra Pradesh – problems and prospects under watersheds – components of watershed development programme
14. Soil and water conservation measures in watershed areas – agronomic measures – mechanical measures – gully control – bench terraces – contour terracing – graded bunds
15. Water harvesting structures – arid region – runoff farming – water spreading – micro catchments – semi arid region – farm ponds, check dams – percolation tank – tank – dug walls – life saving irrigation – in-situ moisture conservation measures – bund farmer – bunding, ridge and furrow system – inter plot water harvesting, mulching – Broad Bed and Furrow (BSF) and leveling
16. Alternate land use systems – advances – agro forestry systems – alley cropping – silvi pastoral systems – agri-silvi-pastoral system – agri-horticultural system – silvi-horticultural system – multi purpose forest tree production system

B) Practical Class Outlines

1. Allotment of plots and preparation of seed bed
2. Fertilizer application and sowing
3. Study of dry farming implements
4. Study of agronomic measures of soil and moisture conservation
5. Study of mulches and anti-transpirants
6. Demonstration of land treatments followed in dryland agriculture
7. Study of the effect of land treatments on moisture conservation
8. Estimation of length of crop growing period
9. Study of drought effects on morphology and physiology of crops
10. Determination of moisture availability index
11. Study of biometric observations of crops subjected to stress
12. Study of relationship between ambient temperature and pan evaporation
13. Study of farm ponds as a source of supplemental irrigation
14. Collection of data on temperature and evaporation
15. Visit to Watershed areas
16. Harvesting post harvesting operations and record of yield of different crops

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1. Course No. : AGRO 201
2. Course Title : **Water Management**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on principles and practices of irrigation water management for efficient utilization of irrigation water and to increase productivity of crops
5. Specific Objectives

a) Theory

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

- i. acquaint with the knowledge on water resources in India and Andhra Pradesh and soil-plant-water relationship
- ii. acquaint with the knowledge on irrigation methods, irrigation scheduling and water use efficiency in different crops

b) Practical

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

- i. develop skills in estimation of soil moisture content, crop water requirements and scheduling of irrigation to crops by different methods
- ii. learn about methods of irrigation, water measuring devices and water management of major crops
- iii. develop skills in operation and maintenance of sprinkler and drip irrigation systems

A) Theory Lecture Outlines

1. Irrigation – introduction – importance – definition and objective
2. Water resources of India – surface and ground water resources – irrigation development in India – important major irrigation projects
3. Water resources of Andhra Pradesh – surface and ground water resources – irrigation development in Andhra Pradesh – important major irrigation projects in Andhra Pradesh
4. Command area development and water management – objectives – reasons for gap between irrigation potential created and utilized – functions of Command Area Development Authority

5. Soil-water relations – importance of soil as three-phase disperse system – physical properties of soil *viz.*, depth, soil texture, soil structure, particle density, bulk density and porosity influencing water retention, movement and availability
6. Water retention in soil – adhesion and cohesion – soil moisture tension – pF – soil moisture characteristic curves
7. Water movement in soils – infiltration – percolation – seepage – permeability – hydraulic conductivity – saturated and unsaturated water flow
8. Kinds of water in soil – gravitational water – capillary water – hygroscopic water – their importance in crop production
9. Soil moisture constants – saturation – field capacity (FC) – permanent wilting point (PWP) – available soil moisture (ASM) – hygroscopic coefficient – moisture equivalent – theories of soil water availability – moisture retentive capacity – FC, PWP and ASM of different soils – problems on calculation of available soil moisture
10. Measurement of soil moisture – direct methods – gravimetric and volumetric method – infra-red moisture balance method – spirit burning method – indirect methods – neutron moisture probe – tensiometer – resistance blocks – pressure plate and pressure membrane apparatus – relative merits and demerits
11. Plant-water relationships – rooting characteristics – soil properties influencing root development – effective root zone depth – moisture extraction pattern – moisture sensitive periods of crops
12. Evapotranspiration – evaporation – transpiration – factors influencing evapotranspiration – daily, seasonal and peak period consumptive use
13. Reference crop evapotranspiration – definition – measurement of reference crop evapotranspiration – Blaney and Criddle method, Thornthwaite method, radiation method, modified Penman method, Penman-Monteith method and adjusted pan evaporation method – applications, their merits and demerits
14. Crop coefficient – definition – normalized crop coefficient curve – crop coefficients for different crops at different stages
15. Water requirement – irrigation requirement – net and gross irrigation requirement – irrigation interval – irrigation period – seasonal water requirement of important crops – sample problems
16. Effective rainfall – definition – factors influencing effective rainfall – drum culture technique in rice

17. Duty of water – base period – relation between duty and base period – sample problems on duty of water – conjunctive use of water – systems of conjunctive use – advantages of conjunctive use
18. Scheduling of irrigation – different criteria – soil moisture regime approach – feel and appearance method – soil moisture tension and depletion of available soil moisture method
19. Scheduling of irrigation – climatological approach – lysimeters – Irrigation Water (IW) / Cumulative Pan Evaporation (CPE) ratio method
20. 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 and critical growth stages
21. Surface irrigation methods – wild flooding, check basin, ring basin, border strip, furrow and corrugations – advantages and disadvantages, Sub-irrigation
22. Sprinkler irrigation method – definition – advantages and disadvantages – system components and layout – suitable crops
23. Drip irrigation – definition – advantages and disadvantages – system components and layout – suitable crops
24. Water Use Efficiency (WUE) – crop water use and field water use efficiency – factors influencing WUE – climatic genetic and management factors
25. Irrigation efficiencies – water conveyance efficiency, water application efficiency, water storage efficiency, water distribution efficiency and project efficiency – sample problems
26. Quality of water – salinity hazard, sodicity hazard, residual sodium carbonate and boron toxicity – criteria and threshold limits – management practices for using poor quality water
27. Water management practices for crops – rice – percolation losses, saturation vs submergence, optimum depth of submergence, critical growth stages and water requirement at different growth stages
28. Water management practices in wheat and maize – effective root zone depth, seasonal water requirement, critical growth stages, irrigation scheduling criteria, thresholds and method of irrigation

29. Water management practices in groundnut and sugarcane – effective root zone depth, seasonal water requirement, critical growth stages, irrigation scheduling criteria, thresholds and method of irrigation
30. Water management practices in mango, banana and tomato – effective root zone depth, seasonal water requirement, critical growth stages, irrigation scheduling criteria, thresholds and method of irrigation
31. Agricultural drainage – surface and sub-surface drainage systems – relative merits and suitability to different soils
32. Cropping systems of irrigated agriculture – efficient rice, sugarcane and groundnut based cropping systems in irrigated areas of Andhra Pradesh

B) Practical Class Outlines

1. Determination of bulk density
2. Determination of soil moisture content by gravimetric and volumetric method
3. Installation and working with tensiometer
4. Installation and working with resistant blocks
5. Determination of field capacity by field method
6. Determination of permanent wilting point
7. Measurement of irrigation water through flumes and weirs
8. Scheduling of irrigation by IW / CPE ratio method
9. Calculation of irrigation water needs (problems)
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, fertigation and injection)
14. Visit to farmers field and cost estimation of drip irrigation system
15. Demonstration of operation of sprinkler irrigation system
16. Visit to farmers field and cost estimation of sprinkler irrigation system

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1. Course No. : AGRO 202
2. Course Title : **Weed Management**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on various aspects of weeds and different methods of weed management for sustainable and higher crop production and also to develop reasonably good technical expertise and competence on weed management
5. Specific Objectives

a) Theory

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

- i. understand about weed biology and ecology and its usefulness in weed management
- ii. understand different methods of weed management including herbicides, their mode of action and selectivity and role of adjuvants for the effective weed control

b) Practical

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

- i. develop the mastery of weed identification
- ii. get acquainted with different herbicides and their usage by studying herbicide label information and field application
- iii. understand and develop technical know-how on computation of herbicide doses and skills on herbicide application for better herbicidal effects and weed management

A) Theory Lecture Outlines

1. Introduction – definition of weed – 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 and vegetative reproduction – dissemination (dispersal) of weeds – dispersal of weed seeds and fruits – dispersal agents – wind, water etc. – dispersal of vegetative propagules
4. Weed biology – characteristic features of weeds – weed ecology – persistence of weeds – climatic – edaphic (soil) and biotic factors – crop weed association with some important crops like rice, maize, wheat, sorghum, pulses, groundnut, sugarcane, cotton and tobacco
5. Crop-weed competition – principles – factors – critical period of crop-weed competition – allelopathy
6. Methods of weed control – physical, mechanical and cultural methods
7. Methods of weed control – chemical and biological methods of weed control – bio-herbicides – integrated weed management
8. Herbicides – definition – advantages and limitations of herbicide usage in India – classification of herbicides based on chemical nature, time and method of application
9. Classification of herbicides based on selectivity, translocation and residual nature – types of formulation
10. Nomenclature of herbicides – commonly available herbicides in India – adjuvants – definition – their use in herbicide application – surfactants, stabilizing agents, solvents, stickers, activators, compatibility agents, drift control agents etc.

11. Mode of action of herbicides – important bio-chemical modes of action of herbicides interfering with photosynthetic reactions, respiration, enzymatic inhibition etc. – effects of sub lethal doses of herbicides on plants
12. Selectivity of herbicides – fundamental principles of selectivity – differential absorption of herbicides – differences in morphology and growth habits of plants – differential translocation of herbicides
13. Selectivity of herbicides – differential rate of deactivation of herbicides by plants – metabolism, reverse metabolism and conjugation of herbicides in plants – differential protoplasmic resistance – multifactor selectivity of herbicides in plants
14. Weed management in different crops and cropping systems – shift in weed flora in cropping systems – rice – nursery – upland and lowland rice – wheat – maize – sorghum – redgram – blackgram – sunflower – groundnut – castor
15. Weed management in different crops and cropping systems – cotton – sugarcane – tobacco – vegetables (tomato, onion, brinjal and chillies) – fruit crops (mango, banana and citrus)
16. Aquatic weeds – water hyacinth, typha and ipomea – algal weeds and their control – problematic weeds – nutsedge, bermuda grass, *Parthenimum*, *cuscuta* and their control

B) Practical Class Outlines

1. Identification of weeds
2. Survey of weeds in crop fields and other habitats
3. Herbarium preparation of weeds
4. Study of crop-weed association and crop-weed competition and determination of critical period
5. Estimation of weed flora and calculation of WCE and WI
6. Study of commonly available herbicides in the market, their nomenclature and label information
7. Computation of herbicide doses
8. Study of herbicide application equipment and calibration
9. Herbicide application methods and precautionary measures

10. Study of phytotoxicity symptoms of herbicides in different crops
11. Field study and control of problematic weeds - nutsedge and bermuda grass
12. Field study and control of problematic weeds - *Parthenium* and *Celosia*
13. Field study and control of problematic weeds - *parasitic* weeds
14. Field study and control of aquatic weeds
15. Weed control in non-cropped area
16. Economics of weed control practices

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1. Course No. : AGRO 203
2. Course Title : **Crop Production - I**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on production of cereals (rice and wheat) millets (maize, sorghum, pearl millet, finger millet, foxtail millet, proso millet, kodo millet and little millet), pulses (redgram, bengalgram, blackgram, greengram, cowpea and horsegram) and fodders (sorghum, maize, cowpea, napier hybrid, paragrass, guinea grass, berseem and lucerne)

5. Specific Objectives

a) Theory

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

- i. get the first hand information on area, production, productivity of crops in India and Andhra Pradesh and general constraints for low production and various uses and by-products of crops
- ii. understand the climatic, soil, varietal requirement, the concepts of integrated weed control, integrated nutrient management and water management for the aforesaid crops
- iii. understand the different cropping systems and post harvest operations

b) Practical

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

- i. learn crop production techniques starting from land preparation to post harvest operations
- ii. experience practically the constraints in crop production by raising a crop
- iii. identify different crops and crop seeds

A) Theory Lecture Outlines

1. Rice – introduction – origin – distribution – area, production and productivity in India and Andhra Pradesh – rice plant types – concept of new plant types – important features of new plant types of rice
2. Rice – adaptation – influence of climate and soil factors – land preparation and puddling
3. Classification of rice – *Indicas*, *Japonicas* and *Javanicas* – important varieties and hybrids – latest varieties for special situations – rice growth and development – reasons for low yield of rice in India
4. Raising of rice nurseries – wet, dry, dapog and modified dapog nurseries – rice growing seasons in Andhra Pradesh and India – seed rate, seed treatment and spacing with reference to different seasons and varietal duration – management of over aged seedlings – package
5. Rice – different rice growing methods including System of Rice Intensification (SRI) technology – rice cultures – upland, rainfed upland, lowland, aerobic, tidal and deep water rice

6. Rice – manures and fertilizers – N, P, K, zinc, iron and bio-fertilizers – integrated nutrient management – steps for increasing fertilizer use efficiency in rice
7. Rice – irrigation water management – water requirement – critical stages – water use efficiency – methods of irrigation – flowing versus submergence
8. Rice – weed management – harvesting – threshing – processing – yield attributes and yield – rice by product utilization – economic importance – export potential – value added products – projections for future requirements – rice based cropping systems
9. Wheat – introduction – origin – distribution – area, production and productivity in India and Andhra Pradesh – wheat growing zones of India – adaptations – varieties – soils – land preparation – seasons – seeds and sowing – manures and fertilizers
10. Wheat – irrigation – weed control – harvesting – threshing and processing – yield attributes and yield – by-product utilization – export potential and economic importance – wheat based cropping systems
11. Maize – introduction – origin – distribution – area, production and productivity in India and Andhra Pradesh – by-products and economic importance – different types and varieties of maize – adaptation and climate
12. Maize – soils – land preparation – seasons – seeds and sowing – zero tillage practice in rice fallows – manures and fertilizers – irrigation – weed control – harvesting – threshing and processing – yield attributes and yield – cropping systems
13. Sorghum – introduction – origin – distribution – area, production and productivity in India and Andhra Pradesh – adaptations – varieties – soils – land preparation – sorghum growing zones and seasons in Andhra Pradesh
14. Sorghum – seeds and sowing – manures and fertilizers – irrigation – weed control – yield attributes and yield – cropping systems
15. Pearl millet – introduction – economic importance – origin – distribution – area, production and productivity in India and Andhra Pradesh – adaptations – soils – varieties – land preparation – seasons – seeds and sowing – management of over aged seedlings – manures and fertilizers – irrigation and cropping systems – weed control – harvesting – threshing and processing – yield attributes and yield
16. Finger millet – introduction – economic importance – origin – distribution – area, production and productivity in India and Andhra Pradesh – adaptations – soils – varieties – land preparation – seasons – seeds and sowing – manures and fertilizers

- irrigation – weed control – harvesting – threshing and processing – yield attributes and yield – cropping systems
17. Italian millet and kodo millet – origin – distribution – area, production and productivity in Andhra Pradesh - soils – varieties – land preparation – seasons – seeds and sowing – manures and fertilizers – irrigation – intercultivation – harvesting – threshing and processing – yield attributes and yield – cropping systems
 18. Common millet and little millet – origin – distribution – area, production – soils – manures and fertilizers – irrigation – weed control – harvesting – threshing and processing – yield attributes and yield – unique characteristics and reasons for reduction in area of minor millets
 19. Pulses – importance of pulses in Indian agriculture – area, production and productivity of pulses in general in India – importance of pulses utilization as food, fodder, feed, green manuring, crop mixtures and crop rotations for improving soil fertility
 20. Pulses – reasons for low yields of pulses in India (genetical, physiological and agronomical reasons) - production strategies for improving productivity of pulses – rice fallow pulse production technology – constraints
 21. Redgram – area, production and varietal improvement – origin – distribution – soils – climate – seasons – seeds and sowing – manures, fertilizers and bio-fertilizers – irrigation – weed control – harvesting – threshing and processing – yield attributes and yield – utility value – cropping systems
 22. Blackgram – area, production and productivity – soils – climate – varieties – production constraints – fertilizers and bio-fertilizers – harvesting – irrigation – threshing and processing – yield components and yield – cropping systems
 23. Greengram – area, production and productivity – soils – climate – varieties – production constraints – fertilizers and bio-fertilizers – harvesting – irrigation – threshing and processing – yield components and yield – cropping systems
 24. Bengalgram – economic importance – area, production and productivity – soils – climate – varieties – manures, fertilizers and bio-fertilizers – irrigation – weed control – harvesting – threshing – threshing – processing and cropping systems
 25. Cowpea and horse gram – economic importance – area, production and productivity – soils – climate – varieties – fertilizers and bio-fertilizers – irrigation – weed control – harvesting – threshing and processing – yield components and yield – by-products utilization and cropping systems
 26. Fodders / forage crops – importance – classification of fodders – hay and silage – their preparation and preservation

27. Fodder sorghum and maize – introduction – origin – distribution – soils – land preparation – varieties – seasons – seeds and sowing – fertilizer - irrigation – weed management – harvesting – yield and major cropping systems
28. Fodder cowpea – introduction – origin – distribution – soils – land preparation – varieties – seasons – seeds and sowing – fertilizer – irrigation – weed management – harvesting – yield and major cropping systems
29. Napier hybrid – introduction – origin – distribution – soils – land preparation – varieties – seasons – seeds and sowing – fertilizer – irrigation – weed management – harvesting – yield and major cropping systems
30. Paragrass and guinea grass – introduction – origin – distribution – soils – land preparation – varieties – seasons – seeds and sowing – fertilizer – irrigation – weed management – harvesting – yield and major cropping systems
31. Berseem – introduction – origin – distribution – soils – land preparation – varieties – seasons – seeds and sowing – fertilizer – irrigation – weed management – harvesting – yield and major cropping systems
32. Lucerne – introduction – origin – distribution – soils – land preparation – varieties – seasons – seeds and sowing – fertilizer – irrigation – weed management – harvesting – yield and major cropping systems

B) Practical Class Outlines

1. Allotment of individual fields for land preparation and sowing of crops
2. Calculation of seed rate and fertilizer requirements
3. Rhizobium inoculation and seed treatment
4. Thinning, weeding, gap filling and recording germination percentage
5. Recording bio-metric observations
6. Time and methods of fertilizer application
7. Study of method of raising rice nurseries including SRI, nursery for mechanical transplanting etc.
8. Identification of crops, crop seeds and forages
9. Study of different growth stages of crops
10. Study of agronomic characters of rice and pulse crop varieties

11. Study of agronomic characters of cereals, millets and fodder crop varieties
12. Study of crop establishment techniques in rice including rice transplanter.
13. Harvesting of crop in individual plots
14. Participation in crop yield estimation and post harvest operations
15. Visit to farm to study the on-going experiments
16. Preparation of hay and silage

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1. Course No. : AGRO 301
2. Course Title : **Crop Production - II**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on crop production technologies for crops like groundnut, sesame, sunflower, soybean, safflower, rapeseed, mustard, niger, linseed, castor, cotton, jute, agave, sunnhemp, sugarcane, sugarbeet and tobacco

5. Specific Objectives

a) Theory

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

- i. know the area, production and productivity of crops and crop management techniques from sowing to harvest (seed to seed) in Andhra Pradesh and India
- ii. get knowledge about the soils and climatic requirements and various cropping systems

b) Practical

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

- i. learn the use of inputs like fertilizer, land, water and seed effectively and judiciously
- ii. experience practically the constraints in crop production by raising a crop

A) Theory Lecture Outlines

1. Importance of oilseed crops – edible and non-edible oils – nutritional value – importance in Indian economy – constraints in oilseed production – need for improvement of productivity and production
2. Groundnut – area, production and productivity in India and Andhra Pradesh – origin – spread – habitat groups – varieties
3. Groundnut – soils – climate – influence of rainfall – temperature – light – land preparation – soil moisture conservation for dryland groundnut – seeds – seed treatment – seed rate – spacing – season – time and method of sowing
4. Groundnut – manures and fertilizers – nutrient removal – method of application – bio-fertilizers – *Rhizobium* – Phosphobacteria – Mycorrhiza – gypsum application – importance of Ca and S nutrition – intercultivation
5. Groundnut – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – symptoms of maturity – harvest – yield attributes and yield – by-products – quality characters like harvest index, shelling percentage, oil out turn etc. - economics – crop products having potentially for export
6. Sesame – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – crop rotation – cropping systems – soils – climate – influence of rainfall – seeds – seed treatment – seed rate – spacing – season – time and method of sowing – manures and fertilizers – nutrient removal – NPK requirement – method of application – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – quality characters

7. Sunflower – origin – distribution – area, production and productivity in India and Andhra Pradesh – soils – climate – varieties – cropping systems – seeds – seed treatment – seed rate – spacing – season – time and method of sowing – manures and fertilizers – nutrient removal – method of application – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – threshing – quality characters like seed composition, amino acid composition etc. – seed production
8. Rapeseed and mustard – origin – distribution – area, production – varieties – crop rotation – cropping systems – soils – climate – land preparation – seeds – seed treatment – seed rate – spacing – season– time and method of sowing
9. Rapeseed and mustard – manures and fertilizers – nutrient removal – NPK requirement – secondary and micronutrients – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – symptoms of maturity – harvest – yield attributes and yield – quality consideration
10. Safflower – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – crop rotation – cropping systems – soils – climate – land preparation – seeds – seed treatment – seed rate – spacing – season – time and method of sowing – manures and fertilizers – nutrient removal – NPK requirement – method of application – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – threshing – quality characters like oil quality
11. Soybean – origin – distribution – area, production and productivity in India and Andhra Pradesh – spread – habitat groups – varieties – crop rotation – cropping systems – soils – climate – tillage – seeds – seed treatment – seed rate – spacing – season – time and method of sowing – manures and fertilizers – NPK requirement – method of application – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – quality characters like oil quality
12. Linseed and niger – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – crop rotation – cropping systems – pyra, utera, relay cropping – soils climate – land preparation – seeds – seed treatment – seed rate – spacing – season – time and method of sowing – manures and fertilizers – nutrient removal – method of application – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – threshing – quality characters like oil quality

13. Castor – origin – distribution – area, production and productivity in India and Andhra Pradesh – spread – habitat groups – varieties – crop rotation – cropping systems – soils – climate – land preparation – soil moisture – seeds – seed treatment – seed rate – spacing – season – time and method of sowing
14. Castor – nipping – manures and fertilizers – nutrient removal – method of application – intercultivation – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – quality characters like oil quality
15. Cotton – importance – uses – origin – distribution – area, production and productivity in India and Andhra Pradesh – cotton growing zones of India – classification – latest released varieties for different situations – soil requirements – climatic requirements – seasons – seeds / seed material – methods of sowing
16. Cotton – fertilizer management – integrated nutrient management – weed control – water management – critical stages of irrigation – time and method of irrigation – crop rotation and cotton based cropping systems
17. Cotton – topping – boll shedding – bad opening of bolls – effect of hormones – Bt cotton
18. Cotton – harvesting – yield attributes and yield – fibre - quality characters – post harvest operations – processing – storage
19. Jute – origin – distribution – area, production and productivity in India and Andhra Pradesh – spread – varieties – jute based cropping systems – soils – climate – tillage – seed treatment – seed rate – spacing – season – time and method of sowing
20. Jute – manures and fertilizers – nutrient removal – method of application – NPK requirement – weed management – irrigation – critical stages – crop rotation and cropping systems – harvesting – retting and extraction – yield and quality characters
21. Mesta – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – soils – climate – land preparation – seeds – seed treatment – seed rate – spacing – season – time and method of sowing – manures and fertilizers – nutrient removal – NPK requirement – method of application – intercultivation – weed management
22. Mesta – irrigation – critical stages – crop rotation and cropping systems – harvesting – retting and extraction – quality characters like harvest index;
 Agave – varieties – soils – climate – land preparation – planting – fertilizers – irrigation – harvesting – retting and extraction

23. Sugarcane – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – soils – climate – influence of rainfall, temperature and light – land preparation – planting time in Coastal, Rayalseema and Telangana regions of Andhra Pradesh
24. Sugarcane – planting material – setts – short crop – nursery crop – method of planting – three budded setts and bud chip method – trash mulching – wrapping and propping
25. Sugarcane – manures and fertilizers – nutrient removal – method of application – weed management – irrigation – critical stages – drip irrigation – crop rotation and cropping systems – method of irrigation
26. Sugarcane – ratoon cane management – factors – affecting quality of sugarcane – arrowing and crop lodging – jaggery making – clarifications
27. Sugarbeet – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – soils – climate – influence of rainfall, temperature, light – land preparation – soil moisture – seeds – seed treatment – seed rate – spacing – season – time and method of sowing
28. Sugarbeet – manures and fertilizers – nutrient removal – method of application – intercultivation – weed management – irrigation – critical stages – harvesting – symptoms of maturity – harvest – yield attributes and yield – by-products – quality characters
29. Tobacco – origin – distribution – area, production and productivity in India and Andhra Pradesh – varieties – crop rotation – cropping systems – soils – climate – land preparation – nursery raising – time of sowing for different types – seeds – seed treatment – seed rate – spacing – season – time and method of planting
30. Tobacco – manures and fertilizers – nutrient removal – method of application – intercultivation – weed management
31. Tobacco – irrigation – critical stages – crop rotation and cropping system – harvesting – priming – curing – quality characters – nicotine content, burning quality, aroma and sugar content
32. Tobacco – methods of curing – flue curing of *Virginia* tobacco

B) Practical Class Outlines

1. Allotment of individual plots for cultivation of crops
2. Preparation of seed material for cotton (delinting) and sugarcane

3. Seed bed preparation for sowing
4. Fertilizer application and sowing the crop
5. Observation for germination and gap filling
6. Thinning and intercultivation
7. Identification of crop varieties of various crops
8. Collection of biometric data
9. Raising of tobacco nursery
10. Estimation of yield in various crops
11. Measurement of brix reading in Sugarcane
12. Visit to nearby farmers' fields
13. Visit to nearby processing units
14. Study of quality parameters of cotton, mesta and tobacco
15. Collection of post harvest data on the crop
16. Interpretation of data collected on crop

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1. Course No. : AGRO 302
2. Course Title : **Principles and Practices of Social Forestry**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on afforestation outside conventional forest area for the benefit of rural and urban communities
5. Specific Objectives

a) Theory

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

- i) identify and know how to raise important multipurpose forest tree species, their establishment and management in different soil and climatic conditions
- ii) know about wasteland development and different agroforestry systems prevailing in Andhra Pradesh

b) Practical

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

- i) learn to identify and know about major and minor forest products and their utilization in day-to-day life
- ii) learn techniques of raising of nurseries and establishment of forest trees

A) Theory Lecture Outlines

1. Forestry – definition – introduction to Indian forests – target area – productivity – branches of forestry – first forest policy and new forest policy
2. Forest influence – various aspects of forest influence on climate (temperature, wind movement, humidity and precipitation) and soil conditions (soil composition and structure, soil temperature, soil moisture, water table, chemical properties of soil, water regime etc.) – forests and floods – forests and erosion – forests and human health and forests and recreation
3. Principles of general silviculture – definition of silviculture – parts and stages of development of a tree, plantation, life history and tree cultivation – tending operations – artificial regeneration – planting methods – planting with roots, container planting, brick planting, planting with polythene bags, stump planting and vegetative propagation
4. Social forestry – concept – need – objectives of social forestry and scope of social forestry – joint forest management – management and harvesting of social forestry

plantations – small timber, fuel, wood, usufructs, oilseeds and leaf manure – protection and marketing – selection of species – protection of plantations

5. Principles and practices of social forestry nurseries – types of nurseries – temporary nursery, permanent nursery, dry nurseries and wet nurseries – factors determining the successful production of nursery stock – selection of nursery and nursery area protection

6. Afforestation in different sites – shifting sand dunes – saline soils – ravine lands – wet lands – lateritic soils – dry rocky soils – murrum areas – grasslands – denuded and eroded hill slope – canal banks – road side areas – bioaesthetic purpose

7. Maintenance and conservation of village wood lots – uses of village wood lots – selection of species and design – measures for shortage of fuel wood – properties of fuel wood – management and advantages of energy plantations – choice of species suitable for energy plantations

8. Subabul – different species – family – varieties – climate – soil – phenology – silvicultural characters – establishment – natural regeneration – artificial regeneration and seed collection and storage – management – growth and yield – utilization – economic importance;

Eucalyptus – family – varieties – climate – soil – phenology – establishment – seed collection and storage – sowing and nursery raising – spacing – fertilization – management – growth and yield – utilization and economic importance

9. Babul – family – different species – climate – soil – phenology – silvicultural characters – nursery raising – spacing – fertilization – establishment – utilization – economic importance;

Casuarina – family – phenology – silvicultural characters – establishment – natural regeneration – artificial propagation – seed collection and storage – planting techniques – spacing – fertilization – management – growth and yield – utilization – economic importance

10. Teak – family – phenology – climate – soil – silvicultural characters – establishment – natural regeneration – artificial regeneration – seed collection – storage and planting techniques – stump method of planting – spacing – fertilization – management – growth – yield – utilization – economic importance;

Bamboo – family – varieties – phenology – silvicultural characters - establishment – natural regeneration – artificial propagation – seed collection – storage and planting techniques – spacing – fertilization – management – growth and yield – utilization – economic importance

11. Tamarind – family – varieties – climate – soil conditions – phenology – silvicultural characteristics – establishment – spacing – fertilization – growth and yield – utilization – economic importance;
 Neem – family – climate – soil requirements – phenology – silvicultural characters – establishment – natural and artificial regeneration – seed collection – storage and planting techniques – spacing – fertilization – management – growth and yield – utilization – economic importance
12. Sissoo – family – phenology – climate and soil requirements – silvicultural characters – establishment – natural regeneration – artificial propagation – seed collection – storage and planting techniques – spacing fertilization – utilization and economic importance;
 Soapnut – family – climate – soil requirements – phenology – silvicultural characters – propagation – spacing – fertilization – management – growth and yield – utilization – economic importance
13. Forestry products, their processing and use – major forest products – timber, paper, ply wood, matches, sports goods, shoe lasts, packing boxes, truck bodies and railway coaches – derivative trees of minor forest products – fibres, oils, tannins, gums, lac and bamboo
14. Farm Forestry – definition – types of farm forestry – commercial farm forestry – non-commercial farm forestry – shelter belts and wind breaks – functional roles of shelter belts – design criteria and characters of tree species suitable for wind breaks
15. Agroforestry – need and concepts – benefits and practices of agroforestry based on rotation and intercropping – choice of tree species for agroforestry
16. Agroforestry systems based on its components – alley cropping, agrisilviculture, agrihorticulture, silvipastoral system, hortipastoral system – timber cum fiber system – tree canopy management through various pruning practice in agroforestry

B) Practical Class Outlines

1. Identification of tree species suitable for timber, fuel wood and fodder
2. Identification of tree species suitable for roadsides, field bunds, wastelands and wind breaks
3. Identification of fast growing, multipurpose, nitrogen fixing trees suitable for alley cropping and agroforestry
4. Identification of seeds of important trees

5. Collection extraction and storage of tree seeds
6. Testing of tree seeds for viability and germination, preparation of nursery beds and seed sowing
7. Application of pre-sowing seed treatments
8. Preparation of nursery beds and seed sowing
9. Raising of bare rooted container seedlings and transplanting
10. Field planting techniques
11. Tree height measurement with Ravi's altimeter
12. Biomass estimation in energy plantations
13. Evaluation of different agroforestry systems
14. Identification of important major and minor forest products
15. Visit to social forest nurseries of forest department
16. Visit to energy plantations and forest research centre

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- Troup R.S. 1986. *Silviculture of Indian Trees (Vol.I, II and III)*. International Book Distributors, Deharadun.

