

**School of Agricultural Sciences**  
**B.Sc. (Hons) Agriculture (Batch 2022) Curriculum**

**Department wise distribution of courses**

<b>Course Code</b>	<b>Department / Discipline</b>	<b>Number of courses</b>	<b>Credit Hours</b>	<b>Total Credits</b>
<b>Agronomy</b>		<b>11</b>	<b>9+9</b>	<b>18</b>
22 AGR 101	Fundamentals of Agronomy and Agricultural Heritage		2+1	3
22 AGR 102	Introductory Agro-Meteorology and Climate Change		1+1	2
22 AGR 201	Crop Production Technology- I (Kharif Crops)		1+1	2
22 AGR 202	Principles of Weed Management		1+1	2
22 AGR 204	Crop Production Technology- II (Rabi Crops)		1+1	2
22 AGR 205	Rainfed Agriculture and Watershed Management		1+1	2
22 AGR 301	Practical Crop Production- I (Kharif Crops)		0+1	1
22 AGR 302	Farming System and Sustainable Agriculture		1+0	1
22 AGR 303	Practical Crop Production- II (Rabi Crops)		0+1	1
22 AGR 304	Principles of Organic Farming		1+1	2
<b>Genetics and Plant Breeding</b>		<b>4</b>	<b>7+4</b>	<b>11</b>
22 PBG 101	Introduction to Agricultural Botany		1+1	2
22 PBG 201	Fundamentals of Genetics		2+1	3
22 PBG 301	Fundamentals of Plant Breeding		2+1	3
22 PBG 302	Crop Improvement		2+1	3
<b>Seed Science and Technology</b>		<b>1</b>	<b>2+1</b>	<b>3</b>
22 SST 201	Principles of Seed Technology		2+1	3
<b>Soil Science and Agricultural Chemistry</b>		<b>3</b>	<b>6+2</b>	<b>8</b>
22 SAC 101	Fundamentals of Soil Science		2+1	3
22 SAC 201	Problematic soils and their Management		2+0	2
22 SAC 301	Manures, Fertilizers and Soil Fertility Management		2+1	3
<b>Agricultural Entomology</b>		<b>3</b>	<b>6+3</b>	<b>9</b>
22 AEN 201	Fundamentals of Entomology		2+1	3
22 AEN 202	Management of Beneficial and Harmful Insects		2+1	3
22 AEN 301	Pests of Crops and Stored Grain and their Management		2+1	3
<b>Agricultural Social Sciences</b>		<b>9</b>	<b>14+6</b>	<b>20</b>
22 AEC 101	Fundamentals of Agricultural Economics		2+0	2
22 AEC 201	Farm Management, Production and Resource Economics		1+1	2
22 AEC 301	Agricultural Marketing Trade and Prices		2+1	3
22 AEC 302	Agricultural Finance and Co- operation		2+1	3
22 AEC303	Intellectual Property Rights		1+0	1
22 AEX 101	Rural Sociology and Educational Psychology		2+0	2
22 AEX 102	Fundamentals of Agricultural Extension Education		2+1	3
22 AEX 201	Communication Skills and Personality Development		1+1	2
22 ARM 301	Entrepreneurship Development and Business Communication		1+1	2
<b>Allied Courses</b>		<b>4</b>	<b>5+3</b>	<b>8</b>
22 LAN 101	Comprehension and Communication Skills in English		1+1	2
22 MAT 111	Elementary Mathematics		2+0	2
22 STA 211	Statistical Methods		1+1	2