1. Course No. : AGRO 303
2. Course Title : **Farming Systems and Sustainable Agriculture**
3. Credit Hours : 2 (1+1)
4. General Objective : (i) To impart knowledge on the fundamentals of farming systems and sustainable agriculture
(ii) To study various components of organic agriculture

5. Specific Objectives

a) Theory

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

- i. learn the fundamental principles of farming systems and sustainable agriculture and how to improve the economic condition of the farmer

b) Practical

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

- i. learn skills involved in vermiculture, sericulture, dairying, poultry, composting and biocontrol of pests
- ii. learn the methods involved in preparation of cropping pattern and farming system to be adopted by the farmer

A) Theory Lecture Outlines

1. Sustainable agriculture – introduction – adverse effects of modern agriculture – definition – concept – goals – elements and current status of sustainable agriculture in India.
2. Factors effecting ecological balance and sustainability of agricultural resources – introduction – land / soil related problems – soil degradation, deforestation, accelerated soil erosion, siltation of reservoirs etc. – causes and extent of these problems in India and ameliorative measures.
3. Rise in water table – water logging – salinization and alkalization in command areas – extent of these problems in India and Andhra Pradesh – prevention, control and reclamation measures – sea water inundation and sand casting during cyclonic storms and their effects on agriculture.
4. Ground water development – resource availability in India and Andhra Pradesh – ground water development scenario – over exploitation problems and safe yield concept – artificial recharge methods
5. Environmental pollution – introduction – greenhouse effect and potential effects on agriculture – depletion of ozone layer, methane emissions from rice fields and mitigation options
6. Fertilizers as a source of pollution and control measures – introduction – nitrate pollution in soil and ground water and eutrophication – management factors to reduce fertilizer pollution
7. Pesticides as source of pollution and control measures – bio-pesticides and bio-herbicides

8. Management of natural resources – introduction – land – water – irrigation problems – Impact on Low External Input Agriculture (ILEIA) and Low External Inputs for Sustainable Agriculture (LEISA) – vegetative cover – present scenario and management practices
9. Conjunctive use of water – definition – objectives – types – advantages and limitations – wasteland and their management – definition – classification – distribution in India and Andhra Pradesh – need for development and regenerative measures
10. Organic farming – definition – principles – relevance to modern agriculture and components of organic farming – integrated nutrient management
11. Organic farming – practices – weed management – pest management
12. Farming systems – system and systems approach – farming system – determinants of farming system – cropping systems and related terminology
13. Study of allied enterprises – significance of integrating crop and livestock – dairying and sheep and goat rearing – breeds – housing – feed and fodder requirements – biogas plant
14. Study of allied enterprises – poultry farming – breeds – housing – feed and fodder requirements – apiculture – species and management
15. Study of allied enterprises – sericulture – moriculture and silkworm rearing – agro-forestry systems suitable for dryland farming
16. Biodiversity – importance – agricultural intensification and biodiversity – adverse impacts of genetic erosion – conservation of natural resources

B) Practical Class Outlines

1. Preparation of cropping scheme to suit different irrigated and garden land situations
2. Preparation of farming systems to suit to dryland situation
3. Compost making
4. Vermicompost
5. Preparation of enriched farmyard manure
6. Recycling of urban waste
7. Use of bio-pesticides
8. Preparation of project proposals for land development
9. Management of problematic soils

10. Management practices to prevent environmental deterioration for sustainable agriculture
11. Visit to wetland farm – observation on resource allocation, recycling of inputs and economics
12. Visit to garden land farm – observation on resource allocation, recycling of inputs and economics
13. Visit to dry land farm – observation on resource allocation, recycling of inputs and economics
14. Methods of profitable utilization of agricultural wastes
15. Methods of profitable utilization of agricultural by-products
16. Methods of profitable utilization of agro-industry wastes

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DEPARTMENT OF GENETICS AND PLANT BREEDING

1. Course No. : GPBR 111
2. Course Title : **Principles of Genetics**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the ultrastructure of cell and cell organelles, principles of genetics and their applications in plant breeding for improving agricultural productivity
5. Specific Objectives

a) Theory

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

- i. understand the basic concepts of the chromosomes, cell division and nucleic acids
- ii. apply the principles of inheritance to plant breeding
- iii. acquaint with the fundamentals of chromosomal and cytoplasmic inheritance, sex determination, mutations and chromosomal aberrations

b) Practical

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

- i. understand the basic concepts of the ultra-structure of cell and cell organelles
- ii. identify various stages of cell division, both mitosis and meiosis
- iii. apply chi-square (χ^2) test for testing the fitness of the data
- iv. understand different epistatic factors
- v. construct the linkage maps based on test cross data

A) Theory Lecture Outlines

1. Introduction and definitions of cytology, genetics and cytogenetics – interrelationships among cytology, genetics, plant breeding and also with other branches of science – cell theory and protoplasm theory
2. History – historical developments in cytology, genetics and cytogenetics

3. Chromosomes – morphology of chromosomes – shape, size and number of chromosomes – structure of chromosome – composition of chromosome – euchromatin and heterochromatin – karyotype and ideogram
4. Chromosomes – special types of chromosomes – salivary gland chromosomes, lamp brush chromosomes, supernumerary chromosomes, iso-chromosomes and sex chromosomes
5. Mitosis – definition – stages of mitosis – significance in plant breeding
6. Meiosis – definition – stages of meiosis – significance in plant breeding – differences between mitosis and meiosis
7. Linkage – definition – types of linkage – characteristic features of linkage – pleiotropism – linkage and pleiotropy – linkage groups
8. Detection of linkage – estimation of linkage – importance of test cross in linkage studies – significance of linkage in plant breeding
9. Crossing over – mechanism of crossing over – types of crossing over – factors effecting crossing over – significance of crossing over in plant breeding – cytological proof of crossing over in *Drosophila* – coincidence – interference
10. Chromosome maps – definitions of linkage map or genetic map, map distance and cytological map – importance of linkage and chromosome maps in plant breeding
11. Mendelian genetics – terminology – Mendel's experiments – reasons for selection of pea as experimental material – characters studied – reasons for Mendel's success
12. Mendel's Laws – Law of segregation – Law of independent assortment – Principle of dominance – Principle of unit characters – exceptions to Mendel's Laws
13. Monohybrid and dihybrid ratios – modifications of F_2 ratio in monohybrid and dihybrid crosses and lethal factors
14. Alleles – characteristic features of alleles – multiple alleles (self incompatibility alleles in plants) – characteristic features of multiple alleles – penetrance (complete penetrance and incomplete penetrance) and expressivity (uniform expressivity and variable expressivity)
15. Qualitative and quantitative characters – definition – monogenic and polygenic inheritance and their differences – multiple factor hypothesis
16. Cytoplasmic inheritance – definition – chloroplast inheritance (leaf variegation in *Mirabilis jalapa*) – mitochondrial inheritance (cytoplasmic male sterility in maize) – characteristic features of cytoplasmic inheritance – differences between chromosomal and extrachromosomal inheritance

17. Sex determination – various mechanisms of sex determination – chromosomal sex determination, genic balance mechanism of sex determination in *Drosophila melanogaster*, male haploidy, single gene effects etc.
18. Sex linked (colour blindness in human beings) sex influenced (horns in some breeds of sheep) and sex limited characters (milk production in female cattle) – pseudo-hermaphrodites – gynandromorphs
19. Deoxyribo Nucleic Acid (DNA) – experiments to prove DNA as genetic material
20. Deoxyribo Nucleic Acid (DNA) and its structure – Watson and Crick model
21. Modes of DNA replication – experimental proof of semi-conservative DNA replication
22. Ribo Nucleic Acid (RNA) – brief description of major types of RNA – messenger RNA (mRNA), ribosomal RNA (rRNA) and transfer RNA (tRNA) – differences between DNA and RNA
23. Central dogma – outline of protein synthesis – brief outline of transcription – genetic code – properties of genetic code – brief outline of translation
24. Gene expression – Operon concept – Lac Operon
25. Gene mutations – definition – brief history – terminology – classification of mutations – characteristic features of mutations – spontaneous mutations and induced mutations
26. Gene mutations – artificial induction of mutations – physical and chemical mutagens – molecular basis of mutations – detection of sex linked lethals in *Drosophila* by C/B technique
27. Structural chromosomal aberrations – deletions (deficiencies), duplications and their significance in plant breeding
28. Structural chromosomal aberrations – inversions – pericentric inversions and paracentric inversions – inversions as cross over suppressors – translocations – simple and reciprocal translocations – meiotic behaviour – their role in plant breeding
29. Numerical chromosomal aberrations – terminology – classification – euploidy and aneuploidy – kinds of polyploids – autopolyploids, allopolyploids and segmental allopolyploids
30. Numerical chromosomal aberrations – euploidy – monoploids – haploids – differences between monoploids and haploids – diploidy – polyploidy – triploids, tetraploids and hexaploids
31. Numerical chromosomal aberrations – aneuploidy – types of aneuploids – monosomics, double monosomics, nullisomics, double nullisomics, trisomics (primary, secondary and tertiary trisomics) and tetrasomics – effects of polyploidy

32. Genomic approaches in agriculture – definitions of genomics, structural genomics and functional genomics – applications of genomics in crop improvement

B) Practical Class Outlines

1. Microscopy
2. Ultrastructure of cell and cell organelles – cell wall, plasma membrane and nucleus
3. Ultrastructure of cell and cell organelles – cytoplasm, endoplasmic reticulum, ribosomes and golgi complex
4. Ultrastructure of cell and cell organelles – mitochondria, plastids, lysosomes, cytoplasmic vacuoles etc.
5. Mitosis
6. Meiosis
7. Monohybrid ratio
8. Modifications of monohybrid ratio
9. Dihybrid ratio and its modifications
10. Interaction of factors
11. Epistasis and supplementary factors
12. Duplicate and complementary factors
13. Additive and inhibitory factors
14. Chi-square (χ^2) analysis
15. Linkage – two-point test cross
16. Linkage – three-point test cross

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1. Course No. : GBPR 211
2. Course Title : **Principles of Plant Breeding**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the principles and procedures of plant breeding in self and cross pollinated crops to develop the high yielding varieties / hybrids
5. Specific Objectives

a) Theory

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

- i. learn breeding procedures in self and cross pollinated crops
- ii. understand exploitation of heterosis utilizing male sterility and other methods
- iii. know about the various population improvement programmes
- iv. study about the fundamentals of mutation, polyploidy and wide hybridization and their role in crop improvement

b) Practical

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

- i. learn emasculation and crossing techniques in various field crops
- ii. understand the experimental designs
- iii. calculate heterosis, general combining ability and specific combining ability
- iv. know the handling of segregating material in different breeding methods *viz.*, pedigree, bulk, backcross methods, etc.

A) Theory Lecture Outlines

1. Definition, aim, objectives and scope of plant breeding
2. History and development of plant breeding – scientific contributions of eminent scientists – landmarks in plant breeding
3. Modes of reproduction – asexual reproduction (vegetative reproduction and apomixis) and sexual reproduction – their classification and significance in plant breeding
4. Modes of pollination – classification of crop species on the basis of mode of pollination – self-pollination – mechanisms promoting self-pollination – genetic consequences

of self-pollination – cross-pollination – mechanisms promoting cross-pollination – genetic consequences of cross-pollination – often cross-pollinated crops

5. Methods 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
6. Plant introduction – primary introduction and secondary introduction – history of plant introduction – plant introduction agencies in India – National Bureau of Plant Genetic Resources (NBPGR) and its activity – procedure of plant introduction – purpose of plant introduction – merits and demerits of plant introduction – germplasm collections – genetic erosion – gene sanctuaries
7. Selection – natural and artificial selection – basic principles of selection – basic characteristics and requirements of selection – selection intensity – selection differential – heritability – genetic advance
8. Mass selection – procedure for evolving a variety by mass selection – modification of mass selection – merits, demerits and achievements
9. Johanssen's pure line theory and its concepts and significance – origin of variation in pure lines – characters of pure lines – progeny test
10. 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
11. Biometrics – definition – qualitative and quantitative characters – role of environment in quantitative inheritance – biometrical techniques in plant breeding – components of genetic variation i.e. additive, dominance and epistatic variance – differences between additive and dominance variance
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. Backcross method of breeding – its requirements and applications – procedure for transfer of single dominant gene

16. Backcross method – transfer of a recessive gene – transfer of two or more characters into a single recurrent parent (simultaneous transfer, stepwise transfer and simultaneous but separate transfer) – merits, demerits and achievements – comparison between pedigree and backcross method; Multiline variety – definition – characteristics of a good multiline – development of multiline varieties – achievements
17. Self-incompatibility – classification – heteromorphic, homomorphic, gametophytic and sporophytic systems of incompatibility – mechanisms of self-incompatibility
18. Self-incompatibility – relevance of self-incompatibility – methods to overcome self-incompatibility – advantages and disadvantages – utilization in crop improvement
19. Male sterility – different types – genetic, cytoplasmic and cytoplasmic genetic male sterility – inheritance and maintenance
20. Male sterility – utilization of male sterile lines in hybrid seed production – their limitations, advantages and disadvantages
21. Hardy Weinberg Law – factors affecting equilibrium frequencies in random mating populations
22. Heterosis – heterosis and hybrid vigour – luxuriance – heterobeltiosis – brief history – heterosis in cross-pollinated and self-pollinated species – manifestations of heterosis
23. Heterosis – genetic bases of heterosis – dominance, over dominance and epistasis hypotheses – objections and their explanations – comparison between dominance and over-dominance hypotheses – physiological bases of heterosis – commercial utilization
24. Inbreeding depression – brief history – effects of inbreeding – degrees of inbreeding depression – procedure for development of inbred lines and their evaluation
25. Exploitation of heterosis – history of hybrid varieties – important steps in production of single and double cross hybrids – brief idea of hybrids in maize, pearl millet, sunflower, rice and forage crops
26. Synthetics and composites – production procedures – merits, demerits and achievements – factors determining the performance of synthetic varieties – comparison between synthetics and composites
27. Population improvement – selection without progeny testing – selection with progeny testing – progeny selection – merits and demerits of progeny selection – line breeding – achievements

28. 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
29. 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
30. Mutation breeding – spontaneous and induced mutations – characteristic features of mutations – procedure of mutation breeding – applications – advantages, limitations and achievements
31. 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
32. 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

B) Practical Class Outlines

1. Study of megasporogenesis and microsporogenesis, fertilization and life cycle of an angiospermic plant
2. Plant Breeder's kit for hybridization
3. Floral biology, anthesis, pollination, selfing and crossing techniques in rice and maize
4. Floral biology, anthesis, pollination, selfing and crossing techniques in millets – sorghum and pearl millet
5. Floral biology, anthesis, pollination, selfing and crossing techniques in oilseeds – groundnut and sunflower
6. Floral biology, anthesis, pollination, selfing and crossing techniques in pulses and fibres – red gram and cotton

7. Field lay out of experiments – Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD) – field trails – maintenance of records and registers
8. Problems on Hardy-Weinberg Law
9. Basic statistics, commonly used in plant breeding – Mean, range, variance, Phenotypic Coefficient of Variation (PCV), Genotype Coefficient of Variation (GCV), Heritability and genetic advance
10. Calculation of heterosis, heterobeltiosis, standard heterosis and inbreeding depression
11. Calculation of heterosis heterobeltiosis, standard heterosis and inbreeding depression
12. Calculation of general combining ability, specific combining ability, variances and effects
13. Calculation of general combining ability, specific combining ability, variances and effects
14. 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
15. Visit to RARS / local research station / ICAR institute to acquaint about the handling of segregating generations – pedigree, bulk and back cross methods – PYT, AVT and other methods
16. Visit to RARS / local research station / ICAR institute to acquaint about the handling of segregating generations – pedigree, bulk and back cross methods – PYT, AVT and other methods

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- 1.Course No. : GBPR 212
- 2.Course Title : **Principles of Plant Biotechnology**
- 3.Credit Hours : 3 (2+1)
- 4.General Objective : To impart knowledge on the various techniques of plant tissue culture, principles of plant biotechnology and their role in crop improvement

5. Specific Objectives

a) Theory

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

- i. understand various techniques of plant tissue culture
- ii. know about the fundamentals of genetic engineering
- iii. study about molecular markers, Quantitative Trait Loci (QTL) mapping and Marker Assisted Selection (MAS)

b) Practical

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

- i. learn various techniques of plant tissue culture
- ii. observe the isolation and culturing of protoplasts
- iii. understand about isolation of DNA and gel-electrophoresis technique
- iv. get an idea about transformation by direct and indirect gene transfer methods and conformation of genetic transformation

A) Theory Lecture Outlines

1. Biotechnology – definitions – major concepts and importance – international organizations involved in biotechnology – biotechnology in India
2. History of plant tissue culture and plant genetic engineering – terminology used in plant tissue culture – applications of plant tissue culture in crop improvement
3. Plant cell and tissue culture – steps in general tissue culture techniques – merits and limitations
4. Different techniques used for sterilization in plant tissue culture, growth room chambers and instruments

5. Nutritional requirements of tissue culture – preparation and composition of Murashige and Skoog (MS) medium
6. Types of media – solid and liquid media – advantages and limitations; Types of cultures – callus and suspension cultures
7. Totipotency and morphogenesis – growth and differentiation in cultures
8. Micropropagation – meristem culture – procedure – various approaches for shoot multiplication
9. Micropropagation – applications – problems – advantages and limitations
10. Somaclonal variation – types – origin – applications – advantages – limitations – achievements
11. Anther / pollen culture – brief procedure – factors affecting androgenesis
12. Haploids – applications of haploids in crop improvement – limitations – achievements
13. Embryo culture – purpose – methods of embryo culture – procedure – applications – achievements – ovule culture – ovary culture
14. Endosperm culture – purpose – procedure – applications
15. Somatic embryogenesis – stages of somatic embryo development – general procedure – factors affecting somatic embryogenesis – applications – limitations
16. Artificial seed / synthetic seed production – desiccated systems and hydrated systems of synthetic seed production – advantages and limitations
17. *In vitro* pollination and fertilization – factors affecting *in vitro* pollination – applications
18. Protoplast culture – methods of protoplast isolation – culture of protoplasts – somatic hybridization – procedure – isolation, culture, fusion of protoplasts, selection and culture of somatic hybrid cells and regeneration of hybrid plants
19. Somatic hybridization – products of somatic hybridization – symmetric hybrids, asymmetric hybrids and cybrids – advantages and limitations of somatic hybridization
20. Genetic engineering – definition – general approach for genetic engineering in plants – risks of genetic engineering
21. Method of cloning DNA in bacteria – steps involved in gene cloning – components of gene cloning and their functions
22. Restriction enzymes – types – nomenclature – cleavage patterns and applications
23. Vectors for gene transfer – properties of a good vector – importance of vectors in biotechnology

24. Genomic libraries and complementary Deoxy Ribonucleic Acid (cDNA) libraries – detection of a gene with in a library – colony hybridization – procedure and applications of blotting techniques
25. Southern blotting (in detail), northern blotting and western blotting – comparison of blotting techniques – probes – definition and applications
26. Polymerase Chain Reaction (PCR) – procedure and applications – comparison of PCR and gene cloning
27. Molecular markers – definition – classification and applications - DNA fingerprinting – applications
28. Quantitative Trait Loci (QTL) mapping – Marker Assisted Selection (MAS) and its applications in crop improvement
29. Methods of gene transfer – indirect method of gene transfer – *Agrobacterium* mediated gene transfer method
30. Methods of gene transfer – direct methods of transformation – particle bombardment or gene gun method, chemical method, electroporation, lipofection, microinjection, macroinjection, pollen transformation, delivery via growing pollen tubes, laser induced, fiber mediated transformation etc.
31. Transgenic plants – applications in crop improvement – limitations – genetic engineering for insect resistance – Bt cotton – genetic engineering for herbicide resistance
32. Genetic engineering for resistance to diseases – genetic engineering for male sterility – genetic engineering for quality modifications and novel features – golden rice – slow fruit softening tomato (*Flavr Savr* tomato)

B) Practical Class Outlines

1. Requirements for plant tissue culture laboratory
2. Techniques in plant tissue culture
3. Media components and preparations
4. Sterilization techniques and inoculation of various explants
5. Aseptic manipulation of various explants
6. Micropropagation of important crops
7. Anther culture – callus induction and plant regeneration

8. Embryo and endosperm culture – callus induction and plant regeneration
9. Hardening / acclimatization of regenerated plants
10. Somatic embryogenesis and synthetic seed production
11. Isolation and culturing of protoplast
12. Plant genomic DNA isolation
13. Gel-electrophoresis technique / southern blotting
14. Direct gene transfer technique
15. Indirect gene transfer technique
16. Confirmation of genetic transformation

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1. Course No. : GBPR 311
2. Course Title : **Breeding of Field and Horticultural Crops**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the botanical description, origin, distribution and various breeding approaches used for the development of varieties / hybrids in various field and horticultural crops

5. Specific Objectives

a) Theory

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

- i. understand the origin, distribution of crop plants and different breeding methods to be adopted for the development of varieties / hybrids in various field and horticultural crops
- ii. study about the plant genetic resources, centres of diversity and breeding for resistance to biotic and abiotic stresses
- iii. learn about the influence of genotype x environment interaction on yield / performance

b) Practical

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

- i. learn botanical description, emasculation and crossing techniques in various field and horticultural crops
- ii. study about breeding for special characters

A) Theory Lecture Outlines

1. Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops
2. Cereals – rice – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
3. Cereals – wheat – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
4. Cereals – maize – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
5. Millets – sorghum – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
6. Millets – pearl millet and finger millet – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties

7. Sugarcane – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
8. Pulses – red gram and soybean – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
9. Pulses – greengram, blackgram and bengalgram – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
10. Oilseeds – groundnut and sesame – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
11. Oilseeds – sunflower and safflower – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
12. Oilseeds – castor and mustard – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
13. Fibre crops – cotton and kenaf – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
14. Fibre crops – mesta, roselle and jute – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
15. Vegetables – tomato, brinjal and chillies – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
16. Vegetables – bhendi and cucumber – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
17. Flower crops – chrysanthemum and marigold – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties

18. Flower crops – rose and gerbera – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
19. Fruit crops – mango and guava – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
20. Fruit crops – banana and papaya – origin – distribution of species – wild relatives and forms – breeding objectives – major breeding procedures for development of hybrids / varieties
21. Plant genetic resources – definition and important features of germplasm – kinds of germplasm – classification of gene pool
22. Plant genetic resources – types of seed collections – germplasm activities – exploration and collection – merits and demerits of exploration and collection of germplasm
23. Plant genetic resources – germplasm conservation – *in-situ* conservation – *ex-situ* conservation – evaluation – documentation – distribution and utilization
24. Plant genetic resources – centres of diversity – types of biodiversity – centres of origin – classification – 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
25. Ideotype breeding – main features of ideotype breeding – features of ideotypes of wheat, rice, maize, barley and cotton
26. Ideotype breeding – factors affecting ideotypes – steps in ideotype breeding – achievements
27. Breeding for resistance to biotic stresses – introduction – brief account of variability in fungal pathogen and pest – hybridization, heterokaryosis, parasexualism, mutation and cytoplasmic adaptation
28. 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
29. Breeding for resistance to biotic stresses – 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 resistance – sources of insect resistance – breeding methods for insect resistance – problems in breeding for insect resistance – achievements

30. Breeding for resistance to abiotic stresses – drought resistance – mechanisms of drought resistance (drought escape, avoidance, tolerance, and resistance) – features associated with drought resistance – sources of drought resistance – breeding methods for drought resistance – limitations – achievements; breeding for resistance to water logging – effects of water logging mechanism of tolerance – ideotype for flooded areas – breeding methods
31. Breeding for abiotic stresses – breeding for salt tolerance – response of plants to salinity – symptoms – mechanisms of salt tolerance – breeding methods for salt tolerance – problems – achievements; Cold tolerance – chilling resistance – effects of chilling stress on plants – mechanism of chilling tolerance – sources of chilling tolerance – selection criteria –freezing resistance – effects of freezing – mechanism of freezing resistance – genetic resources for freezing tolerance – selection criteria – problems in breeding for freezing tolerance
32. Genotype, environment and their interaction – environment – micro-environment and macro-environment – classification of environmental variation – genotype X environment interaction – adaptation – types of adaptation – adaptability – stability – list of models for stability analysis

B) Practical Class Outlines

1. Hybridization techniques and precautions to be taken, floral morphology, selfing, emasculation and crossing techniques in field and horticultural crops
2. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in rice and wheat
3. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in maize and sorghum
4. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in pearl millet and finger millet
5. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in groundnut and castor
6. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in mustard and sesame

7. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in sunflower and safflower
8. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in redgram, and bengal gram
9. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in black gram, green gram and soybean
10. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in cotton, bhendi, roselle and jute / mesta
11. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in chillies, tomato and brinjal
12. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in chrysanthemum and marigold
13. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in guava and papaya
14. Parentages of released varieties / hybrids of important crops
15. Study of special quality characters in various crops
16. Sources of donor for different characters in various crops

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1. Course No. : GPBR 312
2. Course Title : **Principles of Seed Technology**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the seed production and seed science and technology aspects in relation to Seed Act
5. Specific Objectives

a) Theory

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

- i. understand the concepts of quality seed production of different field and vegetable crops
- ii. study about different classes of seed and maintenance of genetic purity during seed production
- iii. learn about seed certification procedure, seed drying, processing, cleaning, testing, packaging, storage, marketing etc.

b) Practical

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

- i. learn about different procedures for testing seed quality viz., physical purity, germination, moisture, viability, seed health etc.
- ii. visit the seed production plots, seed processing plants, seed testing laboratories etc.

A) Theory Lecture Outlines

1. Introduction to seed technology – definitions – concept, role and goals of seed technology – differences between scientifically produced seed and grain used as seed
2. History and development of seed industry in India – pre-Independence and post independence development – First Five Year Plan (FYP) – Grow More Food Enquiry Committee – Second FYP – Coordinated Crop Improvement Schemes and Agricultural Production Team – Third FYP – National Seeds Corporation and High Yielding Variety Programme (HYVP) – Annual Plans (1966-69)
3. History and development of seed industry in India – Fourth FYP – Tarai Development Corporation (TDC) and Indian Society of Seed Technology (ISST) – Fifth FYP –

National Commission on Agriculture (NCA) and National Seeds Programme – Sixth FYP – Seventh FYP – New Policy on seed development – Eighth FYP

4. Seed quality – seed quality attributes – factors affecting seed quality – classes of seed – nucleus, breeder, foundation and certified seed
5. Testing, release and notification of varieties – Central Variety Release Committee (CVRC) and State Variety Release Committee (SVRC) – National Seeds Corporation (NSC), Andhra Pradesh State Seed Certification Agency (APSSCA) and Andhra Pradesh State Seed Development Corporation (APSSDC) and their functions
6. Deterioration of crop varieties – factors responsible for loss of genetic purity – maintenance of genetic purity during seed production – safeguards for maintenance of genetic purity
7. Importance of seed production – seed policy – seed demand forecasting and planning for breeder seed, foundation seed and certified seed production
8. Maintenance of nucleus and breeder seed in self and cross pollinated crops – maintenance of nucleus seed of pre-released or newly released varieties – maintenance of breeder seed of pre-released or newly released varieties – maintenance of breeder seed of established varieties
9. Hybrid seed production – history – importance – development of inbred lines, single crosses, double crosses, three way crosses etc. – evaluation of single cross and double cross hybrids
10. Male sterility – inheritance, maintenance and utilization of different types (genetic, cytoplasmic and cytoplasmic genetic) of male sterility in seed production – sources of male sterility in different crops – transfer of male sterility to a new strain – procedure for converting an inbred (non-restorer) line into a restorer line
11. Seed certification – history of seed certification – procedure for seed certification
12. Foundation and certified seed production of varieties and hybrids in rice and sorghum
13. Foundation and certified seed production of inbreds, hybrids, synthetics and composites in maize and pearl millet
14. Foundation and certified seed production of varieties and hybrids in sunflower and castor
15. Foundation and certified seed production of varieties and hybrids in redgram
16. Foundation and certified seed production of varieties and hybrids in cotton and bhendi
17. Foundation and certified seed production of varieties and hybrids in tomato, brinjal and chillies

18. Foundation and certified seed production of varieties and hybrids in onion, bottle gourd and ridge gourd
19. Seed drying – methods of seed drying – sun drying – forced air drying – principle of forced air drying – properties of air and their effects on seed drying – moisture equilibrium between seed and air – drying zones in seed bin drying – forced air drying method
20. Seed drying – heated air drying system – building requirements – types of air distribution system and seed drying – multiple bin storages – selection of crop dryers and systems of heated air drying – recommended temperature and depth for heated air drying of various crop seeds in bin – management of seed drying operations
21. Planning, layout and establishment of seed processing plant – factors to be considered in planning and designing a seed processing plant – types of layouts – planning
22. Seed cleaning – principle and method of cleaning seeds – air screen machine – principle of cleaning – parts of air screen cleaner
23. Seed cleaning – upgrading the quality of cleaned seeds – different upgrading machines, their principles of operation and uses
24. Seed treatment – Types of seed treatment and their benefits – pre sowing treatments – seed coating – seed pelleting and seed invigoration – precautions to be taken during seed treatment
25. Seed packaging – operations in packaging – equipments used for packaging of seeds – types of bags and packing sizes
26. Seed storage – categories of seeds – orthodox and recalcitrant seeds – factors affecting seed longevity in storage and conditions required for good storage – general principles of seed storage
27. Seed marketing – marketing structure and organization
28. Seed testing – objectives of seed testing – International Seed Testing Association (ISTA) and – establishment of Seed Testing Laboratory (STL) – seed testing procedures for quality assessment
29. Varietal identification through Grow Out Test (GOT) and electrophoresis
30. Seed Act, 1966 – main features of the Seed Act, 1966 – features of New Seed Bill 2004 – Central Seed Committee – Central Seed Certification Board – State Seed Certification Agency – Central Seed Testing Laboratory – State Seed Testing Laboratory – Appellate Authority – recognition of Seed certification Agencies of foreign countries – notification of standards and procedures – notification of variety – regulation of sale of notified varieties – requirements for sale of seed

31. Seed (control) Order, 1983 – duties and powers of seed inspectors – offences of Seed Act and penalties
32. Union for Protection of New Plant Varieties (UPOV) – Intellectual Property Rights (IPR) – Plant Breeders' Rights (PBR) – Benefits and disadvantages of PBR – Protection of Plant Varieties and Farmers' Rights Act, 2001 (PPV & FR)

B) Practical Class Outlines

1. Seed sampling – principles and procedures
2. Physical purity analysis of field crops and vegetable crops.
3. Germination analysis of field crops and vegetable crops
4. Moisture tests of field crops and vegetable crops
5. Viability test of field crops and vegetable crops
6. Seed health test of field crops and vegetable crops
7. Vigour tests of field crops and vegetable crops
8. Seed dormancy – types of dormancy and methods of breaking dormancy
9. Study of different treatment chemicals and seed treatment equipment
10. Identification of objectionable diseases and pests in seed production plots
11. Identification of objectionable weeds in seed production plots
12. Visit to seed production plots of rice, maize, pearl millet and sorghum
13. Visit to seed production plots of cotton, sunflower, groundnut, castor and pulses
14. Visit to vegetable seed production plots
15. Visit to seed processing plants
16. Visit to seed testing laboratories

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- Agarwal, P.K. and Dadlani, M. 1986. *Techniques in Seed Science and Technology*. South Asian Publishers, New Delhi.
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DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

1. Course No. : SSAC 121
2. Course Title : **Introduction to Soil Science**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the fundamentals of soil science and impart skills in collecting and analyzing soils for basic physical, physico-chemical and chemical properties for using it as a medium for plant growth

5. Specific Objectives

a) Theory

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

- i. understand the fundamentals / principles of soil science
- ii. explain how different soils are formed and how does soil act as a medium for plant growth

b) Practical

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

- i. identify important rocks and mineral species
- ii. describe soil profiles
- iii. collect a representative soil sample from field
- iv. analyze the soils for basic physical, physico-chemical and chemical properties

A) Theory Lecture Outlines

1. Introduction – evolution of the earth – spheres of the earth atmosphere, hydrosphere and lithosphere – their characteristics – origin of soil – soil and soil components – mineral matter, organic matter, water and air – definition of soil and various concepts of soil – branches of soil science
2. Rocks – classification of rocks based on mode of origin – igneous rocks, sedimentary rocks and metamorphic rocks – classification of rocks based on silica content – weatherability of rocks

3. Minerals – primary, secondary, essential and accessory minerals – primary minerals – quartz, feldspar, micas, pyroxenes, amphiboles and olivines – weatherability of primary minerals
4. Non-silicate minerals – P, Ca, Mg, S and micronutrient containing minerals – secondary silicate minerals – basic structural units
5. Weathering – types of weathering – physical weathering of rocks – agents of physical weathering and their role
6. Chemical weathering – solution, hydration, hydrolysis, carbonation, oxidation and reduction; Biological weathering – role of flora and fauna in weathering process
7. Parent material – classification of parent materials based on their mode of transport by different agents
8. Soil formation – soil forming factors – classification and their role in soil formation – catena – definition
9. Pedogenic processes – eluviation, illuviation, humification, calcification, laterization, podzolisation, melanisation, salinization and alkalization
10. Soil profile – detailed description of a theoretical soil profile – differences between surface soil and sub soil
11. Soil physical properties – soil texture – definition – various inorganic components in soil and their properties – particle size analysis – methods – various textural classes in soil and their properties
12. Stoke's Law – assumptions and limitations – significance of soil texture
13. Soil consistence – consistence of wet and dry soils – soil crusting – soil plasticity – Atterberg's plastic limits – factors affecting plastic limits – significance of soil consistence
14. Soil structure – classification – types, classes and grades of soil structure – importance of soil structure and its management
15. Density of soil – bulk density and particle density – factors affecting density parameters – importance of bulk density of soil – soil compaction – its importance – calculation of porosity
16. Soil strength and its importance – soil colour – components – significance of soil colour

17. Soil water – forces of soil water retention – pF concept – soil moisture characteristic curves – importance of soil water
18. Soil water potential – components of water potentials – soil moisture constants – field capacity, wilting coefficient, hygroscopic water and saturation – available water and methods for determining soil moisture constants – pressure plate and pressure membrane apparatus
19. Water content – soil water movement – Darcy's Law – saturated, unsaturated and vapour flows – infiltration, percolation and permeability – distribution of water in profile in different soils – soil drainage and its importance
20. Soil temperature – sources of heat – heat capacity and conductivity – factors influencing soil temperature – modification of soil thermal regimes – measurement of soil temperature – importance of soil temperature on crop growth – management of soil temperature and importance
21. Soil air – compositions of atmospheric air and soil air – gaseous exchange – influence of soil air on plant growth, soil properties and nutrient availability – measurement of oxygen diffusion rate – measures to improve soil aeration
22. Soil colloids – definition – general properties – shape, surface area, electrical charge, adsorption, flocculation, deflocculation, plasticity, cohesion, swelling, shrinkage, Tyndall effect and Brownian movement
23. Secondary silicate clay minerals of different types – kaolinite, illite, montmorillonite and chlorite – properties – allophanes
24. Origin of charge in organic and inorganic colloids – negative and positive charges – differences between organic and inorganic soil colloids
25. Adsorption of ions – types of ion exchange – cation and anion exchange – cation and anion exchange capacities of soil – base saturation – factors affecting ion exchange capacity of soils – importance of Cation Exchange Capacity (CEC) of soils – calculation of base exchange capacity and exchangeable acidity
26. Soil biology – biomass – flora and fauna – their important characteristics – role of beneficial organisms – organic matter decomposition, mineralization and immobilization
27. Nitrogen fixation, denitrification, solubilization of phosphorus and biological control of plant diseases – promotion of plant growth promoting substances – harmful activities of soil organisms

28. Soil organic matter – various sources – composition – compounds in plant residues – their decomposability – humus – definition – synthesis of humus
29. Importance of soil organic matter and humus – fractionation of soil humus – carbon cycle – carbon : nitrogen (C:N) ratio of commonly available organic residues – significance of C:N ratio in soil fertility
30. Soil classification – early system of soil classification – diagnostic horizons
31. Soil taxonomy – order, sub order, great group and family series – nomenclature according to soil taxonomy
32. Important soil groups of India – alluvial soils, black soils, red soils, laterite soils and coastal sands

B) Practical Class Outlines

1. Identification of rocks
2. Methods of chemical analysis, principles, techniques and calculations
3. Standardization of silver nitrate / H_2SO_4
4. Collection of soil samples and preparation of soil water extract
5. Description of soil profile in the field
6. Determination of mechanical composition of soil using Bouyoucos Hydrometer
7. Determination of bulk density and particle density of soil
8. Determination of maximum water holding capacity of soil using Keen Razkowski cups
9. Determination of soil moisture content by gravimetric method and soil colour using Munsell color chart
10. Determination of infiltration rate
11. Determination of soil strength by cone penetrometer
12. Aggregate analysis by wet sieving method
13. Determination of carbonates and bicarbonates in soil water extract
14. Determination of chlorides in soil water extract
15. Estimation of Ca and Mg in soil water extract
16. Estimation of organic carbon content in soil

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1. Course No. : SSAC 221
2. Course Title : **Soil Chemistry, Soil Fertility and Nutrient Management**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on plant nutrition, soil fertility, nutrient management, influence of soil biological, physical and chemical properties
5. Specific Objectives

a) Theory

By the end of the course, the students 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 using basic chemical principles, application rates of nutrients and amendments needed to correct plant nutrition problems in the field

- iv. identify different sources of nutrients and efficient use of these nutrients
- v. describe and evaluate soil and nutrient management practices that either impair or sustain soil productivity and environmental quality

b) Practical

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

- i. assess the soil fertility status of soils
- ii. assess the nutrient status of plants
- iii. assess the quality of irrigation water

A) Theory Lecture Outlines

1. Introduction – importance of soil chemistry and soil fertility in crop production – concepts of soil fertility and soil productivity – definitions and differences – soil as a source of plant nutrients
2. Nutrient elements – Arnon's criteria of essentiality – essential, functional and beneficial elements – scientists responsible for the essentiality of individual nutrient elements – classification of essential nutrients – ionic forms of plant nutrients in soil – beneficial elements
3. Movement of ions from soil to roots – mass flow, diffusion, root interception and contact exchange
4. Nitrogen – occurrence, content and distribution – factors influencing the content of nitrogen in soil – forms of soil nitrogen – nitrogen cycle – transformations in soils – mineralization (aminisation and ammonification) – fate of released ammonia – factors affecting ammonium fixation
5. Nitrification – factors affecting nitrification – fate of nitrate nitrogen – leaching losses of nitrate nitrogen – denitrification – nitrification inhibitors – immobilization
6. Nitrogen fixation – different types – biological fixation of nitrogen – symbiotic and non symbiotic – nitrogen balance sheet – gains and losses – functions – deficiency symptoms – corrective measures – toxicity symptoms
7. Phosphorus – P-cycle – content in soils – forms of phosphorus in soil – inorganic and organic phosphorus compounds – phosphorus fixation – mechanisms of phosphate fixation

8. Factors affecting phosphate fixation in soil – methods to reduce phosphate fixation (organic matter additions, placement of P fertilizers etc.) – quantity and intensity parameters – functions – deficiency symptoms – corrective measures – toxicity symptoms
9. Potassium – content in soil – source – forms of soil potassium – potassium fixation
10. Factors affecting potassium fixation – quantity and intensity parameters – luxury consumption – functions and deficiency symptoms – corrective measures
11. Calcium – sources and content – forms of calcium in soil – factors affecting the availability of calcium – functions – deficiency symptoms – corrective measures
12. Magnesium – sources – content – forms of magnesium in soils – factors affecting availability of magnesium – functions – deficiency symptoms – corrective measures
13. Sulphur – S-cycle – occurrence – forms of sulphur in soil – sulphur transformation in soils – mineralization and immobilization
14. Sulphur oxidation – factors affecting sulphur oxidation in soils – sulphide injury – causes, symptoms and remedial measures – functions – deficiency symptoms and corrective measures
15. Micronutrient – sources – forms in soil solution – pools of micronutrients – predisposing factors for occurrence of micronutrient deficiencies in soil and plants
16. Zinc – content – forms in soils – critical limits in soils and plants – factors affecting availability of zinc – functions – deficiency symptoms and corrective measures
17. Copper and iron – content – forms in soils – critical limits in soils and plants – factors affecting its availability – functions – deficiency symptoms – corrective measures – toxicity symptoms
18. Manganese – content – forms in soils – critical limits in soils and plants – factors affecting its availability – functions – deficiency symptoms – corrective measures – toxicity symptoms
19. Boron – content – forms in soil – critical limits in soils and plants – factors affecting its availability – functions – deficiency symptoms – corrective measures
20. Molybdenum and chlorine – content – forms in soils – critical limits in soils and plants – factors affecting their availability – functions – deficiency symptoms – corrective measures – toxicity symptoms

21. Soil reaction – pH scale – active and potential acidity – factors affecting soil pH and problems on soil pH
22. Importance of soil pH on availability of plant nutrients – buffering capacity of soils
23. Problem soils – definition – classification – acid, saline, saline sodic, sodic and calcareous soils – characteristics – formation and nutrient availability in problem soils
24. Reclamation of problematic soils – mechanical, chemical and biological methods – lime requirement – different liming materials – organic amendments – Farm Yard Manure (FYM), compost, pressmud, green manures and green leaf manures – problems associated with over liming – gypsum requirement – classification of crops based on their tolerance to salts
25. Irrigation water – quality of irrigation water – classification based on Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC) and boron content – Indian standards for water quality – use of saline waters in agriculture
26. Soil fertility evaluation – approaches – nutrient deficiency symptoms – soil testing – objectives of soil testing – chemical methods for estimating available nutrients
27. Plant analysis – rapid tissue tests – Diagnosis Recommendation Integrated System (DRIS) – indicator plants
28. Biological methods of soil fertility evaluation – microbiological methods – Sackett and Stewart techniques, Mehlich technique, Cunninghamella plaque method and Mulder's *Aspergillus niger* test
29. Pot culture test – Mitscherlich's pot culture method – Jenny's pot culture test – Neubauer's seedling method – sunflower pot culture technique for boron – A-value
30. Soil test based fertilizers recommendation – critical nutrient concept (Cate and Nelson) – critical levels of nutrients in soils – use of empirical equations for scheduling fertilizer P dosage to crops
31. Nutrient use efficiency – soil, plant and management factors influencing nutrient use efficiency in respect of N, P, K, S, Fe and Zn fertilizers
32. Source, method and time of application of nutrients under rainfed and irrigated conditions

B) Practical Class Outlines

1. Preparation of soil extracts for available nutrients and introduction to colorimetry and flame photometry
2. Estimation of pH and EC of soils
3. Estimation of available N in soils
4. Estimation of available P in soils
5. Estimation of available K in soils
6. Estimation of available S in soils
7. Estimation of available Zn in soils
8. Assessment of quality of irrigation water (a) pH (b) EC
9. Estimation of carbonates, bicarbonates and chlorides in irrigation water
10. Determination of calcium and magnesium in irrigation water by EDTA method
11. Estimation of K and Na in irrigation water
12. Quick tests and interpretation of soil tests and irrigation water analysis data - determination of lime requirement of acid soil
13. Determination of gypsum requirement of alkali soil
14. Estimation of N in plant samples
15. Estimation of P in plant samples
16. Estimation of K in plant samples

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1. Course No. : SSAC 321
2. Course Title : **Manures, Fertilizers and Agro-Chemicals**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on different manures, fertilizers and agricultural chemicals used in agriculture
5. Specific Objectives

a) Theory

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

- i. understand the basic concepts involved in the preparation of organic manures and fertilizers
- ii. know the chemical behavior of the pesticides, their application to soil and impact on soil, water and air pollution
- iii. know the per cent purity and quality of fertilizers and pesticides that are sold in the market
- iv. understand the importance of fertilizer use, their residual effects in soil and Integrated Nutrient Management (INM)

b) Practical

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

- i. collect the representative samples of organic manure, fertilizers and pesticides
- ii. analyze the manures, fertilizers and pesticides for their nutrient contents and per cent purity as per ISI specifications and to detect the adulteration in fertilizers
- iii. familiarize with the use of instruments like flame photometers, spectrophotometers, colorimeters, digestion-cum-distillation units etc. during the analysis of nutrient contents in the fertilizers

A) Theory Lecture Outlines

1. Introduction – definition and differences between manures and fertilizers – classification of manures (bulky and concentrated) with suitable examples – importance of manures in soil fertility management
2. Bulky organic manures – preparation of Farm Yard Manure (FYM) – methods of collection and storage

3. Losses of nutrients from FYM during collection and storage – ways to minimize these losses
4. Compost and composting – different methods of composting indicating the starters and raw materials
5. Methods of preparation of rural and urban compost – mechanical compost plants – their advantages over conventional composting – vermicomposting
6. Green manures – classification with examples – advantages and limitations of green manuring and green leaf manuring
7. Definitions of penning, sewage, sullage, sludge and poudrette – concentrated organic manures – oil cakes, blood meal, bone meal, horn meal, fish meal, meat meal and guano
8. Biogas plant – principles of operation and its advantages
9. Commercial fertilizers – classification with examples – nitrogenous fertilizers – manufacturing process and properties of major nitrogenous fertilizers viz., ammonia
10. Manufacturing process and properties of major nitrogenous fertilizers viz., ammonium sulphate, urea and calcium ammonium nitrate
11. Phosphatic fertilizers – rock phosphate – uses – occurrence, types and properties – manufacturing process and properties of phosphatic fertilizers viz., Single Super Phosphate (SSP), Triple Super Phosphate (TSP) and basic slag
12. Potassic fertilizers – mineral sources – manufacturing process and properties of Muriate of Potash (MOP) and Sulphate of Potash (SOP)
13. Complex fertilizers – preparation and properties of nitrophosphates, ammonium phosphates and urea ammonium phosphates
14. Preparation and properties of ammonium sulphate nitrate, ammonium poly phosphates and NPK complex fertilizers
15. Mixed fertilizers and amendments – advantages and disadvantages over straight fertilizers – compatibility of fertilizers and reactions of NPK fertilizers in soil
16. Secondary and micronutrient fertilizers – different sources of these nutrients and their contents – conditions leading to their deficiency
17. Fertilizer Control Order (FCO) – its importance and regulations – specifications and fertilizer storage standards of important fertilizers

18. Biofertilizers – use of biofertilizers in agriculture and their advantages
19. Outlines of organic chemistry – theory of vitalism – classification of organic compounds based on their chemical nature / structure with examples
20. Differences between organic and inorganic compounds – functional groups – isomerism – structural and stereo-isomerism
21. Diverse types of agrochemicals – classification based on their use with examples – classification of insecticides based on their chemical nature with examples – botanical insecticides – brief mention about essential oils
22. Natural pyrethrum – discovery – sources – chemistry – extraction and properties; Neem and its products – extraction – mode of action of neem based products
23. Advantages and disadvantages of natural botanical insecticides – brief note on synthetic pyrethroids with examples – their use in agriculture
24. Synthetic organic insecticides – cyclodienes – Diels-Alders reaction – structure, properties and uses of endosulfan
25. Organo-phosphorus insecticides – discovery – advantages – classification – mode of action – structure, properties and uses of dichlorvos (DDVP)
26. Thiophosphoric acid derivatives – thio and thiono isomers – structure and activity relationships of thiophosphoric acid derivatives – structure, properties and uses of methyl parathion
27. Dithiophosphoric acid derivatives – structure, properties and uses of phorate and malathion
28. Carbamate insecticides – chemistry, discovery and mode of action, structure, properties and uses of carbofuran
29. Fungicides – definition – systemic and non systemic – classification of fungicides based on chemical nature with examples – structure, properties and uses of copper oxy chloride and zineb
30. Structure, properties and uses of carbandazim, captan, carboxin and tridemorph
31. Herbicides – classification of herbicides based on chemical nature with examples – selectivity of herbicides – brief note on mode of action of herbicides – respiration, mitochondrial activity, photosynthesis, protein and nucleic acid metabolism
32. Structure, properties and uses of 2,4-dichloro phenoxy acetic acid (2,4-D), atrazine, butachlor, glyphosate and benthicarb

B) Practical Class Outlines

1. Sampling of organic manures, fertilizers and pesticides for chemical analysis
2. Quick tests for identification of important fertilizers – acidic and basic radicals
3. Quick tests for identification of unknown salts
4. Estimation of total nitrogen in FYM and Urea
5. Estimation of water soluble P_2O_5 in SSP
6. Estimation of potassium in MOP / SOP
7. Pesticide Control Order
8. Study of pesticide formulations and physical tests for different formulations
9. Iodometric titrations – determination of Iodine present in given sample solution
10. Standardization of given sodium thiosulphate solution by Iodometry
11. Determination of purity of endosulfan by Iodometry
12. Determination of purity of metasystox by acid-base neutralization method
13. Determination of purity of malathion by Iodometry
14. Determination of copper content in copper oxychloride
15. Determination of sulphur content in sulphur fungicides (elemental sulphur)
16. Compatibility of fertilizers with insecticides and fungicides

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- Seetharaman, S., Biswas, B.C., Maheswari, S. and Yadav, D.S. 1996. *Hand Book on Fertilizers Usage*. The Fertilizer Association of India, New Delhi.
- Sreeramulu, U.S. 1991. *Chemistry of Insecticides and Fungicides*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
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DEPARTMENT OF ENTOMOLOGY

1. Course No. : ENTO 131
2. Course Title : **Insect Morphology and Systematics**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on morphology and classification of insects
5. Specific Objectives

a) Theory

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

- i. understand morphology of the insects
- ii. understand the taxonomic characters of insects

b) Practical

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

- i. get training in collection and preservation of insects
- ii. observe external features of insects
- iii. study the mouthparts, digestive system and reproductive system of insects by dissection and observation
- iv. identify different insects of some important families

A) Theory Lecture Outlines

1. History of Entomology in India – Arthropoda – mention of insects in scriptures – contributions of Fabricius, Carolus Linnaeus, Rothney, L De Niceville, H.M Lefroy, T.B.Fletcher, T.V. Ramakrishna Ayyar, Ronald Ross, H.S. Pruthi, M.R.G.K. Nair, S. Pradhan and B.V.David; 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. Contributory factors for abundance of insects – structural characters, developmental characters and protective characters (morphological, physiological, behavioral and construction of protected niches)
3. Classification of Phylum Arthropoda upto Orders – different Classes of Arthropoda and comparison of characters of Class Insecta with Arachnida, Crustacea, Symphyla, Chilopoda, Diplopoda and Onychophora; Sub phyla Apterygota and Pterygota – names of Orders of Apterygota and Pterygota with examples and characters of Class Insecta – economic classification of insects
4. 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
5. Body segmentation of the insects – head – procephalon and gnathocephalon, types of head, sclerites and sutures of insect head; Thorax – segments and appendages (wings and legs)
6. Abdomen – segments and appendages (furcula, cornicles, tracheal gills and pseudoovipositor in Diptera, propodeum, petiole and gaster in Hymenoptera); Epimorphic and anamorphic development in insects
7. Antenna – structure of typical antenna and its modifications in different insects with examples
8. Mouthparts – biting and chewing, sucking (piercing and sucking, rasping and sucking, chewing and lapping, sponging and siphoning), mask and degenerate types with examples
9. Legs – structure of a typical insect leg and modifications of insect legs with examples
10. Wings – venation, margins and angles – types of wings and wing coupling organs with examples
11. Sense organs – compound eyes – structure of ommatidium – ocelli – dorsal ocelli and lateral ocelli – types of images and auditory organs (tympanum and Johnston's organ)
12. Metamorphosis and types of diapause – obligate and facultative diapause – stage of occurrence of diapause with examples
13. Types of larvae and pupae – differences between nymph and larva

14. Digestive system – alimentary canal – structure of foregut, midgut and hindgut – histology, functions, filter chamber and peritrophic membrane – process of digestion
15. 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
16. Excretory system – structure, functions and modifications of malpighian tubules – structure and functions of other organs of excretion
17. Respiratory system – tracheal system – structure of spiracle and trachea – classification based on functional spiracles and other means of respiration
18. Nervous system – neuron and its types (based on structure and function) – synapse, ganglia, central nervous system, sympathetic nervous system and peripheral nervous system
19. Reproductive system – structure of male and female reproductive systems – structure and types of ovarioles and structure of follicle – types of reproduction in insects
20. Secretory (endocrine) system – structure and functions of neurosecretory organs (neuro secretory cells of brain, corpora cardiaca, corpora allata, prothoracic glands and ring gland)
21. Taxonomy – importance – history – binomial nomenclature – holotype, allotype and paratype – suffixes of tribe, subfamily, family and super family – Law of priority – synonyms and homonyms – species – subspecies – genus – family – order
22. Order Orthoptera – general characters – family Acrididae and Tettigonidae – characters with examples
23. Order Dictyoptera – general characters – family Mantidae – characters with examples
24. Order Isoptera – general characters – family Termitidae – characters with examples;
Order Thysanoptera – general characters – family Thripidae – characters with examples
25. Order Hemiptera – general characters – Suborder Heteroptera – characters – families Pentatomidae, Lygaeidae, Miridae, pyrrhocoridae and Coreidae – characters with examples
26. Order Hemiptera – Suborder Homoptera – characters – families Cicadellidae, Delphacidae, Aphididae, Pseudococcidae, Coccidae and Aleurodidae – characters with examples

27. Order Lepidoptera – general characters – differences between moths and butterflies – families Noctuidae, Lymantriidae and Sphingidae – characters with examples
28. Order Lepidoptera – families Pyralidae, Gelechiidae, Lycaenidae, Arctiidae and Papilionidae – characters with examples
29. Order Coleoptera – general characters – families Coccinellidae and Bruchidae – characters with examples
30. Order Coleoptera – families Scarabaeidae, Chrysomelidae, Cerambycidae, Apionidae and Curculionidae – characters with examples
31. Order – Hymenoptera – general characters – families Tenthredinidae, Ichneumonidae, Braconidae and Trichogrammatidae – characters with examples
32. Order Diptera – general characters – families Cecidomyiidae, Trypetidae, Agromyzidae, Tachinidae and Muscidae – characters with examples

B) Practical Class Outlines

1. Methods of collection and preservation of insects including immature stages
2. Study of different types of insect antennae and legs
3. Study of types of mouthparts – biting and chewing, piercing and sucking and rasping and sucking
4. Study of types of mouthparts – chewing and lapping, sponging and sucking and siphoning
5. Study of wing venation, types of wings and wing coupling organs
6. Study of different types of insect larvae and pupae
7. Dissection of digestive system in insects
8. Dissection of female and male reproductive systems in insects
9. Study of characters of Orders Orthoptera and Dictyoptera and its families
10. Study of characters of Orders Isoptera and Thysanoptera and its families
11. Study of characters of Order Hemiptera and its sub order Heteroptera and its families
12. Study of characters of sub order Homoptera and its families
13. Study of characters of Order Lepidoptera and its families
14. Study of characters of Order Coleoptera and its families

15. Study of characters of Order Hymenoptera and its families

16. Study of characters of Order Diptera and its families

Note: Submission of well-maintained insect specimens during the final practical examination is compulsory

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

Snodgrass, R.E. 2001. *Principles of Insect Morphology*. CBS Publishers & Distributors, Delhi.

1. Course No. : ENTO 231
2. Course Title : **Insect Ecology and Integrated Pest Management**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the ecology of insects and various methods of insect and non-insect pest management
5. Specific Objectives

a) Theory

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

- i. know the influence of ecological factors on insect development and distribution
- ii. understand the components of Integrated Pest Management
- iii. understand the mass multiplication techniques of major bio-agents
- iv. understand about non-insect pests and their management

b) Practical

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

- i. know sampling techniques for estimation of insect population
- ii. know about light traps, pheromone traps and insecticides in pest management
- iii. identify the biological agents
- iv. know insecticide formulations and dosage calculation
- v. acquaint with mass multiplication of bio-agents
- vi. identify different nematodes, mites and other non-insect pests

A) Theory Lecture Outlines

1. Ecology – introduction – autecology and synecology – population, community – importance of insect ecological studies in Integrated Pest Management (IPM) – environment and its components
2. Abiotic factors – temperature – its effect on the development, fecundity, distribution, dispersal and movement of insects – adaptations of insects to temperature – thermal constant; Moisture – adaptations 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. Light – 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 behaviour; Air currents – effect on dispersal of insects – edaphic factors – water currents; Biotic factors – food – classification of insects according to nutritional requirements – other organisms – inter and intra-specific associations – beneficial and harmful associations.
4. 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 the causes
5. Pest surveillance – 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

6. IPM – introduction – importance – evolution of IPM, collapse of control systems, patterns of crop protection and environmental contamination – concepts and principles of IPM – Economic Threshold Level (ETL), Economic Injury Level (EIL) and General Equilibrium Position (GEP) – tools or components of IPM – practices, scope and limitations of IPM
7. 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 and host suitability – mechanisms of genetic resistance – non-preference (antixenosis), antibiosis and tolerance – transgenic plants
8. Cultural control – normal cultural practices which incidentally control the pests and agronomic practices recommended specifically against the pests with examples; Mechanical control – different mechanical methods of control with examples
9. Physical control – use of inert carriers against stored product insects – steam sterilization – solarization – light traps – flame throwers, etc; Legislative measures – importance of quarantine – examples of exotic pests – different legislative measures enforced in different countries including India
10. Biological control – types of biological control – introduction, augmentation and conservation; Parasitism – parasite – parasitoid – 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; Predatism – predators – qualities of insect predator – differences between predator and parasitoid
11. Microbial control – bacteria, viruses, fungi, nematodes and protozoa – important species of micro-organisms against major pests for incorporation in IPM; Entomopathogenic nematodes (EPNs) – mode of infectivity and examples; Advantages and disadvantages of biological control
12. Beneficial insects – important species of pollinators – caprification – pollination syndromes – insect weed killers – success stories – scavengers – their importance
13. Chemical control – importance and ideal properties of an insecticide – classification of insecticides based on origin, mode of entry, mode of action and toxicity – evaluation of toxicity of insecticides – acute toxicity and chronic toxicity – oral toxicity and dermal toxicity – LC_{50} (Lethal Concentration), LD_{50} (Lethal Dose), ED_{50}

(Effective Dose), LT_{50} (Lethal Time) KD_{50} (Knockdown Dose) and KT_{50} (Knockdown Time) – bioassay methods; Formulations of insecticides – dusts, granules, wettable powders, water dispersible granules, solutions, emulsifiable concentrates, suspension concentrates, concentrated insecticidal liquids, fumigants, aerosols, baits and mixtures of active ingredients

14. In-organic insecticides – arsenic compounds – fluorine and sulphur; 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
15. Synthetic organic insecticides – chlorinated hydrocarbons – Dichloro Diphenyl Trichloroethane (DDT) and Hexachloro Cyclo Hexane (HCH) – cyclodienes – aldrin, dieldrin, heptachlor and endosulfan – toxicity and mode of action; Organophosphates – systemic, non systemic and translaminar action of insecticides with examples – brief mode of action – toxicity, formulations and uses of malathion, methyl parathion, diazinon, dichlorvos, fenitrothion, quinalphos, phosalone, chlorpyrifos, phosphamidon, monocrotophos, methyl demeton, dimethoate, triazophos, profenophos, acephate and phorate; Carbamates – mode of action – toxicity, formulations and uses of carbaryl, propaxur, carbofuran, thiodicarb and methomyl – insecticides with nematocidal and acaricidal properties
16. Synthetic pyrethroids – brief mode of action – toxicity, formulations and uses of allethrin, resmethrin, bioresmethrin, bioallethrin, fenvalerate, permethrin, deltamethrin, cypermethrin, lambda cyhalothrin, cyfluthrin, fenpropathrin, flucythrinate, fluvalinate and fenfluthrin; Insecticides of other groups – fixed oils; Novel insecticides – neonicotinoid insecticides – brief mode of action – toxicity, formulations and uses of imidacloprid, acetamiprid, thiamethoxam and clothianidin; Phenyl pyrazoles – brief mode of action – toxicity, formulations and uses of fipronil
17. Macrocyclic lactones – spinosyns – brief mode of action – toxicity, formulations and uses of spinosad; Avermectins – brief mode of action – toxicity, formulations and uses of abamectin and emamectin benzoate; Oxadiazines – brief mode of action – toxicity, formulations and uses of indoxacarb; Thiourea derivatives – brief mode of action – toxicity, formulations and uses of diafenthiuron; Pyridine azomethines – brief mode of action – toxicity, formulations and uses of pymetrozine; Pyrroles – brief mode of action – toxicity, formulations and uses of chlorfenapyr. Formamidines – brief mode of action – toxicity, formulations and uses of chlordimeform and amitraz; Ketoenols – brief mode of action – toxicity, formulations and uses of spirotetramat, spiromesifen and spiroticlofen; Diamides – brief mode of action – toxicity, formulations and uses of chlorantranilprole, cyantranilprole and flubendiamide

18. Chitin synthesis inhibitors – brief mode of action – toxicity, formulations and uses of diflubenzuron, flufenoxuron, chlorfluazuron, triflumuron, teflubezuron, flufenuron, novaluron and buprofezin; Juvenile Hormone (JH) mimics – brief mode of action – toxicity, formulations and uses of juvabione, methoprene, hydroprene and kinoprene, pyriproxyfen and fenoxycarb – Anti JH or precocenes; Ecdysone agonists – brief mode of action – toxicity, formulations and uses of methoxyfenozide, halofenozide and tebufenozide; Recent methods of pest control – repellents (physical and chemical) and antifeedants – importance of antifeedants and limitations of their use – attractants – sex pheromones – list of synthetic sex pheromones – use in IPM – genetic control – sterile male technique
19. Rodenticides – zinc phosphide, aluminium phosphide and bromadiolone; Acaricides – sulphur, dicofol, tetradifom and propargite
20. Application techniques of spray fluids – high volume, low and ultra-low volume sprays – phytotoxic effects of insecticides – advantages and limitations of chemical control – 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) – Acceptable Daily Intake (ADI) – waiting periods – Insecticide Act, 1968 – important provisions
21. History of nematology – economic importance in agriculture – classification of nematohelminthes – general characters of plant parasitic nematodes
22. Nematology – different functional systems of nematode
23. Nematology – biology and ecology of nematodes – types of parasitism – complex diseases caused by nematode
24. Nematology – different types of nematodes
25. Nematology – integrated nematode management – host plant resistance – cultural and mechanical methods
26. Nematology – integrated nematode management – physical, biological, quarantine and chemical methods
27. Mites – importance – morphology and biology of mites
28. Mites – classification – characters of family Tetranychidae – host range
29. Mites – characters of important families Tenuipalpidae, Tarsonimidae and Eriophyidae – host range

30. Rodents – important major rodent species – nature of damage – management
31. Other non insect pests – important bird, crabs, snails and animal pest damage to crops – management strategies
32. Household and livestock insect pests – important pests of domestic and veterinary importance and their management

B) Practical Class Outlines

1. Study of distribution patterns of insect population in crop ecosystems
 2. Sampling techniques for estimation of insect pest population and damage
 3. Pest surveillance through light traps and pheromone traps and forecasting of pest incidence
 4. Acquaintance of insecticide formulations
 5. Calculation of doses / concentrations of different insecticide formulations
 6. Compatibility of pesticides with other agrochemicals and phytotoxicity of insecticides
 7. Acquaintance of mass multiplication techniques of important predators – *Cheilomenes*, *Chrysoperla* and *Cryptolaemus*
 8. Acquaintance of mass multiplication techniques of important parasitoids – egg, larval and pupal parasitoids
 9. Acquaintance of mass production techniques of important entomopathogenic fungi
 10. Acquaintance of mass production techniques of Nuclear Polyhedrosis Virus (NPV)
 11. Study of insect pollinators, weed killers and scavengers
 12. Extraction of nematodes from soil and roots – preparation of temporary and permanent slides
 13. Identification of different types of nematodes
 14. Identification of different mite species
 15. Identification of different non-insect pests – birds, rodents, crabs and snails
 16. Identification of different non-insect pests – house hold and veterinary insect pests
- Note : Submission of well-maintained insect specimens during the final practical examination is compulsory

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1. Course No. : ENTO 331
2. Course Title : **Pests of Crops and Their Management**
3. Credit Hours : 4 (3+1)
4. General Objective : To impart knowledge on the identification and management of pests of different crops
5. Specific Objectives

a) Theory

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

- i. know the distribution pattern of insect pests in Andhra Pradesh and India
- ii. know the host range of different insect pests
- iii. know the nature and symptoms of different pests
- iv. know the life cycle of major insect pests of different crops
- v. know the Integrated Pest Management practices of different insect and non-insect pests

b) Practical

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

- i. identify the insect and non-insect pests
- ii. diagnose the different insect pests based on symptoms of damage

A) Theory Lecture Outlines

1. Introduction of economic Entomology and economic classification of insect pests
2. Major insect pests of rice – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of yellow stem borer and gall midge
3. Major insect pests of rice – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of brown plant hopper and green leafhopper
4. Major insect pests of rice – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of hispa, leaf folder and ear head bug
5. Minor insect pests of rice – nature and symptoms of damage and management strategies for grasshoppers, root weevil, swarming caterpillar, climbing cutworm, caseworm, whorl maggot, leaf mite and panicle mite and IPM practices of rice.
6. Major insect pests of sorghum and millets – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of sorghum shoot fly, sorghum stem borer, pink borer, sorghum midge and ear head bug
7. Major insect pests of sorghum – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of Red Hairy Caterpillar (RHC)
8. Minor insect pests of sorghum and millets – nature and symptoms of damage and management practices of Deccan wingless grasshopper, aphids, maize shoot bug, flea beetle, blister beetle, ragi cut worm, ragi root aphid and army worm; Insect pests of wheat – nature and symptoms of damage and management practices of ghujia weevil, ragi pink borer and termites
9. Major insect pests of sugarcane – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of early shoot borer, internodal borer and top shoot borer

10. Major insect pests of sugarcane – nature and symptoms of damage and management strategies of scales, leafhoppers and white grubs
11. Minor insect pests of sugarcane – nature and symptoms of damage and management practices of mealybug, termites, whiteflies, wooly aphid and yellow mite
12. Major insect pests of cotton – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of spotted bollworm, pink bollworm, gram caterpillar and tobacco caterpillar
13. Major insect pests of cotton – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of leafhoppers and whiteflies
14. Minor insect pests of cotton – nature and symptoms of damage and management strategies of aphids, thrips, red cotton bug, dusky cotton bug, leaf roller, stem weevil, grasshopper and mealybug – IPM practices in cotton
15. Insect pests of mesta – distribution – marks of identification – biology, nature and symptoms of damage and management strategies of hairy caterpillar and minor insect pests (aphids, semilooper, flea beetle, mealybug and leafhopper); Insect pest of sunhemp – nature and symptoms of damage and management practices of hairy caterpillar and minor pests (stem weevil, stem borer, flea beetle and mealybug)
16. Major insect pests of pulses, beans and peas – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of gram caterpillar, plume moth, pod fly, stem fly and spotted pod borer
17. Minor insect pests of pulses, beans and peas – nature and symptoms of damage and management practices of cowpea aphids, cowbugs, pod bug, leafhopper, stink bug, green pod boring caterpillar and blue butterflies; Insect pests of peas – nature and symptoms of damage and management practices of pea leaf miner and pea stem fly; Insect pests of soybean – nature and symptoms of damage and management practices of stem fly and *Spodoptera exigua* and minor pest (whiteflies)
18. Major insect pests of castor – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of semilooper, shoot and capsule borer, tobacco caterpillar; Minor insect pests of castor – nature and symptoms of damage and management practices of leafhoppers, butterfly, whitefly, thrips and castor slug
19. Major insect pests of groundnut – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of white grub, leaf

miner, RHC and tobacco caterpillar; Minor insect pests of groundnut – nature and symptoms of damage and management practices of *Helicoverpa*, leafhoppers, thrips, aphids, pod bugs and jewel beetle

20. Major insect pests of sesamum – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of leaf and pod borer and gall fly; Minor insect pests of sesamum – nature and symptoms of damage and management practices of sphinx caterpillar; Major insect pests of safflower – nature and symptoms of damage and management practices of aphid; Minor pests of safflower – nature and symptoms of damage and management practices of *Helicoverpa* and *Spodoptera exigua*
21. Major insect pests of mustard – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of aphids, sawfly and diamondback moth; Minor insect pests of mustard – nature and symptoms of damage and management practices of painted bug; Major insect pests of sunflower – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of *Helicoverpa* and *Spodoptera*; Minor insect pests of sunflower – nature and symptoms of damage and management practices of leafhoppers, bihar hairy caterpillar and thrips
22. Major insect pests of brinjal – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of epilachna beetle, shoot and fruit borer; Minor insect pests of brinjal – nature and symptoms of damage and management practices of stem borer, mealybug, aphids, leafhoppers, lacewing bug, leaf webber and red spider mite
23. Major insect pests of okra – nature and symptoms of damage and management practices of shoot and fruit borer, leafhoppers and white flies; Minor insect pest of okra – nature and symptoms of damage and management practices of spider mite; Major insect pests of tomato – symptoms of damage and management strategies of serpentine leaf miner and fruit borer; Minor insect pests of tomato – symptoms of damage and management strategies of whiteflies
24. Major insect pests of cucurbits – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of fruit flies and pumpkin beetles; Minor insect pests of cucurbits – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of serpentine leaf miner, semilooper and pumpkin caterpillars; Insect pests of *Coccinia* – nature and symptoms of damage and management practices of gall fly and aphids

25. Major insect pests of crucifers – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of diamondback moth, cabbage head borer, leaf webber and aphids; Minor insect pests of crucifers – nature and symptoms of damage and management practices of painted bug, tobacco caterpillar and butterflies and IPM practices.
26. Major insect pest of potato and sweet potato – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of tuber moth, sweet potato weevil and hairy caterpillar; Minor insect pests of potato and sweet potato – nature and symptoms of damage and management practices of tortoise beetle; Insect pest of moringa – nature and symptoms of damage and management practices of hairy caterpillar and bud worm
27. Major insect pests of chillies – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of thrips, pod borer, aphids and mites; Minor insect pests of chillies – nature and symptoms of damage and management strategies of blossom midge; Major insects pests of amaranthus – nature and symptoms of damage and management practices of leaf eating caterpillar and stem weevil
28. Major insect pests of mango – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of leafhoppers, stem borer, nut weevil and fruit fly
29. Minor insect pests of mango – nature and symptoms of damage and management practices of shoot borer, fruit borer, mealybug, aphids, leaf webber, termite, thrips, red tree ant, leaf gallmidges and red spider mite
30. Major insect pests of citrus – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of butterfly, fruit sucking moth, citrus leaf miner, psylla and rust mite; Minor insect pests of citrus – nature and symptoms of damage and management practices of bark eating caterpillar, blackfly and leaf mite
31. Major insect pests of grapevine – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of flea beetles, thrips and mealybug; Minor insect pests – stem girdler, stem borer, *Spodoptera*, *Helicoverpa* and root grub and their nature and symptoms of damage and management practices
32. Major insect pests of cashew – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of tree borer, shoot

and blossom webber, tea mosquito bug and thrips; Minor insect pests of cashew – nature and symptoms of damage and management practices of leaf miner

33. Major insect pests of pomegranate and guava – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of butterfly (pomegranate), tea mosquito bug and mealybug (guava); Minor insect pests of pomegranate and guava – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of thrips, fruit sucking moth (pomegranate) fruit fly and spiraling whitefly (guava)
34. Major insect pests of sapota – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of leaf webber; Minor insect pests of sapota – nature and symptoms of damage and management practices of parijata hairy caterpillar and mealybug; Insect pests of ber – nature and symptoms of damage and management strategies of fruit fly, fruit borer and weevil
35. Major insect pests of banana – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of rhizome weevil; Minor insect pests of banana – nature and symptoms of damage and management strategies of skipper, aphids and pseudo stem weevil; Major insect pests of apple – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of wooly aphid and codling moth
36. Major insect pests of coconut – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of black headed caterpillar, rhinoceros beetle and red palm weevil; Minor insect pests of coconut – nature and symptoms of damage and management strategies of slug, termites, scales and mite
37. Insect pests of tobacco – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of tobacco caterpillar, aphids and whiteflies-minor pest –stem borer
38. Major insect pest of coffee – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of white borer; Minor insect pests of coffee – nature and symptoms of damage and management strategies of red borer and green scales; Major insect pests of tea – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of tea mosquito bug; Minor pests of tea – nature and symptoms of damage and management strategies of thrips, red spider mite, pink mite, purple mite and scarlet mite

39. Major insect pests of turmeric and ginger – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of turmeric rhizome fly; Minor insect pests of turmeric and ginger – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of lacewing bug
40. Insect pests of betelvine – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of shootbug and *Spodoptera*
41. Major insect pest of onion – nature and symptoms of damage and management practices of thrips; Minor insect pest of onion – nature and symptoms of damage and management practices of *Spodoptera exigua*; Insect pests of coriander – nature and symptoms of damage and management practices of aphids and leaf eating caterpillar
42. Major insect pests of rose – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of thrips and scales; Minor pests of rose – nature and symptoms of damage and management strategies of leaf eating caterpillar and chaffer beetle; Major insect pests of jasmine – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of stink bugs and bud worm ; Minor insect pests of jasmine – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of gall mite; Major insect pests of chrysanthemum – distribution – marks of identification – biology – nature and symptoms of damage and management strategies of aphids
43. Stored grain pests – biology – preventive and curative measures of rice weevil, lesser grain borer, red flour beetle, khapra beetle, cigarette beetle, pulse beetle and groundnut bruchid
44. Stored grain pests – biology and preventive and curative measures of saw toothed beetle, rice moth and angoumois grain moth
45. Locusts – phases (solitary and gregarious) – breeding places – migration – damage and control
46. Mites – symptoms of damage – mites infesting sorghum, cotton, redgram, coconut, vegetables, chillies, citrus and their management practices
47. Phytoparasitic nematodes – important phytophagous nematodes in rice (white tip nematode), wheat (cyst and gall nematode), vegetable (root knot nematode), citrus (citrus nematode) and banana (burrowing nematode) and their management
48. Rodents (infesting field and storage) and birds – nature and symptoms of damage and management of rodents and birds

B) Practical Class Outlines

1. Typical symptoms of damage caused by various phytophagous insects
2. Identification of major insect pests of paddy and their damage symptoms
3. Identification of minor insect pests of paddy and their damage symptoms
4. Identification of insect pests of sorghum, maize and other millets and their damage symptoms
5. Identification of insect pests of sugarcane and their damage symptoms
6. Identification of insect pests of cotton, sunhemp and mesta and their damage symptoms
7. Identification of insect pests of pulse crops and their damage symptoms
8. Identification of insect pests of oilseed crops and their damage symptoms
9. Identification of insect pests of vegetables and their damage symptoms
10. Identification of insect pests of mango, cashew and banana and their damage symptoms
11. Identification of insect pests of citrus, sapota and ber and their damage symptoms
12. Identification of insect pests of grapes, pomegranate and guava and their damage symptoms
13. Identification of insect pests of coconut, turmeric, betelvine, onion, ginger and tobacco and their damage symptoms
14. Identification of insect pests of flower and ornamental plants and their damage symptoms
15. Identification of insect pests of stored grains and their damage.
- 16 Study of mite, rodent, bird and nematode pests of crops

Note : Submission of well-maintained insect specimens and herbaria during the final practical examination is compulsory

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1. Course No. : ENTO 332
2. Course Title : **Sericulture, Apiculture and Lac culture**
3. Credit Hours : 1 (0+1)
4. General Objective : To impart knowledge on silkworms, honey bees, lac insects and their products
5. Specific Objectives
 - a) Theory
No theory component
 - b) Practical
By the end of the semester, students will be able to
 - i. gain knowledge on rearing of silkworms, honey bees and lac insects and their products
 - ii. identify different pests and diseases of host plants of silkworms and lac insects and their management
 - iii. identify different enemies of silkworms, honeybees and lac insects and their management

A) Theory Lecture Outlines

No theory component

B) Practical Class Outlines

1. Preparation of planting material and planting of mulberry under irrigated and rainfed conditions
2. Raising nursery beds and methods of planting of mulberry
3. Insect pests, diseases and nutrient deficiencies of mulberry and their management
4. Silkworm rearing house and rearing equipment
5. Study of mulberry silkworm
6. Study of non-mulberry silkworms (Tasar silkworm, Eri silkworm and Muga silkworm)
7. Study of mulberry silkworm races
8. Study of silk glands of mulberry silkworm
9. Chawki rearing of silkworm larvae
10. Rearing of late age silkworm larvae
11. Study of pests and diseases of silkworms
12. Mounting and harvesting of silkworm cocoons and stifling
13. Study of different species of honey bees and different bee hives
14. Study of equipment for handling honey bees
15. Study of insect pest and diseases of honey bees
16. Study of lac insect and types of lac

References

- Ganga, G. and Sulochana Chetty, J. 1997. *An Introduction to Sericulture*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Glover, P.M. 1937. *Lac Cultivation in India*. Indian Lac Research Institute, Namkum, Ranchi.
- Krishna Swami, S., Narasimhanna, M.N., Suryanarayan, S.K. and Kumararaj, S. 1978. *Sericulture Manual – Silkworm Rearing*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Sardar Singh. 1975. *Bee Keeping in India*. ICAR, New Delhi.

1. Course No. : ENTO 333
2. Course Title : **Field Diagnosis in Agriculture**
3. Credit Hours : 2(1+1)
4. General Objective : To impart skill in the diagnosis of damage symptoms on plants caused by insects and pathogens
5. Specific Objectives

a) Theory

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

- i. understand the symptoms of damage caused by various pests and pathogens on different crops

b) Practical

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

- i. get training in identification of damage symptoms caused by various insect and non-insect pests, disease causing organisms and toxicity

A. Theory Lecture Outlines

1. Damage caused by insect pests having different types of mouth parts and the damage symptoms – biting and chewing type, piercing and sucking type, rasping and sucking type, sponging and sucking type, chewing and lapping type, siphoning type and degenerate type of mouth parts with examples and symptoms of damage
2. Identification and diagnosis of mite pests and symptoms of damage in different crops – diagnostic features between tetranychid and eriophid mites, nature of damage by tetranychid, eriophid and tarsonemid mites, predatory mites, mites on different crops *viz.*, rice, jowar, cotton, redgram, citrus, brinjal, chilli, sugarcane and coconut
3. Insects (thrips, leafhoppers, aphids, mealy bugs and whiteflies in different crops) as vector of plant pathogens – classification of virus transmission by insects based on retention of infectivity of the vector, route of virus transport and latest categorization – examples of some aphid borne non persistent viruses – examples of some semi-persistent viruses and their vectors – examples of circulative (persistent) viruses and their vectors
4. Damage caused by insects to plant parts like seed, seedlings, stem and leaves – damage to seed and seedlings, damage to stems and leaf damage

5. Damage caused by insects to plant parts like buds and flowers, roots and tubers by soil inhabiting insects
6. Damage caused by insects to pods and fruits of different crops
7. Complex symptoms caused by insect / non insect pests – damage due to leaf folder / rice hispa, rice whorl maggot / yellow stem borer
8. Complex symptoms caused by insect / non insect pests – damage due to early shoot borer and internodal borer in sugarcane, dipteran galls / psyllid galls rhizome fly / rhizome rot in turmeric and ginger, panicle mite/sheath rot
9. Damage caused by non insect pests like nematodes, snails and slugs in important crops
10. Damage caused by non insect pests like birds, rodents, bats, wild boars and other mammals in important crops
11. Knowledge on plant disease diagnosis – importance of correct diagnosis in relation to effective management; Classification of plant diseases based on cause – parasitic – diseases caused by fungi, bacteria, viruses, phytoplasma and phanerogamic parasites with examples
12. Classification of plant diseases based on cause – non-parasitic – nutritional, environmental and soil factors with examples; Classification of plant diseases based on symptoms – characteristic symptoms of plant diseases
13. Steps in diagnosis – look for signs of biotic causal agents – distribution of symptoms on plant parts – questions to be asked – how long the plant has been in current location – what has been done to the plant or near the plant – what are the prevailing weather conditions; Laboratory tests – incubation and microscopic examination; Bacterial pathogens – ooze test; Viral diseases – Enzyme Linked Immunosorbent Assay (ELISA) and Polymerase Chain Reaction (PCR); Non living factors – mechanical injuries on samples – physical injuries – environmental extremes – temperature, light, heat, drought, water logging, chemical factors – excess of pesticides, nutrient deficiencies / excesses – final diagnosis
14. Distinguishing symptoms due to plant pathogens, insect pests, excess or deficiency of nutrition (nutritional disorders) and pesticide injuries – remote sensing in plant disease diagnosis
15. Detection and diagnosis of post harvest diseases of perishables due to biotic agents, symptoms and associated physiological changes; Symptomatology of important post

harvest diseases – Citrus – blue mold and stem end rot; Banana – anthracnose, Botryodilodia brown rot and cigar end rot; Mango – anthracnose and stem end rot; Papaya – anthracnose

16. Detection and diagnosis of seed borne diseases – fungal and bacterial diseases – blotter test, agar plate method. viruses – ELISA, grow out test, infectivity by indicator plants

B) Practical Class Outlines

1. Survey and methods of surveillance of crop pests and diseases – I
2. Survey and methods of surveillance of crop pests and diseases – II
3. Steps in pest and diseases diagnosis in the field
4. Agro Ecosystem Analysis (AESA) pest defender ratio adopted in farmers field school
5. Field diagnosis of important insect pests and diseases of cereals and millet crops
6. Field diagnosis of important insect pests and diseases of oilseed crops
7. Field diagnosis of important insect pests and diseases of pulses
8. Field diagnosis of important insect pests and diseases of fibre and sugar crops
9. Field diagnosis of important insect pests and diseases of vegetable crops – I
10. Field diagnosis of important insect pests and diseases of vegetable crops – II
11. Field diagnosis of important insect pests and diseases of fruit crops
12. Diagnosis of important insect pests and diseases of stored grain products and perishables – I
13. Diagnosis of important insect pests and diseases of stored grain products and perishables – II
14. Plant protection equipment and their maintenance
15. Laboratory test – isolation of plant pathogens from diseased material
Test for identification of plant pathogens viz., fungi, bacteria and virus.
Final diagnosis report
16. Plant quarantine

References

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- Anna L. Snowdon 1990. *A Colour Atlas of Post Harvest Diseases & Disorders of Fruits & Vegetables: General Introduction & Fruits*. CRC Press, Florida.
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DEPARTMENT OF AGRICULTURAL ECONOMICS

1. Course No. : AECO 141
2. Course Title : **Principles of Agricultural Economics**
3. Credit Hours : 2 (2+0)
4. General Objective : To impart knowledge on the basic principles of agricultural economics
5. Specific Objectives

a) Theory

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

- i. understand basic concepts in economics
- ii. understand the market forces *i.e.*, demand and supply
- iii. know the market structure and its classification
- iv. understand macro-economic concepts like national income and its measurement, besides public finance and public revenue

b) Practical

No practical component

A) Theory Lecture Outlines

1. Economics – meaning – definitions – subject matter of economics – traditional approach – consumption, production, exchange and distribution
2. Modern approach – microeconomics and macroeconomics – methods of economic investigation – deduction and induction
3. Agricultural economics – definitions – meaning – importance of agricultural economics – branches of agricultural economics
4. Agricultural production economics – meaning – definitions – subject matter – objectives; Farm management – meaning – scope – definitions – objectives
5. Agricultural finance – meaning – definitions – micro vs macro finance – need for agricultural finance; Agricultural marketing – meaning – definition – importance of agricultural marketing

6. Basic terms and concepts in economics – goods and services – free and economic goods, utility – cardinal and ordinal approaches – characteristics of utility – forms of utility
7. Value – definition – characteristics; price – meaning; wealth – meaning – attributes of wealth – types of wealth – distinction between wealth and welfare; Wants – meaning – characteristics of human wants
8. Law of diminishing marginal utility – statement – assumptions of law – explanation – limitations of the law – importance
9. Law of equi-marginal utility – meaning – assumptions – explanation of the law – limitations of the law – practical importance
10. Consumer's surplus – meaning – assumptions – explanation – difficulties in measuring consumer's surplus – importance
11. Demand – meaning – definition – types of demand – income demand, price demand and cross demand
12. Demand schedule – demand curve – Law of demand – contraction and extension, increase and decrease in demand
13. Elasticity of demand – meaning – elastic and inelastic demand – kinds of elasticity of demand – perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic and unitary elastic demand
14. Price elasticity – income elasticity and cross elasticity of demand – practical importance of elasticity of demand
15. Supply – meaning – definition – Law of supply – supply schedule – supply curve
16. Increase and decrease in supply – contraction and extension of supply – factors affecting supply
17. Elasticity of supply – kinds of elasticity of supply – perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic and unitary elastic – factors affecting elasticity of supply
18. Price determination – equilibrium price and quantity – determination of market price
19. Markets – definition – essentials of market – classification of market structure – perfect and imperfect markets
20. Characteristics of monopolistic competition – monopoly and oligopoly

21. National income – concepts of national income – gross domestic product, gross national product, net national product, net domestic product – national income at factor cost, personal income, disposable income
22. Methods of measurement of national income – product method, income method and expenditure method
23. Public finance – meaning – role and importance of public finance – functions of the government – differences between public finance and private finance
24. Public revenue – meaning – major and minor sources of public revenue
25. Tax – meaning – classification – direct and indirect taxes – methods of taxation – proportional, progressive, regressive and degressive taxation, agricultural taxation – other types of taxation – Value Added Tax (VAT)
26. Canons of taxation – Adam Smith’s canons of taxation – equality, economy, certainty and convenience – other canons of taxation
27. Public expenditure – meaning – need for public expenditure – social and economic overheads, balanced regional growth, development of agriculture and industry, exploitation and development of mineral resources and subsidies and grants to provinces, local governments, and exporters
28. Principles of public expenditure – Principle of maximum social benefits Principle of economy, i.e., wasteful expenditure should be avoided, Principle of sanction, i.e., authorized expenditure, Principle of balanced budget, Canon of elasticity, i.e., fairly flexible and Avoidance of unhealthy effects on production and distribution
29. Inflation – meaning – definition – related concepts of inflation – *deflation, disinflation, stagflation and reflation* – measurement of inflation - consumer price index, wholesale price index, producer price index and GDP deflator
30. Types of inflation – demand pull and cost push inflation – comprehensive and sporadic inflation – suppressed and repressed inflation – creeping, walking, running and galloping inflation – mark up inflation
31. Causes of inflation – factors causing increase in demand – increase in money supply, increase in disposable income, increase in public expenditure, increase in consumer spending, cheap monetary policy, deficit financing and increase in exports, factors causing shortage of supply – shortage of factors of production, industrial disputes, natural calamities, artificial scarcities, increase in exports, lop-sided production, Law of diminishing returns and international factors

32. Remedial measures to control inflation – monetary measures – credit control, demonetisation of currency and issue of new currency – fiscal measures – reduction in unnecessary expenditure, increase taxes, increase in savings, surplus budgets and public debt

B) Practical Class Outlines

No practical component

References

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1. Course No. : AECO 142
2. Course Title : **Agricultural Finance and Co-operation**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on agricultural finance and co-operation
5. Specific Objectives

a) Theory

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

- i. understand the concepts of agricultural finance and co-operation
- ii. have an exposure to various schemes for financing weaker sections
- iii. have an exposure to higher financing agencies
- iv. have an exposure to principles of co-operation and co-operative movement in India
- v. have an exposure to the role of commercial banks and co-operative credit institutions to improve the economic conditions of farmers
- vi. have an exposure to the crop insurance scheme and understand the mechanics of crop insurance

b) Practical

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

- i. work out various repayment plans of different types of loans
- ii. understand the procedural formalities followed in sanctioning farm loans by commercial banks, co-operative institutions, Regional Rural Banks (RRBs), farmers service cooperative societies etc.
- iii. estimate scale of finance for various crops
- iv. estimate indemnity in the event of crop losses under crop insurance

A) Theory Lecture Outlines

1. Definition of agricultural finance – nature – scope – meaning – significance – micro and macro finance
2. Credit needs in agriculture – meaning and definition of credit – classification of credit based on time, purpose, security, lender and borrower
3. Credit analysis – economic feasibility tests – Returns to investment, Repaying capacity and Risk bearing ability (3 Rs)
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 loan application
6. Repayment plans – lumpsum repayment / straight end repayment, amortized decreasing repayment, amortized even repayment, variable or quasi variable repayment plan, future repayment plan and optional repayment plan
7. 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 – progress – RRBs in Andhra Pradesh
9. Crop loan system – objectives – importance – scale of finance – estimation – term loans – objectives and interest rates – kisan credit card
10. Schemes for financing weaker sections – Differential Interest Rate (DIR), Integrated Rural Development Programme (IRDP), Ganga Kalyan Yozana (GKY), Swarnajayanti Gram Swarozgar Yojana (SGSY), Self Help Groups (SHGs) etc.

11. Crop insurance – meaning and its advantages – progress of crop insurance scheme in India – limitations in application – agricultural insurance company of India – National Agricultural Insurance Scheme (NAIS) – salient features – weather insurance
12. Higher financing agencies – Reserve Bank of India (RBI) – origin – objectives and functions – role of RBI in agricultural development and finance; National Bank for Agriculture and Rural Development (NABARD) – origin, functions, activities and its role in agricultural development; International Bank for Reconstruction and Development (IBRD); International Monetary Fund (IMF); International Development Agency (IDA); Asian Development Bank (ADB) – insurance and credit guarantee corporation
13. Cooperation – meaning – scope – importance and definition – principles – objectives of cooperation
14. Origin and history of Indian co-operative movement – co-operative movement during pre-independence period – progress of cooperative movement during post-independence period
15. Shortcomings of Indian co-operative movement and remedies – recommendations of various committees – development of co-operative credit and non-credit organizations – co-operative credit structure
16. Classification of co-operative credit institutions – Short Term (ST), Medium Term (MT) and Long Term (LT) credit – Primary Agricultural Co-operative Credit Societies (PACS) – Farmers Service Societies (FSS) – Multipurpose Co-operative Credit Schemes (MPCS) and Large sized Adivasi Multipurpose Co-operative Societies (LAMPS) – objectives and functions – reorganization of rural credit delivery system and concept of single window system – Andhra Pradesh mutually aided Co-operative Societies Act, 1995

B) Practical Class Outlines

1. Study of loan application forms
2. Working out the various repayment plans
3. Study of lending procedures of bank
4. Study of commercial banks
5. Study of Regional Rural Banks (RRBs)
6. Study of National Bank for Agriculture and Rural Development (NABARD)

7. Study of Primary Agricultural Co-operative credit Societies (PACS)
8. Study of District Central Co-operative Bank (DCCB)
9. Study of Self Help Groups (SHGs)
10. Study of Self Help Groups (SHGs)
11. Estimation of scale of finance
12. Estimation of indemnity
13. Kisan credit card limits
14. Study of Farmers Service Societies (FSS)
15. Study of Dairy Cooperatives
16. Study of any other cooperative institutions

References

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1. Course No. : AECO 241
2. Course Title : **Farm Management and Production Economics**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the principles of agricultural production economics and farm management
5. Specific Objectives

a) Theory

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

- i. learn the basic production relationships between input and output in agricultural production

- ii. understand the application of economic principles to the organization and operation of farm business
- iii. have an exposure to the management and administration of various farm supplies
- iv. prepare farm plans and budgets

b) Practical

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

- i. work out the seven types of costs
- ii. collect data independently on cost of cultivation of crops and livestock enterprises and compute costs and returns from farm operations
- iii. prepare farm inventory and work out depreciation of farm assets through different methods
- iv. work out the farm budgets

A) Theory Lecture Outlines

1. Farm management – meaning – definitions of farm management – scope of farm management – relationship with other science
2. Economic principles applied to the organization of farm business – principles of variable proportions – determination of optimum input and optimum output
3. Minimum loss principle (cost principle) – Principle of factor substitution – Principle of product substitution
4. Law of equi-marginal returns – opportunity cost principle – Principle of comparative advantage – time comparison principle
5. Types of farming – specialization, diversification, mixed farming, dry farming and ranching – systems of farming – co-operative farming, capitalistic farming, collective farming, state farming, contract farming and peasant farming
6. 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
7. Farm budgeting – meaning – types of farm budgets – enterprise budgeting – partial budgeting and whole farm budgeting – linear programming – meaning – assumptions – advantages and limitations

8. Distinction between risk and uncertainty – sources of risk and uncertainty – production and technical risks – price or marketing risk – financial risk – methods of reducing risk
9. Agricultural production economics – definitions – nature – scope and subject matter of agricultural production economics – objectives of production economics – basic production problems
10. Law of returns – Law of constant returns – Law of increasing returns – Law of decreasing returns
11. Factor-product relationship – Law of diminishing returns – three stages of production function – characteristics – elasticity of production
12. Factor-factor relationship – isoquants and their characteristics – Marginal Rate of Technical Substitution (MRTS) – types of factor substitution
13. Iso-cost lines – characteristics – methods of determining least-cost combination of resources – expansion path – isoclines – ridge lines
14. Product-product relationship – product possibility curves – marginal rate of product substitution – types of enterprise relationships – joint products - complementary – supplementary – competitive and antagonistic products
15. Iso-revenue line and characteristics – methods of determining optimum combination of products – expansion path – ridge lines
16. Resource productivity – returns to scale

B) Practical Class Outlines

1. Visit to farm households – collection of data on cost of cultivation of crops and livestock enterprises – I
2. Visit to farm households – collection of data on cost of cultivation of crops and livestock enterprises – II
3. Visit to farm households – collection of data on cost of cultivation of crops and livestock enterprises – III
4. Determination of optimum input and optimum output
5. Determination of optimum combination of products
6. Computation of seven types of costs – I
7. Computation of seven types of costs – II

8. Computation of cost concepts related to farm management
9. Farm inventory
10. Methods of computing depreciation
11. Farm financial analysis – preparation of net worth statement and its analysis – I
12. Farm financial analysis – preparation of net worth statement and its analysis – II
13. Preparation of farm plans and budgets – enterprise and partial budget – I
14. Preparation of farm plans and budgets – enterprise and partial budget – II
15. Visit to college farm – preparation of college farm plan and budget
16. Preparation of farm house hold particulars in detail

References

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1. Course No. : AECO 341
2. Course Title : **Agricultural Marketing**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on agricultural marketing
5. Specific Objectives

a) Theory

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

- i. know the various marketing functions, marketing agencies and institutions involved in marketing of agricultural products

- ii. have knowledge on marketable and marketed surplus, market integration, marketing efficiency and its empirical assessment
- iii. understand the nature of agricultural product prices, need for price stabilization and price policy, the role of Commission for Agricultural Costs Prices (CACP) and administered prices
- iv. distinguish the domestic trade from international trade and study the origin and role of World Trade Organization (WTO) in global trade with special reference to agricultural commodities

b) Practical

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

- i. understand clearly the functioning of regulated markets, warehousing corporations, co-operative marketing institutions, rythu bazars etc.
- ii. estimate the marketing costs, margins and price spread of various farm commodities

A) Theory Lecture Outlines

1. Market and marketing – meaning – definitions – components of a 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. Marketing functions – meaning – assembling – grading and standardization – transportation – storage – processing – packing – distribution – buying and selling – financing – risk bearing – marketing intelligence
5. Market functionaries – producers – middlemen (merchant middlemen, agent middlemen, speculative middlemen, processors and facilitative middlemen) – problems in marketing of agricultural commodities
6. Remedial measures – regulated markets – definition – important features of regulated markets – functions – progress and defects

7. Cooperative marketing – meaning – structure – functions of cooperative marketing societies – National Agricultural Cooperative Marketing Federation (NAFED) and State Agricultural Cooperative Marketing Federations (MARKFED) – state trading – objectives – types of state trading
8. Warehousing – meaning – warehousing in India – Central Warehousing Corporation (CWC) – working of warehouses – advantages – State Warehousing Corporations (SWC) – Food Corporation of India (FCI) – objectives – functions
9. Quality control – agricultural products – Agricultural Produce Grading and Marketing Act (AGMARK) – CODEX – need of CODEX certification – relevance
10. Producers surplus – meaning – marketable surplus – marketed surplus – importance – factors influencing marketable surplus – marketing channels – definition
11. Market integration – definition – types of market integration – horizontal, vertical and conglomeration – marketing efficiency – meaning – definitions – technical or physical or operational efficiency – pricing or allocative efficiency
12. Marketing cost – margins – price spreads – factors affecting the costs of marketing – reasons for higher marketing costs of agricultural commodities – ways of reducing marketing costs for farm products
13. 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
14. Risks on marketing – meaning – types of risks – measures to minimize risks – speculation – hedging – future trading – meaning – commodities for future trading – services rendered by a forward market – dangers of forward markets – contract farming / contract farming – price forecasting
15. International trade – definition – difference between international and inter-regional trade – free trade vs. protection
16. The General Agreement on Trade and Tariffs (GATT) – World Trade Organization (WTO) – Agreement on Agriculture (AoA) – Market access – Aggregate Measures of Support (AMS) – export subsidies – Sanitary and Phyto-sanitary measures (SPS) – Trade Related Intellectual Property Rights (TRIPS)

B) Practical Class Outlines

1. Identification of marketing channels for agricultural products
2. Identification of marketing channels for livestock

3. Study of rythu bazaars
4. Study of fruit market
5. Study of regulated markets – I
6. Study of regulated markets – II
7. Study of unregulated markets
8. Study of livestock markets
9. Computation of market costs, margins and price spread – I
10. Computation of market costs, margins and price spread – II
11. Estimation of marketed and marketable surplus of different commodities – I
12. Estimation of marketed and marketable surplus of different commodities – II
13. Visit to marketing institutions – MARKFED
14. Study of SWC / CWC and State Trading Corporation (STC)
15. Study of SWC / CWC and STC
16. Study of Food Corporation of India (FCI)

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- Acharya, S.S. and Agrawal, N.L. 2005. *Agricultural Marketing in India*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Kahlon, A.S. and Tyagi, D.S. 1983. *Agricultural Price Policy in India*. Allied Publishers Pvt. Ltd., New Delhi.
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1. Course No. : AECO 342
2. Course Title : **Agribusiness Management**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on management functions and agribusiness management
5. Specific Objectives

a) Theory

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

- i. understand the concept of management functions and agribusiness management and its importance in Indian economy along with the functions of management
- ii. have an exposure to different types of working capital and financial management in agro-industries
- iii. acquire knowledge on agricultural projects and evaluations of agricultural projects through different economic analysis

b) Practical

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

- i. examine relative merits of a business using Strengths Weaknesses Opportunities and Threats (SWOT) analysis
- ii. prepare independently the financial statements of a business
- iii. work out break even output and analyze effects of changes in the prices of inputs and outputs on profits of a business
- iv. appraise a project using various project appraisal techniques
- v. prepare the project feasibility reports

A) Theory Lecture Outlines

1. Agribusiness – meaning – definition – structure of agribusiness (input sector, farm sector and product sector) – importance of agribusiness in Indian economy
2. Agribusiness management – the distinctive features of agribusiness management – the importance of good management – definitions of management
3. Management functions – planning – goals or objectives – strategies – policies – procedures – rules – programmes

4. Planning – characteristics of sound plan – steps in planning
5. Organizing – meaning – purpose – staffing – definition – staffing process
6. Directing – motivation – ordering – leading – supervision
7. Communication and control – meaning and definitions
8. Capital – meaning – working capital – gross working capital – net working capital – permanent working capital – temporary working capital – balance sheet working capital – cash working capital
9. Financial management – importance of financial statements – balance sheet – profit and loss statement
10. Analysis of financial statements – liquidity ratios – leverage ratios
11. Coverage ratios – turnover ratios – profitability ratios
12. Agro-based industries – importance – need – institutional arrangements for the promotion of agro-based industries
13. Procedure to be followed to set up agro-based industries – constraints in establishing agro-based industries
14. Project – meaning – definition – project cycle – identification – formulation – appraisal – monitoring – evaluation
15. Project appraisal and evaluation techniques – undiscounted measures – pay back period – proceeds per rupee of outlay
16. Discounted measures – Net Present Value (NPV) – Benefit-Cost Ratio (BCR) – Internal Rate of Return (IRR) – Net benefit investment ratio (N / K ratio) – sensitivity analysis

B) Practical Class Outlines

1. Preparation of business – Strengths Weaknesses Opportunities and Threats (SWOT) analysis
2. Analysis of financial statements
3. Compounding and discounting
4. Break-even analysis
5. Visit to agro-based industries – I
6. Visit to agro-based industries – II

7. Study of Agro-industries Development Corporation
8. Ratio analysis – I
9. Ratio analysis – II
10. Application of project appraisal technique – I
11. Application of project appraisal technique – II
12. Application of project appraisal technique – III
13. Formulation of project feasibility reports – seed / fertilizers / pesticides
14. Formulation of project feasibility reports – dairy
15. Formulation of project feasibility reports – poultry / piggery
16. Formulation of project feasibility reports – sheep and goat

References

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DEPARTMENT OF AGRICULTURAL ENGINEERING

1. Course No. : AENG 151
2. Course Title : **Fundamentals of Soil and Water Conservation Engineering**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on basic soil and water engineering concepts
5. Specific Objectives

a) Theory

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

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

b) Practical

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

- i. get skills required for water management and conservation engineering

A) Theory Lecture Outlines

1. Surveying – definition and objectives of survey – primary divisions of surveying – geodetic and plane surveys – classifications – uses of surveys
2. Instruments used in chain survey – constructional details of metric chain, metallic and steel tapes, ranging rods, arrows, cross-staff, optical square, plumb bob and pegs
3. Errors in length measurement due to incorrect chains – numerical problems on distance and area corrections; Ranging – definition and methods of ranging – procedure for direct and indirect ranging
4. Chain triangulation – principle – survey stations – location of survey stations – baseline – check line – tie line – offsets
5. Plotting procedure of chain survey – conventional symbols
6. Areas of irregularly bounded fields – different methods

7. Numerical problems on Simpson's trapezoidal rules
8. Leveling – definition – description of dumpy level and leveling staff –terminology connected with leveling – datum, elevation, station, back sight, fore sight, intermediate sight, height of instrument, bench mark and its types, change point
9. Leveling procedure – temporary adjustments in dumpy level – level field note book – recording procedure in level field note book
10. Reduction of levels – height of collimation method and rise and fall method – numerical problems connected with these two methods
11. Types of leveling – simple leveling, differential leveling and profile leveling
12. Contour survey – definition, characteristics and uses of contours
13. Irrigation – definition – classification of irrigation projects based on Culturable Command Area (CCA) and expenditure – benefits of irrigation – ill effects of irrigation – flow irrigation and lift irrigation – water sources
14. Water lifting devices – classification of pumps – centrifugal pump – principle of operation
15. Pump characteristics – pump efficiencies – capacity calculation based on irrigation scheduling – power calculations of centrifugal pump
16. Deep well pumps – turbine and submersible pumps – installation and working principles of these pumps
17. Measurement of irrigation water – importance – methods of measuring water – volumetric and area – velocity method
18. Direct water discharge methods – water meter – weirs – orifices
19. Parshall flume – installation of these devices – conditions for weir installation
20. Water discharge calculation of rectangular and triangular weirs – advantages of parshall flume over the weirs
21. Water conveyance systems – open channel – definitions of wetted perimeter, hydraulic radius, hydraulic slope, area of cross section and free board – Manning's formula for estimating mean velocity, side slopes of channels for different soils
22. Capacity calculations of open channels
23. Underground pipeline – advantages of earthen channels – disadvantages – type of pipes recommended for underground pipeline

24. Components of underground pipeline – installation procedure – discharge calculation of underground pipeline
25. Irrigation methods – sprinkler irrigation – scope – functional components of sprinkler system and their working
26. Types of sprinkler irrigation – operation and maintenance of the system – cost economics
27. Drip irrigation system – scope – functional components of drip system and their working principles
28. Operation and maintenance of the drip system – cost economics
29. Soil and water conservation – definition and scope – soil erosion – definition – types – geological and accelerated soil erosion – causes and ill effects of soil erosion
30. 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
31. Erosion control measures – engineering measures, contour bunds, graded bunds
32. Terracing – broad based terraces and bench terraces

B) Practical Class Outlines

1. Acquaintance with chain survey equipment
2. Ranging and measurement of offsets
3. Chain triangulation
4. Cross staff survey
5. Plotting of chain triangulation
6. Plotting of cross staff survey
7. Leveling equipment – dumpy level, leveling staff, temporary adjustments and taking staff reading
8. Profile leveling
9. Plotting of profile leveling
10. Plotting of contours
11. Study of centrifugal pumping system

12. Measurement of irrigation water using measuring devices
13. Study of different components of sprinkler irrigation systems
14. Study of different components of drip irrigation systems
15. Uniformity of water application in drip and sprinkler systems
16. Study of soil and water conservation measures

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1. Course No. : AENG 251
2. Course Title : **Farm Power and Machinery**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the significance, use and maintenance of farm power and improved farm equipment through various media including demonstrations
5. 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
 - 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

A) Theory Lecture Outlines

1. Farm power – sources of different farm power – advantages and disadvantages
2. Internal combustion engine – different components and their functions – working principle of four stroke and two stroke cycle engine – comparison between diesel and petrol engine – difference between four stroke engine and two stroke engine
3. Terminology related to engine power – Indicated Horsepower (IHP), Brake Horsepower (BHP), Fractional Horsepower (FHP), Drawbar Horsepower (DBHP), compression ratio (CR), stroke bore ratio, piston displacement and mechanical efficiency – numerical problems on calculation of IHP, BHP, Compression Ratio (CR), stroke bore ratio, piston displacement volume
4. Fuel supply and cooling system of Internal Combustion (IC) engine – types – components and their functions – working principle of forced circulation cooling system
5. Ignition and power transmission system of IC engine – types – components and their functions – working principle of battery ignition system
6. Lubrication system of IC engine – types – purpose – components and their functions – working principle of forced feed system; Tractors – classification – types – points to be considered in selection of tractors – estimating the cost of operation of tractor power
7. Tillage – primary and secondary tillage – Mould Board (MB) plough – functions – constructional features – operational adjustments and maintenance
8. Disc plough – functions – constructional details – operational adjustments and maintenance
9. Numerical problems on MB plough and disc plough
10. Harrows – types – functions – operation of disc harrows – cultivators – rigid and spring loaded tynes – puddlers – cage wheel – rotovators – intercultural implements – hoes and weeders for dry and wetland cultivation
11. Sowing equipment – seed cum fertilizer drills – types – functions – types of metering mechanisms – functional components – calibration – paddy transplanters – aqua seed drills
12. Harvesting equipment – sickles – self propelled reaper – alignment and registration – combines – functions of combines

13. Plant protection equipment – types of sprayers – constructional features of knapsack sprayer, hand compression sprayer, foot sprayer, rocker sprayer, power sprayer and Taiwan sprayer – care and maintenance of sprayers
14. Dusters – hand rotary and power operated dusters – care and maintenance of dusters
15. Tractor mounted equipment for land development and soil conservation – functions of bund former, ridger and leveling blade
16. Farm mechanization – engineering intervention for production and productivity – percentage share of different power sources – level of mechanization of different operations (power sources)

B) Practical Class Outlines

1. Study of different components of IC engine
2. Study of working of four stroke petrol engine
3. Study of working of two stroke petrol engine
4. Study of working of four stroke diesel engine
5. Study of different parts of MB plough, measurement of plough size, horizontal and vertical suction, determination of line of pull, etc.
6. Study of different parts of disc plough and harrows
7. Study of seed-cum-fertilizer drills – furrow openers, seed metering mechanisms and calibration of seed drills
8. Study of paddy transplanters
9. Study of different intercultivation equipment in terms of efficiency and field capacity
10. Study of operation and maintenance of tractor
11. Learning of tractor driving – I
12. Learning of tractor driving – II
13. Study of operation and maintenance of power tiller
14. Study of operation, adjustments and repairs of dusters
15. Study of operation, adjustments and repairs of sprayers
16. Study of different parts of mower and its registration, alignment and operation

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

1. Course No. : AENG 252
2. Course Title : **Greenhouses and Post Harvest Technology**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on green house cultivation
5. Specific Objectives

a) Theory

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

- i. know about green house construction, green house environmental controls like temperature, humidity, carbon dioxide, ventilation, light control, green house irrigation and pest control and green house drying
- ii. know about the post harvest technology

b) Practical

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

- i. get knowledge on green houses and utilization of various equipment in post harvest management of farm produce
- ii. get knowledge about post harvest machinery

A) Theory Lecture Outlines

1. Introduction to green houses – history – definition – greenhouse effect – advantages of green houses

2. Brief description of types of green houses – greenhouses based on shape, utility, construction, 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 heating, 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, glass, polyethylene film, poly vinyl chloride film, tefzel T² 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. Threshing – types of threshers – parts – threshers for different crops –terminology – different types of cylinders used in threshers – care and maintenance
11. Terminology related to threshers – components – working – care and maintenance
12. Winnowing – manual and power operated winnowers – care and maintenance
13. Groundnut decorticators – hand and power operated decorticators – principle of working – care and maintenance
14. Castor and maize shelling – manual and power operated shellers – principle of working – care and maintenance
15. Drying – types – grain dryers
16. Storage – grain storage – types – bag storage, cylindrical grain bin, metal bin, rectangular grain bin, Pusa bin

B) Practical Class Outlines

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 greenhouses
4. Study of construction of pipe framed green house
5. Measurement of environmental parameters inside greenhouse
6. Calculation of ventilation rates in active summer cooling system
7. Calculation of rate of air exchange in active winter cooling system
8. Estimation of drying rate of agricultural produce in side green house
9. Field visit to green house
10. Study of threshers – their components, operation and adjustments
11. Study of winnowers
12. Study of groundnut decorticators
13. Study of castor shellers and maize shellers
14. Study of improved grain storage structures
15. Study of different types of dryers
16. Study of grain storage structures

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1. Course No. : AENG 351
2. Course Title : **Renewable Energy Sources**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the alternate sources of energy and their applications
5. Specific Objectives

a) Theory

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

- i. gain knowledge on merits and demerits of renewable and nonrenewable resources of energy
- ii. know the utilization of various sources of renewable energy namely solar, wind, biomass and bio fuel
- iii. acquaint with gadgets related to the renewable energy sources

b) Practical

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

- i. know about the performance of alternate sources of energy

A) Theory Lecture Outlines

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)

B) Practical Class Outlines

1. Constructional details of Khadi Village Industrial Commission (KVIC) and Janata type biogas plants
2. Constructional details of Deenabhandu type biogas plants
3. Field visit to biogas plants
4. Constructional details of different types of gasifiers
5. To study performance of the gasifiers
6. To study the briquettes preparation from biomass
7. To study the efficiency of solar cooker
8. To study the performance of solar still
9. To study the performance of solar dryer
10. To study the performance of solar photovoltaic pumping system
11. To study the performance of domestic solar water heater
12. To study the performance of solar lantern
13. To study the performance 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 *Jatropha*

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DEPARTMENT OF PLANT PHYSIOLOGY

1. Course No. : PPHY 161
2. Course Title : **Crop Physiology**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on different plant metabolic processes and their functions in plants
5. Specific Objectives

a) Theory

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

- i. study the growth and development of plants
- ii. study the effect of nutrients and plant growth regulators and their applications in agriculture
- iii. understand the physiology of seeds and fruit ripening

b) Practical

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

- i. understand various plant metabolic processes occurring at different stages of plant growth which lead to development

A) Theory Lecture Outlines

1. Introduction – definition of crop physiology – importance in agriculture and horticulture
2. Seed physiology – seed structures – development of embryo, endosperm, perisperm and seed coat – morphological, physiological and biochemical changes during seed development
3. Seed physiology – physiological maturity – morphological and physiological changes associated with physiological maturity in crops with examples – harvestable maturity – seed viability and vigour – factors affecting seed viability and vigour
4. Seed physiology – methods of testing seed viability and vigour –germination – utilization of seed reserves (carbohydrates, fats and proteins) during seed germination – morphological, physiological and biochemical changes during seed germination – factors affecting seed germination

5. Growth and development – definition – types of growth – determinate and indeterminate growth – monocarpic and polycarpic species with examples – initiation and development of vegetative and reproductive structures
6. Growth and development – measurement of growth – growth analysis – growth characteristics – definitions and mathematical formulae
7. Crop water relations – physiological importance of water to plants – water potential and its components – importance of water potential – active and passive uptake of water – measurement of water status in plants
8. Crop water relations – transpiration – definition – significance – structure of stomatal complex in monocots and dicots – role of stomata in transpiration – transpiration in relation to crop productivity – Water Use Efficiency (WUE) – WUE in C_3 , C_4 and Crassulacean Acid Metabolism (CAM) plants – WUE of major field crops – factors affecting WUE
9. Photosynthesis – energy synthesis – cyclic and non-cyclic photophosphorylation – CO_2 fixation – C_3 pathway
10. Photosynthesis – CO_2 fixation – C_4 and CAM pathways – methods of measuring photosynthesis
11. Photosynthesis – photorespiration – factors affecting photosynthesis (light, CO_2 , temperature, water stress, water logging, salinity, weeds / weedicides, etc.)
12. Photosynthesis – photosynthetic efficiency – significance of C_3 , C_4 and CAM pathways – relationship of photosynthesis and crop productivity
13. Translocation of assimilates – phloem loading – apoplastic and symplastic transport of assimilates – mechanism of phloem transport – phloem unloading
14. Source and sink concept – dry matter partitioning – harvest index of crops
15. Respiration and its significance – importance of glycolysis, Tricarboxylic Acid (TCA) cycle and Pentose Phosphate Pathway
16. Respiration – interrelationship of respiration and photosynthesis – growth respiration and maintenance respiration – alternate respiration – salt respiration – wound respiration – measurement of respiration
17. Nutriophysiology – definition – essential elements – criteria of essentiality of elements – classification of plant nutrients based on their biochemical role and physiological function
18. Nutriophysiology – physiology of nutrient uptake – active and passive uptake of nutrients – functions of N, P, K, Ca and Mg

19. Nutriophysiology – functions of Fe, Zn, Mn, Cu, B, Mo, Cl, Na and Si – their mobility in phloem
20. Nutriophysiology – deficiency and toxicity symptoms of plant nutrients
21. Nutriophysiology – foliar nutrition – hydroponics – solution and sand culture
22. Photoperiodism and flowering – importance of photoperiodism – classification of plants based on photoperiodic responses – perception of photoperiodic stimulus – biological clock
23. Photoperiodism – phytochrome – flowering hormones – vernalization and flowering – importance of vernalization in relation to crop productivity
24. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role of auxins
25. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role of gibberellins
26. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role of cytokinins
27. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role of Abscisic Acid (ABA)
28. Plant growth regulators – occurrence, biosynthesis, mode of action and physiological role and ill effects of ethylene
29. Plant growth regulators – novel plant growth regulators – commercial application of plant growth regulators in agriculture and horticulture
30. Senescence and abscission – definition – classification – theories of mechanism and control of senescence – physiological and biochemical changes and its significance – abscission and its relationship with senescence
31. Post harvest physiology – seed dormancy – definition – types of seed dormancy – advantages and disadvantages of seed dormancy – causes and remedial measures for breaking seed dormancy with examples – optimum conditions of seed storage – factors influencing seed storage International Seed Testing Association (ISTA) standards
32. Post harvest physiology – fruit ripening – metabolic changes during fruit ripening – climacteric and non-climacteric fruits – hormonal regulation of fruit ripening (with ethyl, Chloro Choline Chloride (CCC), polaris and paclobutrazole) – use of hormones in increasing vase life of flowers

B) Practical Class Outlines

1. Preparation of solutions
2. Imbibition of seed
3. Seed viability and vigour 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. Measurement of water potential by Chardakov's method
9. Absorption spectrum of chloroplast pigments
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 plant growth
14. Breaking of seed dormancy – chemical and mechanical methods
15. Identification of nutrient deficiency symptoms in field crops using prepared photographs / slides / collected specimens
16. Yield analysis

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1. Course No. : PPHY 261
2. Course Title : **Ecophysiology**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the environmental factors and their effect on plants
5. Specific Objectives
 - a) Theory

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

 - i. study the ecophysiological aspects of plants
 - ii. know about pollution and its effect on plant growth
 - iii. understand controlled environment and its use in agriculture
 - b) Practical

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

 - i. understand the response of plants in relation to various environmental factors affecting plant growth and development

A) Theory Lecture Outlines

1. Ecophysiology – introduction – definition – importance in agriculture and horticulture – ecosystem – definition of ecosystem, ecotypes and ecads – biosphere and ecosystem – sub divisions of biosphere – pathways of energy in the biosphere – concept of ecosystem – components of ecosystem – basic structure of ecosystem
2. Different types of ecosystem – freshwater – marine – forest and crop ecosystem – energy in ecosystem – productivity – primary production – secondary production – types of food chains
3. Global climates and crop distribution – influence of climate on crop distribution (rice, wheat, maize, sorghum and sugarcane) – important climatic regions of the world – agro-climatic zones of India – crop distribution in India and Andhra Pradesh
4. Environment – definition – components – biotic and abiotic environments – biotic environment – biotic factors and anthropic factors – abiotic environment – climatic, edaphic, physiographic and pyric factors – climatic factors – radiation – effect of radiation on plant functions – classification of ultraviolet (UV) radiation – effects of UV-B radiation.

5. Abiotic environment – climatic factors – precipitation – forms of precipitation – effect of water deficit and water logging on plant processes – temperature – cardinal temperature – effects of temperature on plant processes – temperature injuries – high temperature and low temperature stress – classification of plants based on heat resistance and cold resistance – heat units
6. Abiotic environment – edaphic factors – classification of plants based on adaptation to different soil types – halophytes and salt stress tolerance mechanisms
7. Abiotic environment – physiographic factors – altitude of the place, steepness of the slope, direction of mountain chain and exposure of the slope to light and wind – effects of topographic factors on vegetation – wind effect on physiological processes
8. Abiotic environment – pyric factors – sources and type of fires – effects of fire on vegetation and environment – management of fires and rejuvenation of crops
9. Biotic factors – herbivores (grazing effect), symbiosis (*Mycorrhiza* and *Rhizobium* associations), insectivorous plants, epiphytism and parasites Anthropic factors – industrialization – shifting cultivation – crop improvement
10. Competition – ecological succession – dominance and subordination – types of competition – inter-specific, intra-specific and intra-plant competition – monoculture and polyculture – multistoried cropping system – mutual shading
11. Allelopathy – definition – concept – sources of allelopathic chemicals in crop and weed species – natural products identified as allelopathic chemicals – mode of action – scope for allelopathy
12. Phyto-remediation – definition – concept – applications in agriculture and industry
13. Pollution – air pollution – sources – physiological effects on plants and its management; Water pollution – sources – physiological effects on plants and its management; Soil pollution – sources – physiological effects on plants and its management
14. Global warming – greenhouse effect – causes of global warming – methane, carbon dioxide, Chloro Fluoro Carbon's (CFC), Nitrous Oxide (NO) gas and ozone – impact of global warming on climate and agricultural productivity – measures to reduce build up of green house gases
15. Controlled environment – purposes – types – designs of structure – commercial applications
16. Carbon dioxide fertilization – definition – concept – importance – sources – methods of CO₂ fertilization – effects on crop yields and limitations; Ecophysiological models – concept – models for different environmental management

B) Practical Class Outlines

1. Morphological and anatomical adaptations in hydrophytes
2. Morphological and anatomical adaptations in mesophytes
3. Morphological and anatomical adaptations in xerophytes
4. Effects of light and shade on crop growth
5. Influence of different soils on crop growth
6. Analysis of competition in crop plants
7. Measurement of microclimate in contrast crop canopies
8. Effect of dust pollution on crop growth
9. Effect of soil pollution on crop growth
10. Measurement of Biological Oxygen Demand (BOD) in polluted water
11. Effect of water pollution on crop growth
12. Effect of water stress on plant growth and development
13. Effect of water logging on plant growth
14. Effect of temperature on plant growth
15. Effect of polyhouse on crop growth
16. Growing plants in controlled environment (growth cabinet)

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DEPARTMENT OF PLANT PATHOLOGY

1. Course No. : PATH 171
2. Course Title : **Introduction to Plant Pathogens**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on pathogens that cause diseases in plants
5. Specific Objectives

a) Theory

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

- i. study different pathogens causing plant diseases
- ii. understand the morphological characters and taxonomic keys associated with the identification of pathogens

b) Practical

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

- i. identify the plant pathogens
- ii. know the modes of transmission of viruses

A) Theory Lecture Outlines

1. Introduction – importance of plant pathogens – important phytopathogenic organisms, viz., fungi, bacteria, fastidious vascular bacteria (RLO's), mollicutes (phytoplasma and spiroplasma), viruses, viroids, algae and protozoa
2. General characteristics of fungi – fungus – definition – somatic structures – types of fungal thalli – plasmodium, unicellular and filamentous – fungi based on reproductive structures – eucarpic, holocarpic, ectophytic and endophytic (intercellular, intracellular and vascular) – septation in fungi – fungal tissues – plectenchyma (prosenchyma and pseudoparenchyma)
3. Modifications of mycelium (rhizomorphs, sclerotium, stroma, haustorium, rhizoids and appressorium) – fungal cell – fungal nutrition – groups of fungi based on mode of nutrition – saprophytes (obligate saprophytes and facultative parasite) and parasites (obligate parasites and facultative saprophytes); Physiology of fungi; Reproduction in fungi – asexual reproduction – fragmentation, fission, budding and sporulation

4. Sexual reproduction – planogametic copulation, gametangial contact, gametangial copulation, spermatization and somatogamy – parasexual cycle – various life cycle patterns displayed by fungi – haplobiontic and diplobiontic life cycles 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, Family Plasmodiophoraceae – differences in the characteristics of *Plasmodiophora* and *Spongospora* – diseases caused by *Plasmodiophora* and *Spongospora*
7. Division Eumycota – Sub-division Mastigomycotina – important characteristics of Class Chytridiomycetes, Order Chytridiales – diseases caused and transmitted by *Synchytrium*
8. Important characteristics of Class Oomycetes, Order Peronosporales – *Pythium* and *Phytophthora*
9. *Albugo* – distinguishing characteristics of downy mildew genera – *Sclerospora*, *Peronospora*, *Peronosclerospora*, *Pseudoperonospora*, *Plasmopara* 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 – 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 – diseases caused by *Claviceps purpurea*
14. Important characteristics of Class Loculoascomycetes, Order Pleosporales Family Venturiaceae – disease caused by *Venturia inaequalis*

15. Important characteristics of Order Myriangiales, Family Myriangiaceae – diseases caused by *Elsinoe fawcetti* – Important characteristics of Order Dothidiales, Family Dothideaceae – diseases caused by *Mycosphaerella arachidicola*, *M. berkeleyi* and *M. musicola* – imperfect stages for the genera of Class Loculoascomycetes
16. Sub-division Basidiomycotina – important characteristics of Class Teliomycetes, Order Uredinales – distinguishing characteristics of *Puccinia*, *Uromyces* and *Hemileia* – disease caused by *Puccinia graminis tritici*, *Uromyces appendiculatus* and *Hemileia vastatrix*
17. Life cycle of *Puccinia graminis tritici* – diseases caused by *Melampsora ricini*
18. Important characteristics of Order Ustilaginales – distinguishing characteristics of *Ustilago*, *Sphacelotheca* and *Tolyposporium* – diseases caused by *Ustilago tritici*, *Sphacelotheca sorghi* and *Tolyposporium ehrenbergii*
19. 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 – diseases caused by *Ganoderma lucidum*
21. Sub-division Deuteromycotina – important characteristics of Class Coelomycetes, Order Sphaeropsidales – distinguishing characteristics of *Phomopsis*, *Phyllosticta*, *Macrophomina*, *Septoria*, *Diplodia* and *Botryodiplodia*
22. Important characteristics of Order Melanconiales, Family Melanconiaceae – distinguishing characteristics of *Colletotrichum*, *Gloeosporium*, *Pestalotiopsis* and *Pestalotia*
23. Important characteristics of Class Hyphomycetes, Order Moniliales – distinguishing characteristics of *Aspergillus*, *Penicillium*, *Pyricularia*, *Botrytis* and *Verticillium*
24. Distinguishing characteristics of *Alternaria*, *Helminthosporium*, *Bipolaris*, *Cercospora* and *Phaeoisariopsis*
25. Important characteristics of Order Tuberculariales, 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. Prokaryotes – Classification (Bergey's Manual of Systematic Bacteriology, 1984) into divisions – Gracilicutes, Firmicutes, Tenericutes and Mendosicutes with examples

27. Bacteria – definition – important characteristics of phytopathogenic bacteria with key for identification of important genera – *Streptomyces* (common scab), *Pseudomonas* (wild fire of tobacco) and *Ralstonia* (wilt of solanaceous crops)
28. Bacteria – important characteristics of phytopathogenic bacteria with key for identification of important genera – *Xanthomonas* (citrus canker), *Agrobacterium* (crown gall), *Erwinia* (fire blight of apple) and *Clavibacter* (tundu disease of wheat)
29. 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
30. Phytoplasmas and Spiroplasmas – important characteristics of Phytoplasmas and Spiroplasmas – little leaf of brinjal, sesamum phyllody, corn stunt and citrus stubborn – vectors
31. Viruses and viroids – important characteristics of plant viruses and viroids – classification of viruses – single stranded (ss) RNA, double stranded (ds) RNA, ssDNA and dsDNA – methods of transmission of plant viruses
32. 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

B) Practical Class Outlines

1. Study of vegetative structures of fungi and their modifications
2. Study of reproductive (sexual and asexual) structures of fungi
3. Study of *Pythium* and *Phytophthora*
4. Study of *Albugo*
5. Study of downy mildew fungi – *Sclerospora*, *Peronosclerospora*
6. Study of downy mildew fungi – *Pseudoperonospora*, *Peronospora*, *Plasmopara* and *Bremia* and Zygomycetes fungi – *Rhizopus*
7. Study of powdery mildew fungi – *Oidium*, *Oidiopsis*, *Ovulariopsis*
8. Study of ascocarps of *Erysiphe*, *Phyllactinia*, *Uncinula*, *Podosphaera* and *Microsphaera*
9. Study of rust fungi – *Puccinia* (different stages), *Uromyces* and *Hemileia*
10. Study of smut fungi – *Sphacelotheca*, *Ustilago* and *Tolyposporium*; – Study of *Ganoderma*

11. Study of imperfect fungi – *Septoria*, *Colletotrichum* and *Pestalotiopsis*
12. Study of imperfect fungi – *Aspergillus*, *Penicillium* and *Pyricularia*
13. Study of imperfect fungi – *Drechslera*, *Helminthosporium*, *Alternaria*, *Cercospora* and *Phaeoisariopsis*
14. Study of imperfect fungi – *Fusarium*, *Rhizoctonia* and *Sclerotium*
15. Isolation of phytopathogenic bacteria (locally available diseased plant material) and study of colony characteristics and Gram's staining
16. Demonstration of mechanical transmission of plant viruses

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1. Course No. : PATH 271
2. Course Title : **Principles of Plant Pathology**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the principles of plant disease management
5. Specific Objectives

a) Theory

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

- i. understand the mode of survival and dissemination of plant pathogens
- ii. understand the infection process and defense responses in plants

- iii. understand the role of weather on disease development
- iv. know the principles of plant disease management

b) Practical

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

- i. learn the laboratory techniques for isolation, culturing and diagnosis
- ii. get training in diagnosis and methods of application of fungicides and bio-control agents

A) Theory Lecture Outlines

1. Introduction to plant pathology – definition and objectives of plant pathology – history of plant pathology – contributions of Anton de Bary, Butler, Mundkur, Stakman, Dastur, Mehta, Sadasivan
2. Terms and concepts used in plant pathology – disease – disorder – pathogen – parasite – pathogenicity – pathogenesis – sign – symptom – syndrome – biotroph – hemibiotroph – perthotroph – inoculum – inoculum potential – infection – incubation period – predisposition – hypersensitivity – epidemic – endemic and sporadic diseases
3. 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 out side the host (soil, root inhabitants and rhizosphere colonizers) dormant spores or structures (seed borne, soil borne and on infected plant parts)
4. Dispersal of plant pathogens – active dispersal – seed, soil and plant parts, passive dispersal – air, water, members of animal kingdom (agents with examples), fungi and phanerogamic parasites
5. Phenomenon of infection – process of infection – pre-penetration, penetration and post-penetration – pre-penetration in fungi (spore germination, germ tube growth, formation of specialized structures like appressorium and rhizomorphs), bacteria and virus
6. 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 – post penetration – colonization of the host
7. Pathogenesis – role of enzymes, toxins, growth regulators and polysaccharides in plant diseases with examples – enzymes – cutinases, pectinases, cellulases, lignases, proteases and lipases

8. Toxins – pathotoxins, phytotoxins and vivotoxins – selective (host specific) and non-selective (host non-specific) toxins; Growth regulators – growth promoting substances (auxins, gibberellins and cytokinins) and growth inhibiting substances and polysaccharides
9. Defense mechanisms in plants – pre-existing structural defense mechanisms – waxes, thick cuticle and epidermal cell wall – structure of natural openings, internal structural barriers – post-infectious structural defense – histological defense (cork layer, abscission layer, tyloses and gum deposition) and cellular defense (hyphal sheathing) structures
10. Biochemical defense mechanisms – 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) – post-infectious defense mechanisms – phytoalexins, hypersensitive reaction – defense through plantibodies
11. Plant disease epidemiology – components of an epidemic – factors affecting plant disease epidemics (disease triangle and disease pyramid)
12. General principles of plant disease management – importance – general principles – avoidance of the pathogen (selection of pathogen free propagating material and seed, selection of field, choice of time of sowing and disease escaping varieties), exclusion – plant quarantine and inspection, quarantine rules and regulations
13. Eradication – cultural methods (rouging, 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)
14. Physical methods – solarization and hot water treatment; Biological methods – role of biological control – mechanisms – competition, antibiosis, hyperparasitism and Induced Systemic Resistance (ISR)
15. Important fungal and bacterial biocontrol agents (*Trichoderma spp.*, *Pseudomonas fluorescens*, *Bacillus subtilis* and *Ampelomyces quisqualis*) – Plant Growth Promoting Rhizobacteria (PGPR) against phytopathogens
16. Chemical methods – fungicides, antibiotics, methods and time of applications

B) Practical Class Outlines

1. Acquaintance with plant pathology laboratory and equipment
2. Preparation of culture media Potato Dextrose Agar (PDA) for fungi and Nutrient Agar (NA) for bacteria

3. Isolation of fungal and bacterial pathogens
4. Plant disease diagnostic techniques – study of symptomatology (symptoms, sign, syndrome, infectious and non-infectious diseases)
5. Preservation of disease samples – dry and wet methods
6. Demonstration of Koch's postulates for fungi
7. Demonstration of Koch's postulates for bacteria
8. Study of different groups of fungicides and antibiotics
9. Preparation of fungicides – Bordeaux mixture, Bordeaux paste and cheshunt compound
10. Methods of application of fungicides – soil application
11. Methods of application of fungicides – seed and foliar application
12. Bioassay of fungicides – poisoned food technique
13. Bioassay of fungicides – inhibition zone technique and slide germination technique
14. Bio-control of plant pathogens – dual culture technique
15. Seed treatment
16. Visit to quarantine station

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- Chaube, H.S. and Ramji Singh. 2001. *Introductory Plant Pathology*. International Book Distribution Co., Lucknow.
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- Vidyasekharan, P. 1993. *Principles of Plant Pathology*. CBS Publishers and Distributors, New Delhi.

1. Course No. : PATH 371
2. Course Title : **Diseases of Field Crops and Their Management**
3. Credit Hours : 3 (2+1)
4. General Objective : To study the diseases of field crops and their management
5. Specific Objectives

a) Theory

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

- i. know the distribution of plant diseases and their economic importance
- ii. identify the diseases based on the symptomatology and the factors influencing the disease development
- iii. acquaint with integrated disease management practices

b) Practical

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

- i. diagnose the plant diseases based on symptomatology
- ii. understand the etiology and host-parasite relationship

A) Theory Lecture Outlines

1. Diseases of rice – blast – economic importance, symptoms, cause, disease cycle and integrated management
2. Diseases of rice – brown spot, sheath rot and stem rot – economic importance, symptoms, cause, disease cycle and integrated management
3. Diseases of rice – sheath blight and false smut – economic importance, symptoms, cause, disease cycle and integrated management
4. Diseases of rice – bacterial leaf blight, bacterial leaf streak and tungro – economic importance, symptoms, cause, disease cycle and integrated management
5. Diseases of sorghum – anthracnose, rust, sugary disease, grain molds and leaf blight – economic importance, symptoms, cause, disease cycle and integrated management
6. Diseases of sorghum – grain smut, charcoal rot, downy mildew and *Striga* – economic importance, symptoms, cause, disease cycle and integrated management

7. Diseases of maize – turicum leaf blight, post flowering stalk rot and *Cephalosporium* wilt – economic importance, symptoms, cause, disease cycle and integrated management
8. Diseases of maize – charcoal rot, banded leaf and sheath blight and downy mildew – economic importance, symptoms, cause, disease cycle and integrated management
9. Diseases of pearl millet – downy mildew, rust, sugary disease and smut – economic importance, symptoms, cause, disease cycle and integrated management
10. Diseases of finger millet – blast, smut and mosaic – economic importance, symptoms, cause, disease cycle and integrated management
11. Diseases of wheat – black stem rust, brown rust and yellow rust – economic importance, symptoms, cause, disease cycle and integrated management
12. Diseases of wheat – loose smut and karnal bunt – economic importance, symptoms, cause, disease cycle and integrated management
13. Diseases of wheat – leaf blight, soil borne mosaic and tundu disease / yellow slime disease – economic importance, symptoms, cause, disease cycle and integrated management
14. Diseases of cotton – bacterial leaf blight, *Fusarium* wilt, *Verticillium* wilt, *Macrophomina* root rot and grey / areolate mildew – economic importance, symptoms, cause, disease cycle and integrated management
15. Diseases of cotton – anthracnose, leaf spots (*Alternaria* and *Myrothecium*) and rust – economic importance, symptoms, cause, disease cycle and integrated management
16. Diseases of sugarcane – red rot, whipsmut, wilt and ring spot – economic importance, symptoms, cause, disease cycle and integrated management
17. Diseases of sugarcane – grassy shoot, mosaic, ratoon stunt and rust – economic importance, symptoms, cause, disease cycle and integrated management
18. Diseases of tobacco – black shank / leaf blight, damping off and frog eye nv. leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
19. Diseases of tobacco – brown spot, mosaic, leaf curl and *Orabanche* – economic importance, symptoms, cause, disease cycle and integrated management
20. Diseases of groundnut – tikka leaf spot, rust, pepper leaf spot and *Sclerotium rolfsii* stem rot – economic importance, symptoms, cause, disease cycle and integrated management

21. Diseases of groundnut – bud and stem necrosis and Kalahasthi malady – economic importance, symptoms, cause, disease cycle and integrated management
22. Diseases of sesamum – *Alternaria* leaf spot, powdery mildew, phyllody, *Macrophomina* stem rot and bacterial leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
23. Diseases of castor – wilt, root rot, grey mold, bacterial leaf spot, seedling blight and rust – economic importance, symptoms, cause, disease cycle and integrated management
24. Diseases of sunflower – *Alternaria* leaf blight, rust, powdery mildew, head rot, sclerotial wilt, downy mildew, mosaic and sunflower necrosis virus – economic importance, symptoms, cause, disease cycle and integrated management
25. Diseases of safflower – *Alternaria* leaf spot, wilt, rust and mosaic – economic importance, symptoms, cause, disease cycle and integrated management
26. Diseases of mustard – white rust, downy mildew, powdery mildew and *Alternaria* leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
27. Diseases of redgram – *Phytophthora* blight and wilt – economic importance, symptoms, cause, disease cycle and integrated management
28. Diseases of redgram – sterility mosaic – economic importance, symptoms, cause, disease cycle and integrated management
29. Diseases of bengalgram – wilt, rust, *Ascochyta* blight, *Macrophomina* stem and root rot – economic importance, symptoms, cause, disease cycle and integrated management
30. Diseases of greengram and blackgram – powdery mildew, rust, *Cercospora* leaf spot, *Corynespora* leaf spot, angular black spot, root rot, bacterial leaf spot, yellow mosaic virus, crinkle virus disease and *Cuscuta* – economic importance, symptoms, cause, disease cycle and integrated management
31. Diseases of soybean – rust, soybean mosaic and bacterial leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
32. Cowpea mosaic – economic importance, symptoms, cause, disease cycle and integrated management

B) Practical Class Outlines

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, cowpea 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

Note: Submission of well-maintained herbaria during the final practical examination is compulsory

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.

1. Course No. : PATH 372
2. Course Title : **Diseases of Horticultural Crops and Their Management**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the diseases of horticultural crops and their management
5. Specific Objectives

a) Theory

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

- i. know the distribution of plant diseases and their economic importance
- ii. identify the diseases based on the symptomatology and the factors influencing the disease development
- iii. acquaint with integrated disease management practices

b) Practical

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

- i. diagnose the plant diseases based on symptomatology
- ii. understand the etiology and host-parasite relationship

A) Theory Lecture Outlines

1. Diseases of citrus – gummosis (*Phytophthora* spp.), diplodia gummosis, dry root rot (*Fusarium*), canker, tristeza, greening and felt – economic importance, symptoms, cause, disease cycle and integrated management
2. Diseases of mango – powdery mildew, anthracnose, malformation, sooty mold, red rust, *Loranthus* – economic importance, symptoms, cause, disease cycle and integrated management

3. Powdery mildew of ber – economic importance, symptoms, cause, disease cycle and integrated management; Wilt of guava – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of sapota – flat limb – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of papaya – powdery mildew, foot rot, mosaic, leaf curl and anthracnose – economic importance, symptoms, cause, disease cycle and integrated management
4. Diseases of banana – sigatoka leaf spot, panama, mosaic, moko, *Erwinia* rhizome rot, bunchy top and banana bract mosaic – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of pomegranate – anthracnose and bacterial leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
5. Diseases of grape – powdery mildew, downy mildew, anthracnose, *Alternaria* leaf spot and rust – economic importance, symptoms, cause, disease cycle and integrated management
6. Diseases of apple – scab, powdery mildew, fire blight and crown gall – economic importance, symptoms, cause, disease cycle and integrated management
7. Diseases of chilli – damping off, dieback and fruit rot, *Choanephora* blight, chilli virus complex (CMV and TMV only) – powdery mildew, *Cercospora* leaf spot, bacterial leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
8. Diseases of brinjal – little leaf, bacterial wilt and phomopsis fruit rot – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of okra – yellow vein mosaic, *Cercospora* leaf spot and powdery mildew – economic importance, symptoms, cause, disease cycle and integrated management
9. Diseases of potato – early blight, late blight, common scab, wart, black leg, brown rot and virus diseases – mosaic, rugose mosaic, leaf roll, potato spindle tuber viroid – economic importance, symptoms, cause, disease cycle and integrated management
10. Diseases of tomato – Septoria leaf spot, tomato spotted wilt, bacterial canker and root knot disease – economic importance, symptoms, cause, disease cycle and integrated management
11. Diseases of crucifers – club root, downy mildew, powdery mildew, *Alternaria* leaf spot, black rot and white rust – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of cucurbits – downy mildew, powdery mildew, CMV and *Cercospora* leaf spot – economic importance, symptoms, cause, disease cycle and integrated management

12. Diseases of betelvine – wilt (*Phytophthora*, *Sclerotium* and *Fusarium*) and anthracnose – economic importance, symptoms, cause, disease cycle and integrated management
13. Diseases of onion – purple blotch, smudge and smut – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of beans – anthracnose, rust, yellow mosaic and bean common mosaic – economic importance, symptoms, cause, disease cycle and integrated management
14. Diseases of coconut – *Ganoderma* basal stem rot, bud rot, stem bleeding, tatipaka and grey blight – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of oil palm- bunch rot and spear rot – economic importance, symptoms, cause, disease cycle and integrated management
15. Blister blight of tea – economic importance, symptoms, cause, disease cycle and integrated management; Rust of coffee – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of turmeric – rhizome rot, leaf spot and leaf blotch – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of ginger – rhizome rot and *Phyllosticta* leaf spot – economic importance, symptoms, cause, disease cycle and integrated management
16. Powdery mildew of mulberry – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of rose – powdery mildew, black spot and diplodia die-back– economic importance, symptoms, cause, disease cycle and integrated management; Diseases of jasmine – rust – economic importance, symptoms, cause, disease cycle and integrated management; Diseases of chrysanthemum – septoria blotch, stunt and wilt – economic importance, symptoms, cause, disease cycle and integrated management; *Fusarium* wilt of crossandra – economic importance, symptoms, cause, disease cycle and integrated management

B) Practical Class Outlines

1. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of citrus
2. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of mango and grape
3. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of ber, guava, sapota and papaya
4. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of banana and pomegranate

5. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of chilli
6. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of brinjal and okra
7. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of potato and tomato
8. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of crucifers and cucurbits
9. Field visit – I
10. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of betel vine and onion
11. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of coconut and oil palm
12. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of tea and coffee
13. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of turmeric and ginger
14. Study of symptoms, etiology, host – parasite relationship and specific control measures of diseases of mulberry, rose, jasmine, chrysanthemum and crossandra
15. Field visit – II
16. Field visit – III

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- Pathak, V. N. 1980. *Diseases of Fruit Crops*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Singh, R.S. 1994. *Diseases of Vegetable Crops*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
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- Sohi, H. S. 1992. *Diseases of Ornamental Plants in India*. ICAR, New Delhi.
- Varma, L.R. and Sharma, R.C. 1999. *Diseases of Horticultural Crops*. Indus Publishing Co., New Delhi.

DEPARTMENT OF HORTICULTURE

1. Course No. : HORT 181
2. Course Title : **Principles of Horticulture and Production Technology of Fruit Crops**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on principles of horticulture and production technology of fruit crops
5. Specific Objectives
 - a) Theory

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

 - i. know principles and production technology of fruit crops
 - b) Practical

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

 - i. learn about identification and production technology of fruit crops

A) Theory Lecture Outlines

1. Definitions of horticulture – literal meaning – olden day's horticulture and modern horticulture – divisions of horticulture – pomology, olericulture, floriculture (commercial and ornamental), plantation crops, arboriculture, spices and condiments, medicinal and aromatic crops, fruit technology, land scaping, nursery and seed production – their definitions with crop examples – role of horticulture in human nutrition and importance of horticulture in national economy – climatic zones of horticultural crops of India and Andhra Pradesh with recommended fruit crops for each zone
2. Area, production and productivity of different fruit crops – establishment of orchard – selection of site – points to be considered – climatic conditions, soil characteristics, availability of facilities like nearness to market, transport, power supply, labour, proximity to established orchards, social factors, presence of nurseries, cost of land etc. – orchard planning – principles to be followed while planning an orchard – guiding principles to manage the orchard most profitably and to present attractive appearance and general principles to be followed

3. Steps in establishment of orchard – clearing of the land – leveling – fencing – purpose of raising fence – live and non-live fences – good fence plant characters – examples of live and non-live fences – wind breaks – beneficial effects of wind breaks and characteristics of good wind break plants – examples of wind break plants – roads – drains – tillage – sowing green manure crops – marking plant positions – digging and filling of pits – selection of plants from the nursery – lifting and packing of plants – season of planting – planting and healing inn
4. Influence of environmental factors on horticultural crop production – temperature, humidity, wind, rainfall and solar radiation
5. Planting systems – layout – points to be considered before selecting a system of planting – different systems of planting – square, rectangular, quincunx, hexagonal and contour planting with their merits and demerits – lay out of different systems in the field – working out the number of plants per unit area in each system – High Density Planting (HDP) – ultra high density planting – advantages and disadvantages of HDP
6. Propagation – definition – methods of propagation – sexual and asexual – advantages and disadvantages of each method; Asexual method of propagation – propagation by division and separation – definition of division and separation – method of division – bulbs and corms and separation – stem tuber, tuberous root, rhizome, suckers (shoot and root suckers) runner and off sets – examples for each type – propagation by cuttings – definition of cutting – different methods of cuttings – stem cuttings – hard wood cuttings, semi hard wood, soft wood and herbaceous stem cuttings – examples for each type – leaf cuttings – plant propagation by layering – definition of layering and layer – types of layering – ground layering – tip layering, simple layering, trench layering, mound or stool layering and compound or serpentine layering – examples for each layering – air layering – examples
7. Plant propagation by graftage – definition of graftage – rootstock and scion selection – characters of a good rootstock and scion material – selection of scion material – variety, tree and budwood for grafting and budding – pre-curing of scion – methods of grafting – attached scion methods of grafting, simple or approach grafting, detached scion methods of grafting, side grafting, veneer grafting, epicotyl grafting, double, soft wood grafting, top working etc.
8. Plant propagation by budding – definition of budding – methods of budding – T-budding and inverted T-budding, patch budding and ring budding

9. Clonal propagation – definition of a clone – micropropagation – definition – merits and demerits of micropropagation
10. Graft incompatibility – types of incompatibility – translocated and localized incompatibility
11. Methods of training and pruning – training – definition – objectives of training fruit trees – reasons for training – methods of training – central leader, open centre and modified leader systems with merits and demerits – pruning – definition – reasons for pruning – objectives of pruning – responses of plants to pruning – activation of buds, dwarfing response, production of water shoots and delay in bearing – methods of pruning – thinning out, trimming, heading back, pollarding, pinching, disbudding and deblossoming – seasons of pruning – pruning and manuring – care of pruned woods
12. Unfruitfulness in fruit trees – causes – environmental causes, nutritional causes, inherent causes, biological causes and cultural causes and their remedies – use of growth regulators in fruit production – growth regulators and plant hormones – types of growth regulating substances – use of growth regulators in propagation – rooting of cuttings, induction of rooting in layering, union of rootstock and scion in grafting and budding, control of flowering, fruit set, fruit drop, parthenocarpy, fruit ripening, fruit size, quality and sex expression – preparation of growth regulators – powder, solution and lanolin paste
13. Mango – origin – importance – climate – soils – varieties – commercial varieties grown in different states – commercial varieties for Andhra Pradesh – baneshan, neelum, bangalora, rumani, khader, suvarnarekha, panchadarakalasa, cherukurasam and janardhanpasand (only names of varieties) – hybrid varieties released from national and state institutions – neeleshan, neelgoa, swarna jahangir, aurumani, manjeera, arka aruna, arka puneeth, arka anmol and arka neelkiran, mallika, amrapali, ratna, sindhu, prabhasankar, mahamudbahar, jawahar, PKM-1, PKM-2 (parentage with one or two important characters) – classification of mango varieties based on utility – table varieties, juicy varieties, table and juicy varieties, pickle varieties and varieties for preservation – depending on time of availability – early, mid, late and off season varieties – examples for each class
14. Mango – propagation – different methods of propagation – commercial methods of propagation – rootstocks – planting – land preparation – method of planting – 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
15. Banana – origin – importance – climate – soils – varieties – table varieties – poovan, dwarf cavendish, robusta, grand nine, rasthali, grosMichel, virupakshi and nendran – cooking types – monthan and bontha (only names of varieties) – dual purpose – nendran – propagation – propagating material – suckers (water and sword suckers) and rhizomes
 16. Banana – planting – land preparation – system of planting – spacing – digging of pits – filling of pits – application of manures – season of planting – intercultivation – de-suckering – trashing – mattocking – wrapping of bunches – removal of male bud – removal of floral remnants – propping – earthing-up – weeding – harvesting – maturity indices – yield
 17. Citrus – origin – importance – different citrus species – climate – soils – varieties of different citrus fruits – sweet orange – sathgudi, mosambi, batavian, malta and malta blood red – mandarin varieties – nagapur mandarin, coorg mandarin, kashi orange and kinnow mandarin – limes – tahiti lime, rangapur lime, sweet lime, coorg lime and acid lime – lemons – seeded and seedless – examples of varieties – pummelo – examples of varieties – grape fruits – examples of varieties (only names of varieties) – climatic and soil requirements of different citrus fruits
 18. Citrus – propagation – different methods of propagation adopted in different citrus fruits and also commercial method adopted – different root stocks used in citrus and their chief characters – 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
 19. Grape – origin – importance – climate – soils – varieties – bangalore blue, gulabi, anab-e-shahi, dilkush, patcha draksha, pusa seedless, thompson seedless, beauty seedless and perlette (only names of varieties) and hybrids – arkavathi, arka kanchan, arka hans, arka shyam, arka neelmani, arka shweta, arka majestic, arka chitra, arka soma, arka thrishna, arka krishna, arka urvashi and pusa navarang (parentage with one or two important characters) – commercial classification of grapes – table, wine, sweet juice and raisin grapes – their characteristics and examples of varieties –

propagation – different methods of propagation – different rootstocks used – planting – land preparation – system of planting – spacing – digging of pits – filling of pits – application of manures – season of planting – training – different methods of training – head, arbour, kniffin, and telephone trellis system – advantages and disadvantages of each system

20. Grape – 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
21. Guava – origin – importance – climate – soils – varieties – seeded – allahabad safeda, lucknow-49, arka mrudula and red fleshed – seedless – nagpur seedless and sahranpur seedless (only names of varieties) – hybrids – safedjam and kohir safeda (parentage with one or two important characters) – 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
22. Sapota – origin – importance – climate – soils – varieties – cricket ball, kalipatti, kirthibatti, pala, baramsi, guthi, CO-2 and PKM-1 (only names of varieties) – hybrids – CO-1, PKM-2 and PKM-3 (parentage with one or two important characters) – propagation – methods of propagation – commercial method of propagation – different rootstocks 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
23. Apple – origin – importance – climate – soils – varieties – diploids – red delicious, yellow delicious and onathan – triploids – baldwin, beauty, romebeauty, ambri, sunheri, ambstarking, ambroyal, ambrich, chaubattia princess, chaubattia anupam and ambred red (only names of varieties) – propagation – methods of propagation – rootstocks – planting – land preparation – system 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 intercropping – harvesting – maturity indices – yield

24. Litchi – origin – importance – climate – soils – varieties – dehradun, calcutta, saharanpur and muzzafarpur (only names of 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 pruning for sanitation and heavy pruning of old trees – irrigation – manuring – intercultivation and intercropping – harvesting – maturity indices – yield
25. Papaya – origin – importance – climate – soils – varieties – CO-1, CO-2, CO-3, CO-4, CO-5, CO-6, CO-7, washington, coorg honeydew, honeydew, pusa dwarf, pusa delicious, pusa giant, pusa majesty, surya and red lady (only names of 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
26. Pineapple – origin – importance – climate – soils – varieties – kew, giant kew, queen, mauritius, jaldhup, lakhat and simhachalam (only names of varieties) – propagation – propagation material – commercial method of propagation – planting – land preparation – systems of planting – spacing – digging of pits – filling of pit – application of manures – season of planting – irrigation – manuring – intercultivation – induction of flowering – harvesting – maturity indices – yield
27. Annonaceous fruits – origin – importance – different species of annonaceous fruits – sithaphal – climate – soils – varieties – lalsithapal, mammoth, balanagar, british guinea, pinks mammoth, island gem, washington, arka sahan and atemoya (only names of varieties) – propagation – different methods of propagation – raising of seedlings – commercial method of propagation – planting – land preparation – system of planting – spacing – digging of pits – filling 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
28. Pomegranate – origin – importance – climate – soils – varieties – bhagwa, bedhana, jodpur, red dholka, ganesh, alandhi, muskat-red, jalore seedless, jyothi and papershell (only names of varieties) – hybrids – mrudula and ruby (parentage with one or two important characters) – 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

29. Ber – origin – importance – climate – soils – varieties – umran, kaithli, banarasi karaka, gola, seb dandan and meharun (only names of varieties) – propagation – method of propagation – raising of seedlings and rootstocks used – planting – land preparation – system of 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; Fig – origin – importance – climate – soils – types of fig – capri fig, adriatic fig, smyrna fig and white sanpedro fig – examples of varieties for each – cultivated varieties – poona, brown turkey, black ischia (only names of varieties) – propagation – methods of propagation – root stocks used – commercial method of propagation – planting – land preparation – system of planting – digging of pits – filling of pits with manures – season of planting – irrigation – manuring – training – single-stem or multi-stem and training to bush form – pruning – heading back – time of heading back – intercultivation and intercropping – flowering and fruiting – harvesting – maturity indices – yield
30. Phalsa – origin – importance – climate – soils – varieties – tall type and dwarf type – propagation – methods of propagation – commercial method of propagation – planting – land preparation – system of planting – spacing – digging of pits – application of manures to pits – season of planting – manures and fertilizers – irrigation – manuring – flowering and fruiting – pruning – season of pruning – level of pruning – harvesting – maturity indices – yield; Jack – origin – importance – climate – soils – varieties – soft fleshed and firm fleshed types – rudrakshi, singapore or ceylon jack and other varieties (only names of varieties) – propagation – methods of propagation – commercial method of propagation – root stocks used – planting – land preparation – system of planting – spacing – digging of pits – filling of pits – season of planting – irrigation – manuring – flowering and fruiting – harvesting – maturity indices – yield
31. Pear – origin – importance – climate – soils – varieties – baghu gosha, conference, bartlett, seckel, favourite, hardy, nashpati and kieffer (only names of varieties) – propagation – commercial method of propagation – rootstocks – planting – land preparation – system of planting – spacing – digging of pits – filling of pits with manures – season of planting – irrigation – manures and fertilizers – training – method of training adopted – pruning to maintain balance of vegetative growth and bearing wood – season of pruning – methods of pruning – thinning out and heading back –

irrigation – manuring – intercultivation and intercropping – weeding – harvesting – maturity indices – yield; Plum – origin – importance – climate – soils – varieties – commercial cultivars – santa rosa, beauty, grand duke, plum red, kelsey, wickson, bur bank and victoria – self fruitful cultivars – beauty, santarosa and mariposa – self unfruitful – kelsey, eldorado, wickson, larado and farmosa (only names of varieties) – propagation – methods of propagation – rootstocks planting – land preparation – system of planting – spacing – digging of pits – filling of pits with manures – season of planting – irrigation – manuring – training – method of training – pruning – pruning for sanitation and bearing – harvesting – harvesting indices – yield

32. Peach – origin – importance – climate – soils – varieties – table – alexander, elberta, j.h.hale, cardinal, redtop, candor and red globe – canning – certex, halford, fortuna, crwafords early, golden bush, vivian and veteran – low chilling – florda belle, florda gold, florda king and may gold – nectarines – nectared, sun grand, sunlite, sun red, sun rise and sun ripe (only names of varieties) – propagation – different methods of propagation – rootstocks used – commercial method of propagation – planting – land preparation – system of planting – spacing – digging of pits – filling of pits with manures – season of planting – irrigation – manuring – training – system of training adopted – pruning – pruning for bearing – methods of pruning – thinning out and heading back – inter cropping – crop regulation – harvesting – harvesting indices – yield; Cherry – package of practices – origin – importance – climate – soils – varieties – sweet cherries – blackheart, compact lambert, jubilee, sam, summit, sue and sunbruste – sour cherries – mont morency, north star and english morello (only names of varieties) – propagation – commercial method of propagation and root stocks – planting – land preparation – system of planting – spacing – digging of pits – filling of pits with manures – season of planting – pruning – pruning for sanitation and bearing – irrigation – manuring – harvesting – maturity indices – yield

B) Practical Class Outlines

1. Study of college orchards
2. Study of horticultural tools and implements
3. Preparation of potting mixtures, potting, depotting and repotting
4. Practicing of vegetative propagation by corms, bulbs and rhizomes
5. Practicing of vegetative propagation by cuttings and layering
6. Practicing of grafting

7. Practicing of budding
8. Study of layouts and planting systems
9. Preparation of growth regulators – powder, solution and lanolin paste
10. Pruning and training in grape
11. Pruning in ber, fig and phalsa
12. Identification and description of varieties of mango, guava, grape and papaya
13. Identification and description of varieties of sapota, banana, citrus and pomegranate
14. Study of irrigation methods including micro-irrigation in fruit crops
15. Application of fertilizers to fruit crops
16. Visit to fruit research stations

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1. Course No. : HORT 281
2. Course Title : **Production Technology of Vegetables and Flowers**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on production technologies of vegetables and flower crops
5. Specific Objectives
 - a) Theory

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

- i. learn about cultivation practices of vegetables and flower crops with location specific recommendations

b) Practical

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

- i. identify different vegetable and flower crops and learn their cultivation practices

A) Theory Lecture Outlines

1. Olericulture – definition – importance of vegetables in human nutrition and national economy – types of vegetable gardens
2. Classification of vegetables based on botany, plant part used as vegetables, life cycle, seasons of growing and methods of culture
3. Tomato -- origin -- species -- importance -- growth habits of tomato --varieties -- climate and soil
4. Tomato -- nursery raising -- transplanting -- spacing -- manuring -- irrigation -- intercultivation -- harvesting -- different stages of maturity -- physiological disorders -- causes and control -- yield
5. Brinjal – importance -- varieties -- climate and soil -- seeds and sowing -- manuring -- irrigation -- intercultural operations – harvesting -- yield
6. Chilli – importance -- varieties -- climate and soil -- seeds and sowing -- manuring -- irrigation -- intercultivation – harvesting -- yield
7. Okra -- importance -- varieties -- climate and soil -- seeds and sowing -- manuring -- irrigation -- intercultivation – harvesting -- yield
8. Cucurbits – introduction – flowering – sex expression and modification
9. Cucurbits -- cucumber – importance – varieties – climate and soil – seeds and sowing – manuring – irrigation – intercultivation – harvesting – yield
10. Gourds – ridge gourd and bottle gourd. – importance -- varieties -- climate and soil -- seeds and sowing -- manuring -- irrigation – intercultivation – harvesting – yield
11. Gourds – snake gourd, bitter gourd and ash gourd – importance -- varieties -- climate and soil -- seeds and sowing -- manuring -- irrigation – harvesting – yield
12. Melons – water melon and musk melon – importance -- varieties -- climate and soil -- seeds and sowing -- manuring -- irrigation – intercultivation –harvesting – yield

13. Cole crops – cabbage – introduction – importance – varieties – climate and soil – seeds and sowing – nursery raising – planting – manuring – irrigation – intercultivation – harvesting – yield
14. Cole crops – cauliflower and knol-khol – introduction – importance – varieties – climate and soil – seeds and sowing – nursery – manuring – irrigation – intercultivation – harvesting – yield – physiological problems of cauliflower
15. Bulb crops – onion and garlic – introduction – importance – varieties – climate and soil – seeds and sowing – intercultivation – harvesting – curing of onion and garlic – yield – bolting in onion
16. Beans – french bean and cluster bean – introduction – importance – varieties – seeds and sowing – planting – intercultivation – irrigation – manuring – harvesting – yield
17. Beans – peas, cow pea and dolichos beans – introduction – importance – varieties – climate and soil – seeds and sowing – manuring – irrigation – intercultivation – harvesting – yield
18. Tuber crops – colocasia – introduction – importance – varieties – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield
19. Tuber crops – elephant foot yam and dioscorea – introduction – importance – varieties – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield
20. Root tubers – sweet potato and tapioca – introduction – importance varieties – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield
21. Root crops – carrot, radish, turnip and beetroot – introduction – importance – varieties – climate and soil – seeds and sowing – manuring – irrigation – intercultivation – harvesting – yield
22. Leafy vegetables – amaranthus, palak and gogu – introduction – importance – varieties – climate and soil – seeds and sowing – manuring – irrigation – intercultivation – harvesting – yield
23. Perennial vegetables – coccinia – introduction – importance – varieties – climate and soil – propagation – manuring – irrigation – intercultivation harvesting – yield
24. Perennial vegetables – curry leaf and drumstick – importance – climate and soil – planting – manuring – irrigation – intercultivation – harvesting – yield
25. Ornamental gardening – importance – features of ornamental gardening

26. Planning of ornamental gardens – principles involved in layout of gardens
27. Types and styles of ornamental gardens – use of trees, shrubs, climbers, palms, indoor plants and seasonal flowers in the gardens
28. Commercial floriculture – rose – Importance – climate and soil – types of roses – varieties – propagation – planting – pruning – manuring – irrigation – harvesting – yield
29. Jasmine – importance – climate and soil – different species of jasmine – varieties – propagation – planting – pruning – manuring – irrigation – harvesting – yield
30. Chrysanthemum – importance – climate and soil – classification – varieties propagation – planting – pinching – manuring – irrigation – harvesting – yield
31. Crossandra and marigold – importance – climate and soil – varieties – propagation – planting – manuring – irrigation – harvesting – yield
32. Tuberose – importance – climate and soil – classification based on petals – varieties – propagation – planting – manuring – irrigation – harvesting – yield

B) Practical Class Outlines

1. Planning and layout of kitchen garden
2. Identification of important vegetable seeds and plants
3. Raising of vegetable nurseries
4. Sowing of okra for seed production
5. Transplanting of tomato / brinjal seedlings in main field
6. Establishment of lawn
7. Seed extraction in tomato / brinjal
8. Identification of ornamental plants (trees, shrubs, climbers, indoor plants and palms)
9. Visit to commercial vegetable farms
10. Training and pruning of rose -- pinching and disbudding chrysanthemum
11. Planning and layout of gardens and garden designs for public and private areas
12. Intercultural operations in vegetable plots
13. Harvesting indices of different vegetable crops
14. Grading and packing of vegetables

15. Prolonging the shelf life of cut flowers

16. Development of garden features

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1. Course No. : HORT 282
2. Course Title : **Production Technology of Spices, Aromatic, Medicinal and Plantation Crops**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on cultivation practices of spices, aromatic, medicinal and plantation crops
5. Specific Objectives

a) Theory

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

- i. understand the scientific reasons for different cultivation practices with location specific recommendations

b) Practical

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

- i. identify different spices, aromatic, medicinal and plantation crops and acquaint with processing technologies

A) Theory Lecture Outlines

1. Spices – uses – properties and classification – importance of spice industry in India
2. 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
3. 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
4. Black pepper – scientific name – family – plant parts used – origin and distribution – introduction – botany – varieties – climate – soil – selection of site – systems of cultivation – propagation – planting of standards and vine – shade and shade regulation – training and pruning of pepper vine – manuring – irrigation – intercultural operations – harvesting – yield – processing of pepper
5. Cardamom – botanical name – family – plant parts used – origin and distribution – introduction – botany – varieties – climate – soil – preparation of land – propagation – planting of standards and cardamom – shade and shade regulation – manuring – irrigation – intercultural operations – cropping – harvesting – processing and yield
6. Coriander – botanical name – family – plant parts used – origin and distribution – varieties – climate – soil – preparation of land – season – seed and sowing – irrigation – manuring – intercultivation – harvesting and yield
7. Fenugreek and cumin – botanical name – family – origin – economic part – importance – botany – varieties – climate – soil – preparation of land – seed and sowing – irrigation – manuring – intercultivation – harvesting and yield
8. Aromatic crops – importance – essential oils – use of aromatic crops and their by-products – essential oil industry in India; Lemon grass – botanical name – family – origin – economic part – importance – botany – varieties – climate – soil – preparation of land – propagation and planting – manuring – irrigation – intercultivation – harvesting – yield and oil extraction
9. Palmarosa and citronella – introduction – uses – botany – varieties – climate – soil – preparation of land – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield and distillation

10. Geranium and davanam – introduction – uses – botany – varieties – climate – soil – preparation of land – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield and distillation
11. Vettiver – introduction – uses – botany – varieties – climate – soil – preparation of land – propagation – planting – manuring – irrigation – intercultivation – harvesting – yield and distillation
12. Plantation crops – introduction and importance in Indian economy; Areca nut – botanical name – family – origin – importance – botany – varieties – climate – soil – raising of planting material – preparation of land – planting – manuring – irrigation – intercultivation – cover cropping – intercropping – harvesting – yield and processing
13. Cacao – botanical name – family – origin – importance – botany – varieties – forestero, criollo and other types – climate – soil – propagation – preparation of land – planting – irrigation – weeding – mulching – pruning
14. Cacao – intercropping – cover cropping – manuring – harvesting – yield – processing – uses
15. Cashew nut – botanical name – family – origin – introduction – importance – botany – climate – soil – varieties and propagation
16. Cashew nut – preparation of land – planting – irrigation – manuring – intercultivation – intercropping – training and pruning – cropping – harvesting – yield – processing
17. Coffee – botanical name – family – origin – introduction – importance – botany – *arabica* and *robusta* coffee – varieties – climate and soil
18. Coffee – propagation – preparation of land – planting – provision of shade – training and pruning – manuring – irrigation – inter cropping – soil management – mulching – weed control – cropping – harvesting – yield – processing
19. Coconut – botanical name – family – origin – economic part – importance – botany – varieties – tall, dwarf and hybrids
20. Coconut – climate – soil – planting – manuring – irrigation – intercultivation – harvesting and yield
21. Oil palm – botanical name – family – origin – economic part – importance – botany – varieties – climate – soil – propagation and planting – irrigation – intercultivation – harvesting – yield – processing

22. Medicinal plants – scope and importance – cultivation of medicinal plants in India; Dioscorea and rauwolfia – botanical name – family – origin – economic part – importance – botany and varieties
23. Dioscorea and rauwolfia – propagation – climate – soil – preparation of land – planting – irrigation – intercultivation – manuring – harvesting – yield
24. Opium and stevia – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
25. Ocimum and periwinkle – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
26. Aloe and solanum – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
27. Nuxvomica and guggal – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
28. Aonla – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
29. Senna – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
30. Coleus and plantago – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
31. Acorus and belladonna – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield
32. Aswagandha – introduction – botany – varieties – propagation – climate – soil – preparation of land – planting – irrigation – manuring – intercultivation – harvesting – yield

B) Practical Class Outlines

1. Field identification of aromatic plants
2. Botanical description of aromatic plants

3. Identification of varieties in oil palm and coconut with their characteristics
4. Characters to be considered for selection of mother palms and seed nut in coconut and oil palm
5. Propagation techniques in aromatic crops
6. Planting of ginger / turmeric
7. Propagation techniques and rapid multiplication of pepper and cardamom
8. Harvesting procedures, distillation units and distillation procedures for aromatic crops
9. Processing and curing techniques in ginger
10. Processing and curing techniques in turmeric
11. Training techniques and procedure in betelvine
12. Rejuvenation techniques in cashew nut
13. Procedures for extraction of oleoresins from spices / condiment
14. Study of different products and by-products of spices and plantation crops
15. Visit to local commercial medicinal and aromatic plants, field and research institutes
16. Visit to commercial nurseries and plantation fields

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1. Course No. : HORT 382
2. Course Title : **Post Harvest Management and Value Addition of Fruits and Vegetables**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on post harvest management practices and value addition in fruits and vegetables
5. Specific Objectives

a) Theory

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

- i. know about the post harvest losses and its management
- ii. know about different value added products of fruits and vegetables

b) Practical

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

- i. know about different storage methods of fruits and vegetables
- ii. prepare different value added products of fruits and vegetables

A) Theory Lecture Outlines

1. Importance of post harvest technology of horticultural crops – meaning and importance of post harvest technology – causes of post harvest losses
2. 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 – disinfestation – post harvest treatments and waxing
3. Maturity – definition – physiological maturity and horticultural maturity / harvest maturity – determination of harvest maturity – chemical methods and physiological methods – determination of maturity – methods – skin colour, optical methods, shape, size, aroma, leaf changes, abscission, firmness, juice content, oil content, moisture content, sugars, starch content, acidity and specific gravity
4. 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, CO₂, O₂, radiation, air humidity, volatiles, growth regulators – chemicals used for hastening and delaying ripening of fruits and vegetables

5. 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 and diseases, pesticides, maturity and mechanical injury
6. Factors responsible for deterioration of harvested fruits and vegetables – respiration, transpiration, ethylene, mechanical damages, pests and diseases
7. 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 – storage in barrens – storage in cellars – clamp storage
8. 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
9. Importance and scope of preservation of fruits and vegetables in India – status of fruits and vegetable preservation in India
10. Principles and methods of preservation – principles – methods – asepsis – preservation by high temperature, low temperature, drying, filtration, chemicals, salt, sugar, oil, acid fermentation, carbonation, antibiotics and irradiation
11. Layout and establishment of fruit and vegetables preservation unit / commercial canning unit – availability of raw material – site and building – availability of labour – duration of canning season – water supply – transport facilities
12. 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 – syruling or bringing – lidding or clinching – exhausting – sealing – processing – labelling, 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

13. 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 and chemical reaction – Maillard reaction – spoilage due to physical and chemical changes – microbial spoilage
14. 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 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
15. Pickles – method of pickling – preservation with salt, vinegar, oil and spices – problems in pickle making – preserve – candy and crystallized fruits and vegetables – glazed fruits and vegetables – chutneys and sauces / ketchups – flowchart for ketchup – flowchart for sauce
16. Fruit juices, squashes and cordials – preparation – selection of fruit, washing, extraction of juice, deaeration, straining, filtration and clarification and preservation – preservatives and colours permitted and prohibited in India

B) Practical Class Outlines

1. Visit to rythu bazar for vegetable harvesting indices
2. Visit to vegetable market to study harvesting indices
3. Visit to fruit market to study packing, transport and handling of fruits
4. Studies on physiological loss of weight
5. Analysis of total sugars – reducing and non reducing sugars
6. Analysis of acidity and ascorbic acid in different fruits
7. Study of different packing materials for handling of fresh fruits and vegetables
8. Studies on importance of ventilation in storage of fruits and vegetables
9. Pre-cooling and methods of pre-cooling for export and domestic market

10. Different methods adopted to extend the shelf life of fresh produce
11. Studies on use of ethylene to hasten fruit ripening
12. Visit to cold storage units
13. Equipment required in fruit and vegetable preservation
14. Preparation of squash / cordials
15. Preparation of jam / jelly / marmalades
16. Preparation of chutneys, pickles and ketchup

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DEPARTMENT OF AGRICULTURAL EXTENSION

1. Course No. : AEXT 191
2. Course Title : **Dimensions of Agricultural Extension**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the concepts and history of agricultural extension, the extension systems and extension programme development

5. Specific Objectives

a) Theory

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

- i. analyse the meaning, concepts, objectives and principles of extension education and agricultural extension
- ii. differentiate formal, non-formal and informal education
- iii. acquaint with the history of extension education
- iv. acquaint with different developmental programmes
- v. analyse the present extension systems implemented in the country
- vi. analyse the principles and steps of programme planning

b) Practical

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

- i. analyse the ongoing developmental programmes
- ii. acquaint with the village institutions and their functioning
- iii. carry out Participatory Rural Appraisal (PRA) techniques
- iv. acquaint with the present extension approaches

A) Theory Lecture Outlines

1. Education – formal, non-formal and informal education
2. Extension education – meaning – definition – concepts – characteristics and terminology in extension
3. Extension education – objectives – principles – scope and importance

4. Rural development – meaning – definition – concepts – objectives – importance and problems in rural development
5. Extension programme planning – meaning of planning, programme, importance
6. Principles and steps in programme development process
7. Monitoring – meaning and types; Evaluation – meaning, definition, objectives, types and importance
8. Developmental programmes – pre-independence era – Sriniketan, Sevagram, Marthandam and Gurgaon experiment; post-independence era – Firka development, Etawah pilot project and Nilokheri experiment
9. Community development programme – meaning – definition – concepts – philosophy
10. Community development programme – principles – objectives – similarities and differences between community development and extension education – National Extension Services (NES)
11. Panchayat Raj system / democratic decentralization and Panchayat Raj – need, three tiers of Panchayat Raj system – powers, functions and organizational setup; Mandal system in Andhra Pradesh
12. Agricultural developmental programmes – Intensive Agricultural District Programme (IADP), Training and Visit (T and V) system – features – Watershed Development Programme
13. Social justice and poverty alleviation programmes – Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarnajayanti Gram Swarozgar Yojana (SGSY) and Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGP)
14. Women development programmes – Development of Women and Children in Rural Areas (DWCRA), IKP, Integrated Child development Scheme (ICDS), Mahila Samridhi Yojana (MSY) and Andhra Pradesh Training of Women in Agriculture (ANTWA)
15. New approaches in extension – Participatory Rural Appraisal (PRA), National Agricultural Technology Project (NATP), Agricultural Technology Management Agency (ATMA), Strategic Research Extension Plan (SREP) and Agriculture Technology Information Center (ATIC)
16. Privatization of extension, market led extension, Rythu Chaitanya Yatra (RCY), Providing Urban Amenities in Rural Areas (PURA)

B) Practical Class Outlines

1. Visit to a village to study ongoing developmental programmes – I
2. Visit to a village to study ongoing developmental programmes – II
3. Visit to Panchayat Raj institutions to study the functioning of Gram Panchayat (GP)
4. Visit to Panchayat Raj institutions to study the functioning of Mandal Praja Parishad (MPP)
5. Visit to Panchayat Raj institutions to study the functioning of Zilla Praja Parishad (ZPP)
6. Visit to study the District Rural Development Agency (DRDA)
7. Visit to watershed development project area
8. Visit to a village to study the self help groups of Development of Women and Children in Rural Areas (DWCRA)
9. Visit to Non-Governmental Organization (NGO) / Voluntary Organization (VO) to study the developmental activities
10. Participatory Rural Appraisal (PRA) techniques in a village to identify agricultural problems – I
11. Participatory Rural Appraisal (PRA) techniques in a village to identify agricultural problems – II
12. Visit to a village to study the women developmental programmes – I
13. Visit to a village to study the women developmental programmes – II
14. Visit to Agricultural Technology Management Agency (ATMA) district to study the extension reforms
15. Presentation of students work – I
16. Presentation of students work – II

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1. Course No. : AEXT 291
2. Course Title : **Fundamentals of Rural Sociology and Educational Psychology**
3. Credit Hours : 2 (1+1)
4. General Objectives : To impart knowledge on sociological and psychological aspects of rural people and to acquaint with some important features of rural society

5. Specific Objectives

a) Theory

By the end of course, students will be able to

- i. understand concept of rural sociology, its importance in agricultural extension, characteristics of Indian rural society
- ii. understand social groups, social stratification, culture, social values, social control and attitudes, leadership and training
- iii. understand concept of educational psychology, intelligence, personality, perceptions, emotions, frustration, motivation, teaching and learning

b) Practical

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

- i. acquaint with characteristics of rural society, village institutions and social organizations
- ii. select lay leaders and train them
- iii. assess personality types, leadership types and emotions of human beings
- iv. create a training situation under village conditions

A) Theory Lecture Outlines

1. Sociology and rural sociology, extension education, agricultural extension – meaning and definitions
2. Importance of rural sociology in agricultural extension and their interrelationship
3. Characteristics of Indian rural society – differences and relationships between rural and urban societies
4. Social group(s) – classification – formation and organization of groups – role of social groups in agricultural extension

5. Social stratification – meaning – forms – class system and caste system
6. Culture and different cultural concepts and their role in agricultural extension
7. Social values, social control and attitudes – types and their role in agricultural extension
8. Leadership – meaning – classification of leaders – roles of a leader and different methods in selection of a leader
9. Training of leaders – lay and professional leaders – advantages and limitations in using local leaders in agricultural extension
10. Psychology and educational psychology – meaning – scope and importance
11. Intelligence – meaning – types – factors and importance in agricultural extension
12. Personality – meaning – types – factors and importance in agricultural extension
13. Perception, emotions and frustration – meaning – types – factors and importance in agricultural extension
14. Motivation – meaning – types of motives – theories of motivation – importance of motivation in agricultural extension
15. Teaching, learning, learning experience and learning situation – meaning and definition – elements of learning situation and its characteristics
16. Principles of learning and their implications in teaching – steps in extension teaching

B) Practical Class Outlines

1. Visit to a village to study the characteristics of rural society
2. Visit to village institutions – school or cooperative society or gram panchayat
3. Visit to social organizations – youth club or milk cooperative centre or Water Users Association
4. Visit to a village to conduct the selection of lay leaders based on sociogram technique
5. Visit to a village to identify different social groups to which the farmers are associated
6. Visit to a village to list out the taboos, folkways, rituals and social values in the village
7. Administering psychological tests by students to assess level of intelligence of human beings
8. Administering psychological tests by students to assess the personality types of human beings
9. Conducting role play technique by the students to exhibit different leadership styles

10. Simulated exercises to exercise positive and negative emotions of farmers in village
11. Simulated exercises to reveal the positive and negative emotions of the students in real life situation
12. Simulated exercises on identification of positive and negative emotions and emotionally balanced behaviour
13. Nature of learners behaviour in motivation
14. Creating a learning situation under village conditions for a specific teaching activity
15. Training need assessment of farmers of a village
16. Visit to a village for conducting a training programme

References

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- Chitamber, J.B. 1997. *Introductory Rural Sociology*. Wiley Eastern Limited, New Delhi.
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- Vidyabhushan and Sach Dev, D.R. 1998. *An Introduction to Sociology*. Kitab Mahal Agencies, Allahabad.

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|----------------------|--|
| 1.Course No. | : AEXT 292 |
| 2.Course Title | : Extension Methodologies for Transfer of Agricultural Technology |
| 3.Credit Hours | : 2 (1+1) |
| 4.General Objectives | : To impart knowledge on various extension methodologies, information tools, agricultural journalism and adoption and diffusion of innovations useful for transfer of agricultural technology and to develop skills in preparing visual aids, conducting some selected extension teaching methods, preparing information materials, scripts for radio and television and handle video camera |

5. Specific Objectives

a) Theory

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

- i. describe the meaning of communication, explain models of communication process along with elements and their characteristics
- ii. classify the methods and explain the meaning, objectives, procedure involved in carrying out various individual, group and mass contact methods and describe the factors influencing selection of extension methods
- iii. discuss about the various information tools and sources like internet, cyber cafes, kiosks, video and teleconferencing, Parishkaram (Farmers Call Centre) in A.P. and kisan call centres and agriclincs including agricultural journalism
- iv. discuss about the adoption and diffusion process and explain the models of adoption process and innovation-decision process, classify adopter categories and enlist the characteristics and explain the factors affecting adoption process
- v. describe the importance of capacity building of extension personnel and farmers and explain the meaning of training and discuss different types of training to farmers and enumerate the objectives of Farmers' Training Centre (FTC), mandate of Krishi Vigyan Kendra (KVK) and objectives of District Agricultural Advisory and Transfer of Technology Centres (DAATTC)

b) Practical

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

- i. experience the distortions in communication and conduct group discussion, method demonstration / skill teaching
- ii. gain first hand information about the FTC / KVK / DAATTC
- iii. prepare the script for Radio and TV programmes, agricultural information materials like leaflet, folder, news story and success story
- iv. explain the meaning of audio-visual aids, importance, classification and principles of planning, selection, preparation, presentation and evaluation of visual aids
- v. prepare charts, posters, OHP transparencies and Power Point slides and operate video camera

A) Theory Lecture Outlines

1. Communication – definition, models of communication process – Aristotle, Shannon-Weaver, Berlo, Schramm, J.P. Leagans, Rogers and Shoemaker, Litterer, Westley-Macleans and extension communication system; functions of communication
2. Elements of communication and their characteristics – communicator, message, channel, treatment, audience, audience response and feedback
3. Types of communication – oral, written and non-verbal; non-verbal communication – types and functions – barriers / problems in communication – some concepts relating to communication – frame of reference, perception, communication fidelity, communication gap, time lag in communication, empathy, heterophilly and homophilly
4. Extension teaching method – definition – functions and classification according to use and form – strong and weak points of individual – group and mass contact methods – individual contact methods: farm and home visit – meaning – purpose – procedure – advantages and limitations
5. Individual contact methods – field trial – meaning – objectives – procedure – advantages and limitations – result demonstration – meaning – principles – purpose – procedure – advantages and limitations
6. Group contact methods – method demonstration – meaning – objectives – procedure – advantages and limitations – basis for demonstration – differences between method demonstration and result demonstration; group discussion – meaning – purposes – procedure – roles of chairman, members and expert – advantages and limitations
7. Group contact methods – field trips and field days – meaning – objectives – procedure – advantages and limitations – Farm Field School (FFS) – meaning – concept – objectives and steps in organizing FFS
8. Small group discussion techniques – lecture / extension talk – meaning – characteristics – advantages and limitations – difference between extension talk and lecture – symposium – panel – debate – forum – buzz group – workshop – brain storming – seminar – conference – meaning
9. Mass contact methods – campaign – meaning – objectives – procedure – advantages and limitations – exhibition – meaning – objectives – procedure – advantages and limitations – kisan mela – meaning – objectives – dimensions of activities – procedure and limitations
10. Radio – meaning – purposes – advantages and limitations; rural and farm broadcasting – farm and home units – objectives; radio rural forums – farm school on All India

Radio (AIR) – Meaning and procedure and agricultural programmes; Television – meaning – objectives – agricultural programmes – advantages and limitations

11. Information sources – internet – meaning – purposes – benefits and limitations – cyber cafes / kiosks – meaning – video and teleconferences – meaning – components – advantages – cyber extension – meaning – features – five successful models – advantages – factors influencing selection and combination of extension teaching methods
12. Call centres – Parishkaram (Farmers Call Centre) in Andhra Pradesh and Kisan Call Centers – meaning – objectives – operational mechanism (Three levels) – agri-clinics – meaning – objectives – eligibility – training – loan assistance and advantages – agricultural journalism – meaning – scope – importance – characteristics of news – factors determining the news value – types of news and sources of news
13. Diffusion and adoption of innovations – adoption – diffusion – adoption process and innovation – meaning – models of adoption process – five and seven stage models – attributes of innovation – relative advantage, compatibility, complexity, trialability, observability and predictability
14. Innovation – decision process – meaning and stages (knowledge, persuasion, decision, implementation and confirmation); concepts dissonance and rejection – active rejection and passive rejection – discontinuance – replacement and disenchantment discontinuance, over adoption, rate of adoption and innovativeness – adopter categories and their characteristics
15. Factors influencing adoption process – social, personal and situational; capacity building of extension personnel and farmers – training – meaning – types of training – pre-service training, in service, orientation, induction training, refresher training and training for professional qualification – training to farmers – time, duration and venue
16. Farmers' Training Centre (FTC) – objectives and trainings organized; Krishi Vigyan Kendra (KVK) – mandate; District Agricultural Advisory and Transfer of Technology Centre (DAATTC) – objectives

B) Practical Class Outlines

1. Simulated exercises on communication
2. Simulated exercises on distortion communication
3. Organizing a group discussion

4. Conducting method demonstrations / skill teaching
5. Visit to Krishi Vigyan Kendra (KVK) / Farmers' Training Centre (FTC)
6. Visit to District Agro Advisory and Transfer of Technology Centre (DAATTC)
7. Planning and writing a script for radio
8. Planning and writing a script for television
9. Audio-Visual aids – importance and classification, planning, presentation and evaluation of visual aids
10. Planning and preparation of charts and posters
11. Planning and preparation of OHP transparencies
12. Planning and preparation of power point slides
13. Planning and preparation of information materials – leaflet, folder and pamphlet
14. Planning and preparation of news stories and success stories
15. Handling of video camera – I
16. Handling of video camera – II

References

- Dahama, O.P. and Bhatnagar, O.P. 1980. *Education and Communication for Development*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
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- Somasundaram, T. 1977. *Producing Agricultural Information Materials*. Kansas State University, USA and APAU, Hyderabad.
- Yella Reddy, N. 1998. *Audio-Visual Aids for Teaching, Training and Extension*. Haritha Publishing House, Hyderabad.

1. Course No. : AEXT 391
2. Course Title : **Entrepreneurship Development and Communication Skills**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on entrepreneurship and its importance in socio-economic development of the nation.
5. Specific Objectives

a) Theory

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

- i. describe the concepts of entrepreneurship, agripreneurship, characteristics of entrepreneur, motivation and entrepreneurship and project management
- ii. gain knowledge and skills in project formulation, project report preparation and evaluation of projects
- iii. explain entrepreneurship development programme, government policies, schemes and incentives for promotion of entrepreneurship and social responsibility of business
- iv. explain the concept and process of supply chain management and understand the importance of women entrepreneurship and problems of women entrepreneurs

b) Practical

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

- i. study successful enterprises and develop project proposal through field visits
- ii. analyze the selected enterprises in terms of their management process and functions through study visits
- iii. develop the skills of an effective manager through simulated exercises
- iv. prepare and present the project reports

A) Theory Lecture Outlines

1. Concept of entrepreneur, entrepreneurship, functions of entrepreneur
2. Entrepreneurial characteristics – distinction between an entrepreneur and a manager – Agri-entrepreneurship- – concept, need and scope
3. Assessing overall business environment in Indian economy – globalization – implications of social, political and economic systems on entrepreneurship

4. Entrepreneurship Development Programmes (EDPs) – objectives, phases, problems of EDPs, criteria for assessment or evaluation of EDPs
5. Generation, incubation and commercialization of business ideas
6. Role of entrepreneurship in economic development, motivation and entrepreneurship development, managing an enterprise
7. Importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise
8. Researching / managing competition – ways to define possible competitors, competitive information, SWOT analysis-concept, meaning and advantages
9. Venture capital – concept, aims, features, financing steps sources, criteria to provide venture capital finance, Export and Import policies relevant to agriculture sector
10. Forms of business – contract farming, joint ventures and public private partnerships
11. An overview of agricultural input industry in India; fertilizer, pesticide, seed and farm machinery industry
12. Over view of Indian agricultural processing industry
13. Social responsibility and business ethics
14. Project – meaning – importance – components and preparation
15. Government schemes and incentives for promotion of entrepreneurship and government policy on small and medium enterprises
16. Supply chain management – meaning, advantages, stages, process, drivers and scope of agri-supply chain management, Women entrepreneurship-concept, problems and development of women entrepreneurs

B) Practical Class Outlines

1. Field visit to successful enterprise – study of characteristics of successful entrepreneurs – case study
2. Field visit to successful agri-enterprise – study of characteristics of successful agripreneurs – case study
3. Communication skills – listening and note taking – simulated exercises
4. Communication skills – writing skills – simulated exercises
5. Communication skills – presentation – oral impromptu and public speaking – simulated exercises

6. Communication skills – reading and comprehension – simulated exercises
7. Visit to a public private enterprise
8. Visit to agriclinics and agribusiness centers
9. SWOT analysis of selected enterprise
10. Development of project proposals – idea generation
11. Development of project proposals – SWOT analysis
12. Development of project proposals – formulation of project plan – I
13. Development of project proposals – formulation of project plan – II
14. Presentation of project reports by the students – I
15. Presentation of project reports by the students – II
16. Presentation of project reports by the students – III

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- Gupta, C.B. 2001. *Management : Theory and Practice*. Sultan Chand and Sons, New Delhi.
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DEPARTMENT OF BIOCHEMISTRY

1. Course No. : BICM 101
2. Course Title : **Biochemistry**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the fundamentals of biochemistry
5. Specific Objectives

a) Theory

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

- i. understand the concepts of biochemistry
- ii. know the structural organization of plant cell
- iii. understand the biochemical reactions occurring in plant cell
- iv. study the industrial applications of biomolecules

b) Practical

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

- i. have clear concepts of the structures of biomolecules
- ii. differentiate between qualitative identification and quantitative estimations
- iii. understand the separation of biomolecules using various biochemical techniques

A) Theory Lecture Outlines

1. Introduction – importance of biochemistry – scope of biochemistry – historical aspects of biochemistry and impact of biochemistry
2. Plant cell – various organelles in plant cell and their functions; Biomolecules – structure, properties and applications
3. Different components of plant cell wall – primary and secondary cell wall – composition and functions – role of plant cell wall in livestock, food and paper industry
4. 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 – reactions of amino acids like Ninhydrin reaction and peptide bond formation

5. Peptides and their functions – oligopeptides – cyclic and acyclic peptides – malformin, glutathione and gramicidin – hormones – insulin
6. Structure of proteins – primary, secondary, tertiary and quaternary structures and forces involved in stabilizing proteins
7. Properties of proteins – Ultraviolet (UV) absorption – isoelectric point – zwitterions – immunological properties – denaturation – molecular chaperons – solubility – factors influencing solubility
8. Sequencing of amino acids by Edman degradation method – purification techniques – salting in and salting out, gel filtration, ion exchange chromatography
9. Classification of proteins based on function – plant protein quality evaluation methods like Protein Efficiency Ratio (PER), Digestibility Coefficient (DC) and Biological Value (BV)
10. Enzymes – characteristics of enzymes – chemical nature, speed, specificity, active site and mode of action – activation energy and change in free energy of enzyme catalyzed reaction
11. Measurement of enzyme activity – factors affecting enzyme activity – enzyme inhibition – isoenzymes – multienzyme complexes – allosteric enzymes and coenzymes
12. Classification of enzymes – immobilization and industrial applications of enzymes
13. Lipids – classification – functions and properties like saponification, hydrogenation, iodine number and acid value
14. Acyl lipids and their industrial applications in soaps, detergents, paints, rubber, bio diesel etc.
15. Carbohydrates – functions – structure and classification
16. Role of mono, oligo and polysaccharides in industry
17. Nucleic acids – functions – structure of nitrogen bases – nucleosides and nucleotides – Adenosine triphosphate (ATP), Guanosine triphosphate (GTP), Cytidine triphosphate (CTP), Thymidine triphosphate (TTP) and Uridine triphosphate (UTP) – secondary structure of DNA
18. Various types of DNAs and RNAs – packing of DNA into chromosomes
19. Metabolism – anabolism – catabolism – stages of respiration – over all metabolic view of carbohydrates, proteins and lipids

20. Protein metabolism – central dogma – genetic code – ribosomes – ribozymes – tRNA – translation and its inhibitors
21. Post translational modification – enzymatic hydrolysis of protein – general reactions of amino acid metabolism – decarboxylation, transamination and deamination
22. Assimilation of ammonia – entry of carbon skeleton into various metabolic pathways
23. Metabolism of lipids – anabolism of saturated fatty acids, unsaturated fatty acids and triacyl glycerols
24. Catabolism of lipids – triacyl glycerols – a and b oxidation of fatty acids in brief and b oxidation in detail – glyoxylic acid cycle
25. Metabolism of carbohydrates – anabolism – photosynthesis in brief; catabolism – hydrolysis of starch
26. Glycolysis and Tricarboxylic Acid (TCA) cycle
27. Oxidative pentose phosphate pathway – metabolic energy generation in the above cycles
28. Oxidative phosphorylation and substrate level phosphorylation – electron transport chain in mitochondria
29. Electron transport chain in chloroplast – metabolic regulation – lac operon
30. Secondary metabolites – terpenoids – chemical nature – classification and application in plants, food and pharmacological industry
31. Secondary metabolites – alkaloids – chemical nature – classification and application in plants, food and pharmacological industry
32. Secondary metabolites – phenolics (lignins, tannins and flavonoids) – chemical nature – classification and application in plants, food and pharmacological industry

B) Practical Class Outlines

1. Atomic models of amino acids
2. Reactions of amino acids
3. Protein denaturation – heat, pH – precipitation of proteins heavy metals, organic solvents and acidic agents – immune reaction
4. Paper electrophoresis for separation of plant pigments
5. Paper model of protein – protein estimation by Lowry method

6. Enzyme kinetics (graphical representation) – competitive inhibition
7. Enzyme immobilization – enzyme induction
8. Extraction of DNA from onion – test for DNA
9. Column chromatography of RNA hydrolysate
10. Fatty acid model – characterization of lipids by Thin Layer Chromatography (TLC)
11. Extraction of oil from oil seeds
12. Estimation of fatty acids by Gas Chromatography (GC)
13. Atomic models of sugars – paper model of starch
14. Quantitative determination of sugars after removal of interfering substances
15. Separation of sugars and amino acids by paper chromatography
16. Determination of phenols

References

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DEPARTMENT OF AGRICULTURAL MICROBIOLOGY

1. Course No. : AMBE 201
2. Course Title : **Agricultural Microbiology**
3. Credit Hours : 3 (2+1)
4. General Objective : To impart knowledge on the principles of Microbiology and role of microorganisms in improving agricultural production
5. Specific Objectives

a) Theory

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

- i. understand the requirements for the growth of bacteria
- ii. appreciate the importance of microorganisms in agriculture
- iii. know the role of microorganisms in different environments such as in soil, water and food

b) Practical

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

- i. grow bacteria in the laboratory on artificial media following suitable methods such as aseptic technique, sterilization etc
- ii. identify morphology of different bacterial cultures
- iii. isolate bacteria from different environments
- iv. maintain pure cultures in the laboratory
- v. quantify microbial population in cultures

A) Theory Lecture Outlines

- 1 Introduction to microbiology – microorganisms – different microbial groups – bacteria, fungi, protozoa and algae – importance of different microbial groups
2. History of microbiology – spontaneous generation theory and contributions of Antony von Leeuwenhoek, Francesco Redi, Lazzero Spallanzani, Franz Shultz, Schroder and von Dush, Louis Pasteur and John Tyndal; Role of microbes in fermentation and contributions of Cagnaird Latour, Theodor Schwann, F.Kutzing, Louis Pasteur etc.,

3. Germ theory of disease – contribution of Hippocrates, Louis Pasteur and Robert Koch; Pure culture methods by Joseph Lister, Robert Koch, Beijerinck, Winogradsky, Schroder and Von Dush, John Tyndall etc.,
4. Protection against infection – contributions of Edward Jenner, F. Loeffler, Behring, Kitasato and Louis Pasteur; Applied areas of microbiology – agricultural microbiology, industrial microbiology, medical microbiology, exo microbiology, geo microbiology, pollution microbiology, aero microbiology, aquatic microbiology, food microbiology and microbial biotechnology
5. Bacterial cell structure – morphological types of bacteria – functions of different parts of bacterial cells – cell wall composition – differences between prokaryotes and eukaryotes
6. Growth of microorganisms – cell division – growth cycle of bacteria (lag phase, log phase, stationary and death phase) – generation time – growth rate – growth yield
7. Heterotrophy – respiration heterotrophy – definition of chemo-heterotrophy and photo-heterotrophs, aerobic respiration, anaerobic respiration, Embden Meyerhof Parnas (EMP), Entner Duodoroff Pathway (EDP), oxidative and substrate level phosphorylation
8. Fermentation – components of fermentation – list of different types of fermentations with examples of microorganisms
9. Nutritional groups of bacteria – chemo autotrophy – definition – different chemoautotrophs with suitable examples of nitrifying bacteria – sulfur oxidizing bacteria – importance of chemoautotrophs
10. Photo autotrophy – definition – different photo-autotrophs with suitable examples – non-cyclic photo-phosphorylation – cyclic photo-phosphorylation in bacteria
11. Bacteriophages – structure and properties of viruses and phages (bacterial viruses) – structure of T₂ phage – general properties of bacterial viruses – different morphological types of phages
12. Lytic and lysogenic cycle – virulent phages and temperate with examples – different steps in lytic cycle of bacteriophages and lysogenic cycle with examples – viroids and prions
13. Bacterial genetics – definition of variation, adaptation, mutation, phenotype, genotype, genome, plasmid and episomes – contributions of Luria and Delbruck, Joshua Lederberg and Esther Lederberg

14. Fluctuation test and replica plating – Fluctuation test of Luria and Delbruck for spontaneous mutations in bacteria – replica plating method for selection of bacterial mutants
15. Types of mutations – spontaneous and induced mutations (substitution addition and deletion – mutations leading to nonsense, missense, neutral and frameshift mutations)
16. Genetic recombination – contributions of Avery, MacLeod and McCarty, Griffith, Tatum and Lederberg, Zinder and Lederberg, Beedle and Tatum, Benzer – genetic recombination by transformation in *Pneumococcus* – genetic recombination by conjugation, sex factor, plasmid, episome, F⁺ x F⁻ cross, Hfr x F⁻ crosses in *E. coli*
17. Transduction – products from genetically modified strains of *E. coli* – genetic recombination by transduction in *Salmonella* – generalized transduction and specialized transduction – products such as interferon, human growth hormone, human Insulin etc. from genetically modified strains of *E. coli*
18. Replication – transcription – translation – genetic code – regulation of gene expression – operon concept
19. Lac operon in *E. coli* – induction and repression, negative and positive regulation of Lac operon
20. Soil microbiology – important groups of microbes and their role in fertility of soils and plant growth – rhizosphere, rhizoplane and phyllosphere microflora
21. Carbon cycle – microbes involved in CO₂ reduction under aerobic and anaerobic condition – degradation of organic carbon by bacteria
22. Nitrogen cycle – mineralisation – immobilisation – nitrification – denitrification – nitrogen fixation
23. Phosphorus cycle – solubilisation – oxidation – reduction; Sulphur cycle – oxidation – reduction
24. Water microbiology – water born diseases – water standards – microbiological examination of water (presumptive, confirmed and completed test)
25. Microbiology of foods – intrinsic factors such as pH, water activity, redox potential, anti-microbial compounds, biological structures – extrinsic factors such as storage temperature, humidity etc.
26. Microbial spoilage of fruits, nuts and vegetables – list of different micro organisms involved in spoilage of fruits, vegetables and nuts – influence of pH and water content on spoilage of fruits and vegetables

27. Food preservation – aseptic handling – reducing microbial load – inhibition or killing of the spoilage bacteria – high temperatures (pasteurization of milk, blanching of leafy vegetables etc.), low temperatures, dehydration, osmotic pressure, irradiation, addition of preservatives, pickling and fermented foods with usage of natural flora like lactic bacteria, yeast etc.
28. Industrial microbiology – types of fermentations – batch, fed- batch continuous and solid state fermentations
29. Beneficial microorganisms in agriculture – biofertilizers (bacterial, cyanobacterial and fungal) – list of bacteria, cyanobacteria, fungi used as bioinoculants / biofertilizers – steps in *Rhizobium* inoculant production – advantages and disadvantages of biofertilisers – different methods of application
30. Microbial insecticides – microbial agents for control of plant diseases – microbial insecticides – list of different bacteria and molds used in commercial preparations – method of application – advantages and disadvantages
31. Microbial biocontrol agents – different bacteria, molds and viruses used in commercial preparations – method of application – advantages and disadvantages
32. Biodegradation – definition – composition of biogas – microbiology of biogas production and biogas manures

B) Practical Class Outlines

1. General Instructions
2. Familiarization with instruments, materials, glassware etc.
3. Evaluation of aseptic technique with nutrient broth tubes
4. Evaluation of aseptic technique with nutrient agar plates
5. Preparation of nutrient broth, nutrient agar plates, nutrient agar slants
6. Sterilization of glassware by dry heating
7. Sterilization of nutrient broth by autoclaving
8. Isolation of bacteria by streak plate method
9. Isolation of aerobic spore forming bacteria by enrichment using streak plate method
10. Checking of purity of a bacterial culture by streak plate method
11. Morphological examination of bacteria by simple and differential staining

12. Different biochemical tests for identification of bacterial cultures
13. Enumeration of bacteria by stained slide method
14. Enumeration of bacteria by most probable number method
15. Enumeration of bacteria by pour plate method
16. Enumeration of bacteria by spread plate method

References

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- Jamaluddin, Malaviya, N. and Sharma, A. 2006. *General Microbiology*. Scientific Publishers, Washington.
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- Sullia, S.B. and Shantaram, S. 1998. *General Microbiology*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

DEPARTMENT OF ENVIRONMENTAL SCIENCE AND TECHNOLOGY

1. Course No. : EVST 301
2. Course Title : **Environmental Science**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on different environmental concerns and to create a pro-environmental attitude
5. Specific Objectives

a) Theory

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

- i. get knowledge on the importance of environmental studies
- ii. understand about the natural resources and their importance
- iii. acquaint with different types of pollution and their control measures and also on social issues and the environment

b) Practical

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

- i. gain analytical skills in assessing the quality of water, air and soil
- ii. know about the physiological changes in plants with environment

A) Theory Lecture Outlines

1. Definition – scope and importance of environmental studies – need for public awareness, people and institutions in environment
2. Natural resources – renewable and non renewable resources – forest resources – functions of forests – causes and consequences of deforestation
3. Water resources – sources, uses and over utilization of surface and groundwater; Dams – benefits and problems – sustainable management of water
4. Food resources – food sources, world food problems and food security
5. Energy resources – renewable and non-renewable energy sources and their impact on environment

6. Land resources – land degradation, desertification and land use planning – role of an individual in conservation of natural resources
7. Biodiversity – definition – types of biodiversity – bio-geographical classification in India – methods of measuring biodiversity – Biodiversity Act – functions of National Biodiversity Board
8. Threats to biodiversity – habitat loss – poaching of wild life – man-wild life conflicts – conservation of biodiversity – *in situ* and *ex situ*
9. Environmental pollution – causes, effects and control measures of air and water pollution – tolerable limits for toxic gases in air
10. Causes, effects and control measures of soil pollution – bioremediation – tolerable limits for heavy metals in soil
11. Causes, effects and control measures of thermal, marine and noise pollution
12. Causes, effects and management of nuclear hazards, hazardous wastes, agricultural wastes and industrial wastes
13. Disaster management – floods, earthquake, cyclones, tsunami and land slides
14. Social issues and the environment – unsustainable to sustainable development – The Environment Protection Act – The Air (prevention and control of pollution) Act
15. The Water (prevention and control of pollution) Act – The Wildlife Protection Act and Forest Conservation Act
16. Woman and child welfare – Human Immuno-deficiency Virus (HIV) / Acquired Immuno-deficiency Syndrome (AIDS) – role of information technology on environment and human health

B) Practical Class Outlines

1. Collection, processing and storage of effluent samples
2. Determination of chemical oxygen demand in waste water sample
3. Estimation of dissolved oxygen in waste water sample
4. Determination of total dissolved solids in waste water sample
5. Analysis of temporary hardness of waste water sample by titration
6. Analysis of total hardness of waste water sample by titration
7. Preparation of sludge / waste water sample for analysis of heavy metals

8. Estimation of heavy metals in sludge / waste water by Atomic Absorption Spectrophotometer (AAS)
9. Determination of sound level by using sound level meter
10. Estimation of species abundance of plants
11. Estimation of respirable and non-respirable dust in air by using dust sampler
12. Study of transpiration and water balance in plants
13. Assessment of chlorophyll content in plants
14. Visit to *in-situ* or *ex-situ* conservation center / Social Service Organization / Environmental Education Centre
15. Information and Communication Technology (ICT) in Environmental Science
16. Visit to a local polluted site – observations and remedial measures

References

- Bharucha, E. 2005. *Textbook of Environmental Studies for Under Graduate Courses*. University Grants Commission, University Press. Hyderabad.
- Gupta, P.K. 2004. *Methods in Environmental Analysis – Water, Soil and Air*. Agrobios (India), Jodhpur.
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- Manoharachari, C. and Jaya Ram Reddy 2004. *Principles of Environmental Studies*. B S Publication, Hyderabad.
- Sharma, J.P. 2003. *Introduction to Environmental Science*. Lakshmi Publications, Guntur.

DEPARTMENT OF STATISTICS AND COMPUTER APPLICATIONS

1. Course No. : STCA 101
2. Course Title : **Statistics**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on basic concepts and statistical techniques applied in agriculture
5. Specific Objectives

a) Theory

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

- i. acquaint with applications of concepts and statistical techniques in agriculture

b) Practical

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

- i. acquaint with the practical applications of statistical techniques in agriculture
- ii. make self sufficient and to draw valid conclusion of statistical techniques

A) Theory Lecture Outlines

1. Introduction to statistics – definition – advantages and limitations – data –types of data – quantitative and qualitative – variable – discrete and continuous
2. Need for frequency distribution table – construction of frequency distribution table (inclusive and exclusive) – number of classes, length of class, tally marks, frequency, class mid point, cumulative frequencies
3. Measures of central tendency – definition – different measures – characteristics of a satisfactory average
4. Definition and calculation of Arithmetic Mean, Median and Mode for grouped and ungrouped data – merits and demerits of Arithmetic Mean, Median and Mode
5. Measures of dispersion – definition – different measures (relative and absolute) standard deviation (SD), variance and coefficient of variation
6. Normal distribution – density function, curve and its properties including area under the curve – 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

7. Tests of significance – introduction to statistical test of significance – null hypotheses – types of errors – level of significance and degrees of freedom – steps involved in testing of hypothesis
8. Large sample tests – introduction to standard normal distribution – test for population means – Z-test for 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)
9. 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)
10. Chi-square distribution, $r \times c$ contingency table, chi-square test in 2×2 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)
11. 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)
12. Regression – definition – fitting of two lines Y on X and X on Y – properties – inter relation between correlation and regression
13. Experimental designs – need – basic principles of experimental designs – analysis of variance – assumptions in ANOVA
14. Completely Randomized Design (CRD) – layout – analysis with equal and unequal replications – advantages and disadvantages
15. Randomized Block Design (RBD) – layout – analysis – advantages and disadvantages
16. Latin Square Design (LSD) – layout – analysis – advantages and disadvantages

B) Practical Class Outlines

1. Construction of frequency distribution tables
2. Computation of arithmetic mean for grouped and un-grouped data
3. Computation of median and mode for grouped and un-grouped data
4. Computation of standard deviation and variance for grouped and un-grouped data
5. Computation of coefficient of variation for grouped and un-grouped data
6. Z-test for one sample and two samples, population SD known and unknown
7. Student's t-test for single and two samples
8. Paired t-test and F-test
9. Chi-square test – 2 x 2 contingency table with Yates' correction
10. Computation of correlation coefficient and its testing
11. Fitting of simple regression equations Y on X and X on Y
12. Lay out of Randomised Block Design
13. Collection of data (plant height / number of tillers) from experimental field
14. Analysis of data in a Completely Randomized Design (CRD) – analysis with equal and unequal replications
15. Analysis of data in a Randomized Block Design (RBD)
16. Analysis of data in a Latin Square Design (LSD)

References

- Nageswara Rao, G. 2007. *Statistics for Agricultural Science*. BS Publications, Hyderabad.
- Rangaswamy, R. 1995. *A Text Book of Agricultural Statistics*. New Age International (P) Limited, Hyderabad.

1. Course No. : STCA 301
2. Course Title : **Introduction to Computer Applications**
3. Credit Hours : 2 (1+1)
4. General Objective : To impart knowledge on the basic concepts of computer and its applications

5. Specific Objectives

a) Theory

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

- i. to expose and acquaint the student with the concepts of computer applications, software and the professional way of using the MS Office packages

b) Practical

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

- i. to train and practice with the computer softwares DOS, WINDOWS and the MS Office packages of Word, Excel, and Access in a professional way

A) Theory Lecture Outlines

1. Introduction to computers – definition – advantages and limitations
2. Anatomy of computers – components of computers and its functions –overview of input devices of computer
3. Overview of output devices of computer, memory, processors, hardware, software and speed
4. Types of software – operating system, translators and programming languages
5. Types of software – application programmes, utility programmes and general purpose programmes, classification of computers
6. Operating System (OS) – functions of OS – types of OS – DOS and WINDOWS OSs – booting process
7. Some fundamental DOS commands – FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD and DELTREE
8. WINDOWS – GUI, desktop and its elements, anatomy of a window – title bar, minimize, maximize, restore and close buttons, scroll bars, menus and tool – starting and shutting down of windows
9. WINDOWS explorer – working with organization of files and folders, copy, move and print files – setting time and date
10. MSWORD – word-processing and units of document, features of word-processing packages

11. MSWORD – creating, editing, formatting and saving a document in msword – features of file, edit and format menus
12. MSEXCEL – electronic spreadsheets – concept, packages, creating, editing and saving a spreadsheet with MSEXCEL
13. MSEXCEL – use of in-built statistical and other functions and writing expressions, creating data analysis option in tools menu, use of data analysis tools – correlation and regression, t-test for two-samples, creating graphs
14. MSACCESS – concept of database – units of database
15. MSACCESS – creating database
16. Internet – World Wide Web (WWW) – concepts

B) Practical Class Outlines

1. Study of computer components – booting of computer and its shut down
2. Practice of some fundamental DOS commands – TIME, DATE, DIR, MD, CD, RD, DELTREE, COPY, VOL and LABEL
3. Practicing windows Operating System (OS) – use of mouse, title bar, minimum, maximum and close buttons, scroll bars, menus and tool bars
4. WINDOWS explorer – creating folders, COPY and PASTE functions
5. MSWORD – creating a document – editing and saving – use of options from the tool bars – Format, Insert and Tools, alignment of paragraphs and text
6. MSWORD – creating a table, merging of cells, columns and row width
7. MSEXCEL – creating a spreadsheet, alignment of rows, columns and cells using Format tool bar
8. MSEXCEL – entering formula expressions through the formula tool bar and use of inbuilt functions – SUM, AVERAGE and STDEV
9. MSEXCEL – data analysis using inbuilt tool packs – correlation and regression
10. MSEXCEL – data analysis using inbuilt tool packs – tests of significance t-test for single sample
11. MSEXCEL – data analysis using inbuilt tool packs – tests of significance t-test for two samples

12. MSEXCEL – creating and saving graphs
13. Transforming the data of WORD and EXCEL to other forms
14. MSACCESS – creating database, structuring with different types of fields
15. MSACCESS – use of query facility for accessing the information
16. Internet Explorer – using search engines

References

- Parmar, A., Mathur, N., Prasanna, U.D. and Prasanna, V.B. 2000. *Working with WINDOWS: A Hands on Tutorial*. Tata McGraw-Hill Publishing Co., New Delhi.
- Viescas. 2005. *Microsoft Office Access 2003-Inside Out*. PHI Publishers, New Delhi.
- Vikas Gupta. 2002. *Comdex Computer Course Kit*. Dreamtech Press, New Delhi.
- Winston. 2000. *Microsoft Excel Data Analysis and Business Modeling*. PHI Publishers, New Delhi

DEPARTMENT OF ENGLISH

1. Course No. : ENGL 101
2. Course Title : **Comprehension and Communication Skills in English**
3. Credit Hours : 2 (1+1)
4. General Objective : To improve the knowledge of the students in comprehension and communication skills in English

5. Specific Objectives

a) Theory

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

- i. understand the basic concepts of comprehension
- ii. understand the fundamentals of grammar
- iii. enhance their vocabulary
- iv. improve their skills in written communication

b) Practical

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

- i. have a clear concept of communication skills in English by using AV aids in Spoken English
- ii. improve their reading skills
- iii. present the reports orally and participate in debates and group discussions

A) Theory Lecture Outlines

1. From the text “ Current English for Colleges” – 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 the text book, “The Sporting Spirit” by George Orwell – 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, “A Layman Looks at Science” by Raymond B. Fosdick – comprehension pertaining to the textual grammar i.e., fill in the blanks, matching and vocabulary and reading comprehension
6. A Dilemma – a lesson from the text book, “A Layman Looks at Science” by Raymond B. Fosdick – reading comprehension and answering the questions related to the text
7. Homonyms – use words in two ways – more words at a glance and exercises related to GRE and TOEFL
8. Homophones – a list of homophones – fill in the blanks, underline the correct word and exercises related to GRE and 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 and vocabulary and Reading Comprehension
10. You and your English – a lesson from the text book, “Spoken English and Broken English” by G.B. Shaw – reading comprehension and answering the questions related to the text
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 and 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 letter – planning a letter – quotations, orders and tenders – sales letters – claim and adjustment letters – job application letters– social correspondence – personal correspondence and Curriculum Vitae (CV)
14. The Style – importance of professional writing – choice of words and phrases – clichés – jargons – foreign words and phrases
15. Precis writing – summarizing – the essential features of a good precis – important points while making a precis – some don’ts – make a precis of a paragraph and suggest suitable title and 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 interview 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 The English and Foreign Languages (EFL) University
3. Spoken english, vowels, consonants, monophthongs, diphthongs, 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 and written communication
8. Telephonic conversation
9. Reading skills, skimming, scanning, extensive reading, intensive reading and examples
10. Meeting – purpose, procedure, participation and physical arrangements
11. Presentation of reports by using power point and LCD
12. Interviews – mock interviews
13. Debate and group discussion
14. Using a dictionary effectively
15. Vocabulary
16. Pronunciation practice

References

- Balasubramanian, T. 1989. *A Text book of Phonetics for Indian Students*. Orient Longman, New Delhi.
- Balasubramanyam, M. 1985. *Business Communication*. Vani Educational Books, New Delhi.
- Jean Naterop, B. and Rod Revell. 1997. *Telephoning in English*. Cambridge University Press, Cambridge.
- Krishna Mohan and Meera Benerjee. 1990. *Developing Communication Skills*. Macmillan India Ltd. New Delhi.
- Krishnaswamy, N. and Sriraman, T. 1995. *Current English for Colleges*. Macmillan India Ltd. Madras.
- Narayanaswamy, V.R. 1979. *Strengthen Your Writing*. Orient Longman, New Delhi.
- Sharma, R.C. and Krishna Mohan. 1978. *Business Correspondence*. Tata McGraw-Hill Publishing Co., New Delhi.

COMMERCIAL AGRICULTURAL COURSES

1. Course No. : AGRI 206
 2. Course Title : **Commercial Crop Production – I**
 3. Credit Hours : 1 (0+1)
 4. General and Specific Objectives : To provide practical training on project mode in crop production, plant protection, marketing etc. using the latest technologies
- Course in-charge : Instructional farm incharge of the college. Farm manager / Farm superintendent / teacher of agronomy, soil science, plant breeding, agricultural economics, agricultural engineering etc.

Mode of operation

- Around 5 to 10 students each are made into a batch and a name is given. Example: Godavari / Green / Mahatma
- Relevant crop(s), taught in the semester and appropriate to season, have to be grown
- Inputs are provided by the instructional farm
- Crop(s) continue irrespective of semester break or holidays
- Profits (50 : 50) are shared by the instructional farm and group of students

1. Course No. : AGRI 207
 2. Course Title : **Commercial Crop Production – II**
 3. Credit Hours : 1 (0+1)
- Continuation of Commercial Crop Production – I in second semester

1. Course No. : AGRI 306
2. Course Title : **Commercial Crop Production – III**
3. Credit Hours : 1 (0+1)
4. General and Specific Objectives : To provide practical training on project mode in crop production, plant protection, marketing etc. using the latest technologies

Course in-charge : Instructional farm incharge of the college. Farm manager / Farm superintendent / teacher of agronomy, soil science, plant breeding, agricultural economics, agricultural engineering etc.

Mode of operation

- Around 5 to 10 students each are made into a batch and a name is given. Example: Godavari / Green / Mahatma
- Relevant crop(s), taught in the semester and appropriate to season, have to be grown
- Inputs are provided by the instructional farm
- Crop(s) continue irrespective of semester break or holidays
- Profits (50 : 50) are shared by the instructional farm and group of students

1. Course No. : AGRI 307

2. Course Title : **Commercial Crop Production – IV**

3. Credit Hours : 1 (0+1)

- Continuation of Commercial Crop Production – III in second semester

SKILL PRACTICE COURSES

1. Course No. : SKPR 101
2. Course Title : **Skill Practice Courses (9) – I**
3. Credit Hours : 1 (0+1)
4. General and Specific Objectives : To impart professional skills to the students in the below mentioned skill practice courses

List of skill practice courses

I. Agronomy

1. SPAG 01 Field preparation and sowings
2. SPAG 02 Intercultivation
3. SPAG 03 Sprinkler and drip irrigation

II. Genetics and Plant Breeding

4. SPGB 01 Emasculation and pollination
5. SPGB 02 Rouging

III. Agricultural Economics

6. SPEC 01 Conduct market surveys for the product
7. SPEC 02 Preparation of project reports
8. SPEC 03 Filling and processing of loan application
9. SPEC 04 Maintenance of forecast register and cash book

1. Course No. : SKPR 102
2. Course Title : **Skill Practice Courses (9) – II**
3. Credit Hours : 1 (0+1)
4. General and Specific Objectives : To impart professional skills to the students in the below mentioned skill practice courses

List of skill practice courses

I. Entomology

1. SPEN 01 Preparation of pesticide spray fluids and application

II. Agricultural Engineering

2. SPAE 01 Tractor driving
3. SPAE 02 Tractor repair and maintenance
4. SPAE 03 Instrument attachment to tractor
5. SPAE 04 Repair of sprayers

III. Horticulture

6. SPHT 01 Grafting
7. SPHT 02 Pruning
8. SPHT 03 Preparation of jams, jellies and marmalades

IV. Agricultural Extension

9. SPEX 01 Preparation of teaching aids

Operational Mechanism for imparting skills in SKPR – 101 and SKPR – 102

- All the students shall be made into nine groups and each group may have 5 to 7 students.
- Each skill practice should be for a minimum of 3 days and a maximum of one week depending on the need.
- The timings of skills practice is from 6 – 8 A.M. and / or 4 – 6 P.M.
- Labs, farms and workshops are to be kept opened during that period.
- Farm staff (AEOs, Record Assistant) may be present in those timings.
- Engage a mechanic on contract basis if trained mechanics are not available.
- A power tiller, a mini tractor, power sprayers etc., are to be provided to the work shop for practicing skills.
- All green houses at Colleges are to be made operational for use of students.
- ICAR developmental grants may be used for this purpose.
- Evaluation is internal (Grading has to be followed).
- Each skill practice has 10 marks (for 9 practicals $9 \times 10 = 90$ marks) and ten marks for overall evaluation.

NON-CREDIT COURSES

1. Course No. : COCA 100
2. Course Title : **Physical Education**
3. Credit Hours : 1 (0+1)
4. General Objective : To improve the physical skills and fitness of the students to make them more active, alert and successful
5. Specific Objectives

a) Theory

No theory component

b) Practical

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

- i. develop sound body and mind
- ii. build good character
- iii. promote team work
- iv. present the reports orally and participate in debates and group discussions

A) Theory Lecture Outlines

No theory component

B) Practical Class Outlines

1. Introduction of physical education
2. Posture – exercise for good posture
3. Physical fitness exercise for agility, strength, co-ordination, endurance and speed
4. Rules and regulations of important games
5. Skill development in any one of the games – foot ball, hockey, cricket, volley ball, basket ball, ball badminton, throw ball and tenni koit
6. Participation in any one of the indoor games – shuttle badminton, chess, caroms and table tennis
7. Rules and regulations of athletic events
8. Participation in any one of the athletic events – broad jump, high jump, triple jump, javelin throw, discus throw, shot put, short and long distance running

9. Safety education
10. Movement education
11. Effective ways of doing day to day activities
12. First-Aid training
13. Coaching in major games and indoor games
14. Asanas and indigenous ways for games for leisure time
15. Leadership development in games or sports
16. Participation and experience in intercollegiate and All India Agricultural Meets

NOTE: Warming up and conditioning exercises are compulsory before the commencement of each class

References

- Chakravar, P.S. 1989. *Book of Rules of Games and Sports*. YMCA Publishers, Madras.
- Mangal, S.K. 1980. *Health and Physical Education*. Prakash Brothers Publishers. London.
- Thomas, J.P. 1961. *Organization of Physical Education*. Gnanodaya Press, Madras.

1. Course No. : COCA 200
2. Course Title : **National Service Scheme (NSS)**
3. Credit Hours : 1 (0+1)
4. General Objective : To develop overall personality of the students to inculcate discipline, leadership qualities and social services
5. Specific Objectives
 - a) Theory

No theory component
 - b) Practical

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

 - i. develop personality through social service

A) Theory Lecture Outlines

No theory component

B) Practical Class Outlines

1. Introduction of NSS – aims and philosophy of NSS – orientation of student to national problems – history and growth of NSS
2. Organizational overview of NSS – historical perspectives of NSS in India and Andhra Pradesh
3. NSS – objective – the motto – NSS badge – NSS day – NSS song – important thrust areas
4. Aims of NSS programmes – classification – role of NSS programme officer – NSS volunteer and community
5. NSS regular activities in adopted villages, slums and with voluntary organizations – objectives and implementation
6. Special camping programme – objectives – suggestive list of activities during regular as well as special camping
7. Administrative structure of NSS at national, state and university level – their functions
8. Planning of NSS programmes – calendar of activities – month wise
9. Enrollment of students as NSS volunteers – minimum number of students in one unit – maintenance of records – eligibility criteria for issue of NSS certificate
10. Cultural and other activities in India and outside India that can be participated by NSS volunteers and NSS programme officers
11. Funding of NSS – for regular and special camp activities
12. Socio-economic structure of Indian society – population problems
13. Functional literacy – nonformal education of rural youth
14. Awareness about eradication of social evils – consumer rights – environment enrichment and conservation
15. Awareness about health, family welfare and nutrition – reporting system in NSS – monthly, quarterly, half-yearly and yearly reports
16. Personality development of students through NSS – inculcating social service activities in NSS volunteers

References

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Directions from the secretary, APSCHCE, Govt. of A.P. vide Lr.No. APSSHCE/um-651/Univ. Corrs.-NSS/2012 Dt. 03-02-2012.

1. Course No. : COCA 200
2. Course Title : **National Cadet Corps (NCC)**
3. Credit Hours : 1 (0+1)
4. General Objective : To develop overall personality of the students to inculcate discipline, leadership qualities etc.

5. Specific Objectives

a) Theory

No theory component

b) Practical

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

- i. understand the necessity of discipline and know little bit about Indian Army and the role of NCC cadets in the building of nation

A) Theory Lecture Outlines

No theory component

B) Practical Class Outlines

1. Introduction of NCC – NCC song – introduction – aims of NCC philosophy of training – incentive to cadets – introduction to defence services – Army, Navy and Air Force
2. Foot Drill – aim – words of command – attention – stand at ease and stand easy – turning – sizing – forming up in three ranks – numbering – close order march – dressing open order march – getting on to parade – dismissing and falling out
3. Saluting – types of salutes – saluting at the halt and while marching – types of marching – length of pace and time turning at the march and wheeling – side pace – pace forward and to the rear
4. Arms drill – attention – stand at ease and stand easy – getting on parade with arms – dressing at the order dismissing and falling out – ground and take up arms shoulder from the order and vice versa – present arm from the order and vice versa – saluting at the shoulder at the halt and on the march
5. Examine of arms from the order – order from the examine – guard mounting – guard of honour – procedure – composition and strength – compliments ceremonial drill – compliments – procedure

6. Weapon training – characteristics of a rifle – ammunition fire power – stripping – assembling – care and cleaning use of pull – through – loading – unloading and bolt manipulation – firing positions – lying – standing – kneeling and sitting position
7. Range and figure targets – aiming – trigger control and firing a shot – range procedure and safety precautions – inspection of weapons – alteration of sight – mean point impact – elevation – theory of group and snap shooting
8. Field craft – introduction to field craft – ground important points – procedure of description – sequence visual training – importance – personal camouflage and concealment – correct use of cover – judging distance – methods of judging distance
9. Fire discipline and fire control orders field signals – with hand, with weapons, with whistles section battle drill
10. Scouts and patrols – types of patrols – strength and composition – stages of patrolling – tasks – responsibilities of patrol leader and scouts – conduct of patrol ambushes – types of ambushes – conduct of ambushe
11. Map reading – introduction to map and conventional signs – scale – topographical forms and technical terms – grid system – relief contours and gradient cardinal points and finding north – use of service protractors – prismatic compass and its use in settling a map – finding own position and finding north – map to ground – ground to map
12. Self defence – introduction – principles – precautions – preliminaries and vulnerable parts of body – basic throws – attacking – release and counter attack
13. First Aid – principles of First Aid – structure and function of the body – hemorrhage and fractures – injuries to internal organs – air raid casualties first aid emergencies
14. Hygiene and sanitation – personal hygiene – preventive diseases – water supply and its purification different types of latrines – urinals – soakage pits and disposal of garbage
15. Civil defence – organization – civil defence services fire fighting – constituents – modes of fire spread fire extinguishers – protection – air raid messages, protection against air attack
16. Leadership – discipline and duty – duties of good citizen – customs of the services – leadership traits man management

References

Director General, NCC 2000. *Cadet's Hand Book – Army Wing*. Printech Ways, New Delhi.



APPENDIX

REGULATIONS GOVERNING UNDER GRADUATE PROGRAMMES OF THE UNIVERSITY

(as amended upto 21-04-2011)

In exercise of the powers conferred by clause (d) of subsection - 2 of Section 22 of the Acharya N.G. Ranga Agricultural University Act 1963, (Act No.24 of 1963) read with Statute No.21 of the first statutes made by the Government of Andhra Pradesh and statues No. 1 of the additional statutes made by the Board of Management and issued in the proceedings No.750/Stat/6.5 dated 27-7-1965 the Academic Council of the Acharya N.G. Ranga Agricultural University, hereby makes the following regulations (Issued in proc. No. 1415/Acad.I(AI)12002 dt.06-8-2002 and proc. No. 1918/Acad.1 (AI/2001 dt.24-8-2001)

1.0 Short Title

These regulations shall be called 'The ANGRAU Regulations, 2010 governing the under graduate courses of study leading to the award of the degrees of B.Sc.(Ag), C.A. & B.M, B.Tech. (Food Sci.) in the Faculty of Agriculture; B.Tech.(Ag. Engg.) in the Faculty of Agricultural Engineering & Technology and B.Sc.(Hons.) Home Sc. & B.Sc (Hons.) Fashion Technology in the Faculty of Home Science. These regulations shall apply to the students admitted from the academic year 2010-11 and onwards.

2.0 Definitions

2.1 Academic year

The academic year of the University shall ordinarily be from June to April (except in the case of year of admission) and shall consist of two semesters.

***2.2 Semester**

A minimum duration of 110 working days, consisting of 95 instructional days and 15 examination days except during the year of admission.

For a short semester in the year of admission the number of classes should be increased proportionately.

2.3 Credit hour

Each credit hour represents one hour lecture or two to three hours of laboratory or field practicals each week in a semester. It is also known as semester credit or credit.

2.4 Course

A course is a unit of instruction or segment of subject matter (as specified in the course catalogue) to be covered in a semester. It has a specific number, title and credits.

2.5 Grade point of a course

It is the value obtained by dividing the percentage of marks secured in a course by 10. The grade point is expressed on a 10 point scale upto 1 decimal place.

2.6 Credit point of a course

It is the product of credit hours and grade point obtained by a student in a course.

* Amended vide proc.No.1959/Acad.I/A1/11, dt: 25-03-2011.

2.7 Grade Point Average (GPA)

It is the quotient of the total credit points obtained by a student in various courses at the end of each semester divided by the total credit hours taken by him/her in that semester. The grading is done on a 10 point scale. The GPA is to be corrected up to first decimal place.

2.8 Overall Grade Point Average (OGPA)

It is the quotient of cumulative credit points obtained by a student in all the courses taken by him/her from the beginning of the first semester of the degree course divided by the total credit hours of all the courses which he/she had completed upto the end of a specified semester from the first semester. It determines overall performance of a student in all the courses taken during a period covering more than a semester. The OGPA is to be corrected upto second decimal place.

2.9 Semester final examinations

Semester final examinations for each course are conducted by the University at the end of each semester in the theory portion of the course.

3.0 Admissions

3.1 Admission including selections to the under graduate courses, ordinarily made in the beginning of the first semester of the academic year, shall be in accordance with the regulations laid down from time to time by the University.

3.2 Fee

The fee for application, semester fee, special fee, examination fee and other fee shall be as prescribed by the University from time to time.

4.0 Courses, credits and syllabi

The details of the courses, credits and syllabi of the under graduate courses shall be as prescribed by the Academic Council from time to time.

5.0 Advisory system

The students on their admission shall be divided into convenient batches by the Associate Dean of the college, and each batch is assigned to one of the teachers who are designated as 'Advisor'. Each student immediately after enrolment fills up all the registration cards with the guidance of his/her advisor. Among other things, the advisor shall help the students in planning the programmes of their studies.

The advisor will establish and foster close personal relationship with students assigned to him/her during their entire stay in the college by having periodical meetings either with the entire batch of students or with each individual student as often as is considered necessary in an effort to know their problems, review their study programmes and take such remedial actions as may be necessary in consultation with the teachers concerned and the Associate Dean.

The advisor will maintain a record containing particulars of previous history of the student, courses registered and examinations appeared and grades obtained in each course in each semester as per the format prescribed by the University (Format - 1).

6.0 Registration

6.1 Registration for the first time in the University

Students who have received notification of admission from the University into various faculties will receive, on arrival, guidelines for registration from the Associate Dean of the respective colleges.

A registration and orientation programme will be conducted by the Associate Dean of the college for the benefit of the students joining the University for the first time.

Attendance in respect of fresh students for the first semester shall be reckoned from the date of registration of the student concerned.

6.2 Registration in the subsequent semesters

The following are the steps in registration of students for different courses.

- 6.2 (a) The student in each batch shall have to register for the set of courses offered in toto for that batch and fill in the registration cards in person producing the identity card at the registration center on the day of registration. The students having backlog courses can register the total backlog courses and few fresh courses offered in that semester for that batch and fill in the cards. The Advisor in turn will countersign and send them to the Associate Dean's office. The Associate Dean's office should prepare a list of students who have registered for each course and send them course-wise to the concerned teacher within a week.
- (b) The payment of fee and other arrears due to the college, department, hostel, library etc., shall precede registration.
- (c) Late fee for U.G. students shall be Rs. 10/- for the first three working days starting from the next day of the scheduled date of registration and thereafter Rs. 100/- per day for a further period of seven (7) days.

*Amended vide Proc.No.1700/Acad.I/2003, Dt:25-08-2003

The attendance will however be reckoned from the day the instruction commences as per the academic calendar. However, in respect of RWEF / intern ship / Experiential Learning Programmes (ELP), the rules as prescribed in RWEF manual / intern ship guide lines / Experiential Learning Programmes' manual shall be followed.

6.3 Study load for semester

For the purpose of calculation of study load, number of credits registered in a semester includes fresh courses and courses registered for want of attendance. The total study load for a student shall not be more than 23 credit hours per semester.

***7.0 Attendance**

- 7.1 Every student shall ordinarily attend all classes in a course. However, the minimum attendance prescribed in a course is 75%. The attendance shall be reckoned for

*Amended vide Proc.No.352/Acad.I/A1/11, Dt:05-06-2011

theory and practicals separately. A student who fails to put in the minimum attendance either in theory or practical examination and his/her registration, for that course shall be treated as cancelled.

- 7.1 (a) The minimum attendance requirements can be relaxed upto 10% on medical grounds (i.e., upto 65% for theory and practical separately) only in case of indoor hospitalization.
- 7.2 (a) If a student admitted to the first year U.G. courses does not register the courses of first semester of that year or having registered does not put in atleast 75% of attendance in all the courses, his/her admission shall stand cancelled, provided that the admission of a student may not be cancelled in exceptional and deserving cases having regard to the facts and merits of the case as provided in clause (b) of this regulation
- (b) A student who wishes to seek relaxation of provision in clause (a) of this regulation for good and exceptional reasons may make an application within 7 calendar days from the last day of instruction of first semester to the Associate Dean of the college concerned giving the grounds and the proof thereof due to which he/she could not fulfil the minimum attendance requirement, provided he/she puts in atleast 60% attendance during the first semester of admission. Such application shall be considered by a committee consisting of Associate Dean, a senior Professor or a senior Associate Professor in the colleges where a Professor is not existing, as nominated by the Associate Dean, the Academic advisor of the college, Advisor of the student concerned and the University Medical Officer. If the committee is satisfied that there were exceptional circumstances warranting exercise of discretion to relax the provision in clause (a) of this regulation, the Associate Dean may pass an order allowing the student to continue the studies in relaxation of the provision in clause (a). The student so permitted to continue the studies shall re-register the courses, in which he/she had shortage of attendance, when offered next.
- *7.3 When a student has to leave the college after completion of first semester of study, for reasons beyond his/her control, he/ she shall obtain prior permission of the Associate Dean for discontinuation within one month from the date of discontinuation. If a student fails to take such permission, he/ she shall not be eligible for readmission. The maximum period of break shall not exceed 4 (four) semesters under any circumstances including the semester during which he/she discontinued. A student, permitted to discontinue by the Associate Dean, shall apply to the Associate Dean for readmission, atleast one month before the commencement of the semester in which readmission is sought.
- 7.4 Where a student leaves the colleges taking a T.C. he/she shall not be eligible for readmission.

* Amended vide proceedings No. 1201/Acad.1/A1/99. Dt. 14-6-99 applicable w.e.f 1999 admitted batch students.

8.0 Evaluation of student, examinations and grades

- 8.1 (a) The evaluation of the student in a course shall be based on his/ her performance in various kinds of examinations, records, class work and other types of exercises
- (b) The detailed course outlines in each course shall be prepared by the concerned teacher(s) in consultation with the University Head of the Department/Head of the Department, which will be made available to the students during the first week of the semester. A schedule of the mid-semester examinations of the academic programme shall be prepared by the Associate Dean and notified to the students at the beginning of each semester
- (c) Answer scripts of mid-semester examinations are evaluated by the teacher shall be shown to the students. The students shall have the option to request the teacher for clarification of any doubts in scoring, provided that such clarification is requested for when the answer scripts are made available to them. This, shall not apply for final examinations.

8.2 Mid-semester examinations

There shall be one mid-semester examination to be conducted by the teacher offering the course after 50% of the working days are over in a semester. The duration for mid-semester examination shall be for one and half hours.

The marks allotted for mid-semester and semester final theory examinations shall be 50 and 100, respectively. Ordinarily no condonation for absence of mid-semester examination shall be given. However, if a student is genuinely prevented from taking examination as in the case of serious illness or accident or any other case, a special re-examination may be arranged by the concerned teacher in consultation with the Head of the department. This repeat examination shall be held within two weeks from the date of examinations so missed, and shall be a common examination for all such students.

Unless a student appears for the mid-semester examination he/she shall not be permitted to appear for the semester final theory and practical examinations in the course concerned.

The regular mid-semester examination and the special re-examination shall be conducted as per the time to be fixed by the Associate Dean.

8.3(a) Semester final examinations

The semester final examinations shall be held at the end of each semester in each course. The semester final examination in the theory portion shall be of two and half hours duration. It shall be the responsibility of the University to conduct the theory portion of semester final examination. Practical examinations shall be conducted by the respective colleges. The students shall be given two preparation holidays (inclusive of the public holiday) before the commencement of semester final theory examinations.

(b) Answer scripts of semester final theory examination are evaluated through common spot valuation system in selected centres, year of study wise. On the last day of semester final examinations, the Associate Dean shall send all the sealed answer scripts to the selected

center where they are coded, before distribution for valuation. The duration of spot valuation is 6 working days.

Teacher shall be nominated by the Dean of Agriculture for spot valuation. The nominated teachers shall report to the concerned Associate Dean shall submit award list of marks to the Associate Deans after completion of correction of answer scripts allocated to her/him.

8.4 Computation and award of course grades

In the allocation of marks for the course, each credit may be evaluated for 50 marks. Marks allotted for theory and practicals shall be in proportion to the credits for the theory and practicals. The proportion of marks for the semester final common theory examinations and mid-semester examinations shall be 60:40 respectively. Marks for the practical shall be based on continuous evaluation of practical classes and a final practical examination which shall include a viva-voce examination.

The proportion of marks between continuous internal evaluation of practical work and final practical examination shall be of 1:1. In respect of RWE Programme, internship and ELP, etc., the criteria for evaluation of students as prescribed in manuals of respective programmes shall be followed.

8.5 Mass absence of students from a class or examination

Absence of students 'enmasse' from a class or examination shall not be condoned. The Associate Dean, in addition, may order suspension of the course, if deemed necessary.

8.6 Unfair means during tests and examinations

The Associate Dean of the college shall be responsible for dealing with all cases of use of unfair means in various examinations.

The phrase, 'Use of Unfair Means' include possession of any information or material by the student, talking to other students, copying from other students or from printed or written material may include 'use of mobiles or any other electronic gadgets', impersonation etc. The invigilator concerned, on finding the use of unfair means by any student may take the answer scripts of the student and the material evidence, if any, and the explanation from the student. The student may also be sent out of the examination hall immediately. The invigilator concerned shall report each case of unfair means direct to the Associate Dean immediately with full details of the incident, answer scripts, the available evidence and explanation of the concerned students, if any. The Associate Dean, on receipt of the report, may give an opportunity to the concerned student to represent his/her case considering all the available evidence, the Associate Dean shall take appropriate action immediately. The penalty shall be as indicated below:

- (a) A student found using unfair means during mid-semester examination shall be deemed to have failed in that course.
- (b) A student found using unfair means during semester final examination shall be deemed to have failed in all the courses, he/she has registered in that semester and/or in such of those courses in which he/she appeared for semester final

examination in that semester. In such cases, the student shall not be permitted to take the remaining examinations, if any, in that semester

- (c) The Associate Dean shall report each case falling under (a) and (b) above immediately, after passing order to the Dean of the concerned faculty.
- (d) For using unfair means of a serious nature such as ignoring the repeated instructions of invigilator, or abusing or threatening or assaulting the invigilator, warranting higher penalties than those indicated in clauses (a) and (b) above, the Associate Dean, besides treating the student as failed in all the courses he/she registered in that semester, may further debar the student for the succeeding semester and the fact informed to the Dean of the faculty. If further or more severe punishments felt necessary, the Associate Dean shall immediately inform the University about the full details of each together with all the material evidence if any, and his/her recommendation. The explanation or representation of the student, if any, may also be sent. The Vice-Chancellor after examining the case, may debar the student for further period or permanently. The decision of the Vice-Chancellor is final.

The parent or the guardian of the concerned student shall be informed of any punishment awarded to the student and the reason therefor.

8.7 Scrutiny of grades

The student may apply to the Registrar within one week after the announcement of the grades for scrutiny of the totalling of marks of the semester final examination or calculation of grade points obtained by him advancing sufficient reasons for such a request. The fee for such scrutiny shall be as prescribed from time to time.

9.0 Academic status and scholastic deficiencies

9.1 (a) A student shall get minimum of 50% marks in both final theory and final practical examinations separately for a pass in the final examination of a course. If a student does not achieve this he/she has to reappear for the final examination in theory/practical or both as the case may be, when next conducted for such course(s).

(b) A student obtaining a grade point of 5.0 shall be considered to have passed the course. A student getting less than 5.0 shall be deemed to have failed in the course and 'F' shall be indicated in the grade report. A student who secured grade point below 5.0 or who secures above 5.0 but secures less than 50% marks in semester final theory/practical examination of the course (or) was marked absent has to appear for either final theory or practical examination or both (as the case may be).

A student may also have the option to write the mid-semester examination of the course in the same semester when he/she next takes the final examination of that particular course.

In the case of final year B.Sc.(Ag), CA & BM, B.Tech. (Food Science), B.Tech.(Ag.Engg.), and B.Sc (Hons.) Home Science students, re-examination shall be conducted within one month from the date of reopening the colleges after the semester vacation i.e. first semester of the succeeding academic year, in not more than three failed courses,

provided the student would complete his/her graduation requirements by passing said three courses.

(c) Whenever a student wants to take re-examination in any course(s) he/she should fill in the particulars in a prescribed application form duly paying the re-exam fee of Rs. 50/- (Rupees fifty only) for each course subject to a maximum of Rs. 100/- (Rupees hundred only) within 40 days from the date of commencement of the subsequent semester.

**** 9.1 (d) Deleted**

9.2*

Promotion to second year A candidate is automatically promoted to second year irrespective of the number of courses as absent/failed courses in the first year.

Promotion to third year A candidate should have passed all the courses of first year and should not have more than 6 courses of second year as backlog courses (failed).

Promotion to fourth year A candidate should have passed all the courses of second year and should not have more than 6 courses of third year as backlog courses (failed).

(Implemented from the academic year 2008-09 onwards)

9.3 Year of standing

The year of standing of a student shall be determined solely on the basis of his completion of certain number of credit hours as prescribed by the Academic Council.

10.0 Graduation requirements

@10.1 The student shall satisfy minimum residential requirements and maximum duration as below

The minimum residential requirement is eight Semesters for U.G. Degree Programmes in the University.

The maximum duration of degree programmes is fourteen semesters (7 academic years).

In case of U.G. Home Science, specialization in any one of the following disciplines is obligatory for all the students admitted from the academic year 2000-2011 onwards. However, based on the recommendation of IV Deans Committee of ICAR, the titles of disciplines are changed. Titles of disciplines from 2000-01 to 2006-07 academic years and changed titles from 2007-08 academic year onwards are as follows:

* Amended vide Proc.No.562/Acad.I/A1/08, Dt.24-03-2008

** Deleted vide Proc.No.336/Acad.I/A1/2011, dt:14-06-2011

@ amended vide Proc.No.2226/Acad.I/A1/2011, dt:25-3-2011 and Memo. No.53/Acad.I/ A1/2011, dt:21-04-2011.

2000-01 to 2006-07	2007-08 onwards
1. Apparel & Textiles (APTX)	Textile & Apparel Designing
2. Extension Education (EXTN)	H.Sc. Extension and Communication Management
3. Food and Nutrition (FDNT)	Foods & Nutrition
4. Human Development and Family Studies (HDFS)	Human Development & Family Studies
5. Resource Management & Consumer Sciences (RMCS)	Family Resource Management

The first two years (first four semesters) of study would consist of common core courses and remaining four semesters are for specialization courses. Option for specialization shall be exercised by the students in order to perform at the time of admission the students shall be allocated to different branches based on their performance. Merit shall be taken into consideration if there is more competition for any single specialization.

10.2 Requirements for Bachelor's Degree

A student undergoing courses of study leading to award of the Bachelor's degree viz., B.Sc.(Ag.) (Bachelor of Science in Agriculture), B.Sc.(CA & BM) (Bachelor of Science in Commercial Agriculture and Business Management), B.Tech. (Ag. Engg.) (Bachelor of Technology in Agril. Engineering), B.Tech. (Food Science) (Bachelor of Technology in Food Science) or B.Sc. (Hons.) Home Science or B.Sc. Fashion Technology in Faculties of Agriculture or Agriculture Engineering & Technology or Home Science as the case may be shall pass courses and complete the minimum number of credit hours prescribed there for by the Academic Council from time to time by obtaining minimum OGPA of 5.00 in the 10 point scale.

A student undergoing instructions in U.G. courses of study leading to the award of Bachelor of Science in Agriculture, Bachelor of Science in Commercial Agriculture and Business Management, Bachelor of Technology in Agril. Engineering, Bachelor of Technology in Food Science and Bachelor of Science (Hons.) in Home Science shall have to complete satisfactorily the Rural Work Experience Programme/internship/Experiential Learning Programme, etc., during the final year of the course as prescribed from time to time.

10.3 Classification of successful candidates

The successful candidates after completion of graduation requirements who secured an OGPA of 5.00 or more in the 10 point scale shall be classified as under:

Pass	5.00 to 5.99
Second Class	6.00 to 7.49
First Class	7.50 to 8.49
First Class with Distinction	8.50 and above

NOTE: Class/division shall not be mentioned in the degree certificate but, classification may be given in the transcript as footnote.

11.0 Student responsibility

All under graduate students studying in various faculties of this University are expected to know the requirements for the award of Bachelor's Degree and general academic requirements and assume full responsibility for meeting them. They are expected to keep constantly in touch with their advisors so that the latter may watch their progress and guide them along right lines. In no case a regulation be waived or exception made simply because a student pleads ignorance of it.

12.0 Transfers

12.1 Transfer of a student from one college to another in the same course shall be at the discretion of the University.

For valid reasons transfers may also be permitted by the Vice-Chancellor on an application by the student through the Associate Dean of the college concerned to the Dean of the faculty.

12.2 Transfer of students from other Universities to this University is not permitted.

13.0 Record of courses

To ensure that requirements for the award of degree have been completed by a student, the University shall keep a record of courses completed by the students. A copy of the same shall be maintained by the Associate Dean of the concerned college.

14.0 Authorities to approve results and issue pass certificates, transcripts etc.

The Vice-Chancellor shall approve the results on the recommendation of the Dean of the faculty and Registrar shall issue the Provisional Pass Certificates, transcripts etc. to the candidates.

15.0 Award of diploma

A diploma under the seal of the University and duly signed by the officers authorised in this behalf shall be presented at a convocation to each candidate who has successfully completed the graduation requirements for the award of degree. Diplomas of the candidates who have successfully completed the graduation requirements for the award of degree and are admitted 'IN ABSENTIA' to a degree at a convocation shall be sent by post. The diploma

shall set for the name of the candidate, father's name, mother's name, degree, month and year of successful completion of the graduation requirements etc.

16.0 Amending or cancellation of result

If the result of a candidate is discovered to be vitiated by error, malpractice, fraud, improper conduct or any other reasons, the Vice-Chancellor shall have the power to amend the result in such a manner as to accord with the true position, and to make such declaration as the Vice-Chancellor may deem necessary in that behalf.

If it is found that the result of a candidate has been vitiated by malpractices, fraud or other improper conduct whereby he has been benefited and that he has in the opinion of the Vice-Chancellor, been a party to or connived at the malpractice, fraud or improper conduct, the Vice-Chancellor shall have the power at any time, notwithstanding the award of the Diploma or a Certificate or Prize or a Scholarship, to amend the result of such candidate and to make such declaration as the Vice-Chancellor may deem necessary in, that behalf, including debarring of the candidate from the University for such a period as may be specified and the cancellation of the result of the candidate in such manner as the Vice-Chancellor may decide.

17. Transitory provision

These regulations shall apply to the students who shall be admitted from the academic year 2010 -11 and onwards.

18. No Regulation made by the Academic Council, governing the under graduate courses of study shall be constructed to limit or abridge the powers of the Academic Council to deal with any case or cases of any student or students of the under graduate courses in such manner as it may appear to it to be just and equitable.

FORMAT -1
(REGULATION 5.0)
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
REGISTRATION & AWARD BOOK

1 . Name of the College :

2. Course of student :

3. Name of the student :

4. I.D.NO :

Inner front page :

Name of the College :

Name of the student in full :

I.D.No. :

Father's Name & Occupation :

Mother's Name :

Permanent Address :

Present Address :

Local Address, if residing outside the Hostel :

Name & Address of guardian, if any :

Name of the Institute last studied :

Particulars of the Advisor

Signature of the Student

Name:

Designation:

Department:

Signature of the Advisor

Sl.No.	Advisory meeting during the semester (dates on which student attended)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Sl.No.	Discipline & conduct, punishment awarded, prizes won, if any	Other remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		