22 COM 211	Agri-informatics	1+1	2
<b>Agricultural Engineering</b>		<b>4</b>	<b>5+4</b>
22 SWE 111	Soil and Water Conservation Engineering	2+1	3
22 FMP 211	Farm Machinery and Power	1+1	2
22 ERG 211	Renewable Energy and Green Technology	1+1	2
22 APE 311	Protected Cultivation and Secondary Agriculture	1+1	2
<b>Horticulture</b>		<b>5</b>	<b>5+5</b>
22 HOR 111	Fundamentals of Horticulture	1+1	2
22 HOR112	Production Technology for Vegetables and Spices	1+1	2
22 HOR 211	Production Technology for Fruit and Plantation Crops	1+1	2
22 HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1	2
22 HOR 311	Post Harvest Management and Value Addition of Fruits and Vegetables	1+1	2
<b>Plant Pathology</b>		<b>4</b>	<b>7+4</b>
22 PAT 201	Fundamentals of Plant Pathology	2+1	3
22 PAT 202	Principles of Plant Disease Management	1+1	2
22 PAT 301	Diseases of Field and Horticultural Crops and their Management I	2+1	3
22 PAT 302	Diseases of Field and Horticultural Crops and their Management II	2+1	3
<b>Food Science and Technology</b>		<b>1</b>	<b>1+1</b>
22 FSN 111	Principles of Food Science and Nutrition	1+1	2
<b>Supplementary Courses</b>		<b>7</b>	<b>11+7</b>
22 BIC 101	Fundamentals of Plant Biochemistry	1+1	2
22 CRP 101	Fundamentals of Crop Physiology	2+1	3
22 AGM 101	Fundamentals of Microbiology	2+1	3
22 FOR 111	Introduction to Forestry	1+1	2
22 ENS 301	Environmental Studies and Disaster Management	2+1	3
22 ABT 301	Plant Biotechnology	2+1	3
22 RSG 301	Geo-informatics, Nanotechnology and Precision Farming	1+1	2
<b>Animal Production</b>		<b>1</b>	<b>2+1</b>
22 AMP 201	Livestock and Poultry Management	2+1	3
<b>Elective Courses</b>		<b>3</b>	<b>6+3</b>
22 ELC ***	Elective Courses I	2+1	3
22 ELC ***	Elective Course II	2+1	3
22 ELC ***	Elective Course III	2+1	3
<b>TOTAL</b>		<b>58</b>	<b>86+53</b>
<b>Student READY</b>		<b>4</b>	<b>0+41</b>
22 AEX 401	Rural Agricultural Work Experience and Agro-Industrial Attachment (RAW& AIA)	0+20	20
22 ELP ***	Experiential Learning Programme I	0+10	10
22 ELP ***	Experiential Learning Programme II	0+10	10
22 AGR 401	Project Work	0+1	1
<b>Non- Gradual Courses*</b>		<b>4</b>	<b>0+4*</b>
22 NSS/ NCC 101	NSS or NCC	0+1	1
22 PED 101	Physical Education and Yoga Practices	0+1	1

22 AGR 203	Study Tour	0+1	1
22 AEX 402	All India Study Tour	0+1	1
<b>TOTAL</b>		<b>8</b>	<b>0+45</b>
<b>Grand Total</b>		<b>67</b>	<b>86+94+4*</b>

### ELECTIVE COURSES

S. No	Course Code	Course Title	Credit Hours	Total Credits	Semester
<b>Elective Course I</b>					
1	22 ELC 201	Agricultural Journalism	2+1	3	IV
2	22 ELC 202	Food Safety and Standards	2+1	3	IV
3	22 ELC 203	Hi-tech Horticulture	2+1	3	IV
<b>Elective Course II</b>					
1	22 ELC 301	Bio Pesticides and Bio Fertilizers	2+1	3	V
2	22 ELC 302	Agribusiness Management	2+1	3	V
3	22 ELC 303	Micro Propagation Technologies	2+1	3	V
<b>Elective Course III</b>					
1	22 ELC 304	Commercial Plant Breeding	2+1	3	VI
2	22 ELC 305	Agrochemicals	2+1	3	VI
3	22 ELC 306	Landscaping	2+1	3	VI

### Semester wise distribution of courses

#### Semester I

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 101	Fundamentals of Agronomy and Agricultural Heritage	2+1	3
2.	22 SAC 101	Fundamentals of Soil Science	2+1	3
3.	22 HOR 111	Fundamentals of Horticulture	1+1	2
4.	22 AEX 101	Rural Sociology and Educational Psychology	2+0	2
5.	22 BIC 101	Fundamentals of Plant Biochemistry	1+1	2
6.	22 FOR 111	Introduction to Forestry	1+1	2
7.	22 LAN 101	Comprehension and Communication Skills in English	1+1	2
8.	22 PBG 101	Introduction to Agricultural Botany	1+1	2
9.	22 NSS/ NCC 101	NSS or NCC *	0+1*	1*
10.	22 PED 101	Physical Education and Yoga Practices*	0+1*	1*
		<b>Total</b>	<b>11+9</b>	<b>20</b>

\*Non- gradial courses

#### Semester II

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 102	Introductory Agro-Meteorology and Climate Change	1+1	2
2.	22 AEC 101	Fundamentals of Agricultural Economics	2+0	2
3.	22 SWE 111	Soil and Water Conservation Engineering	2+1	3
4.	22 HOR 112	Production Technology for Vegetables and Spices	1+1	2
5.	22 FSN 111	Principles of Food Science and Nutrition	1+1	2
6.	22 AEX 102	Fundamentals of Agricultural Extension Education	2+1	3
7.	22 CRP 101	Fundamentals of Crop Physiology	2+1	3
8.	22 AGM 101	Fundamentals of Microbiology	2+1	3
9.	22 MAT 111	Elementary Mathematics	2+0	2
<b>Total</b>			<b>15+7</b>	<b>22</b>
10.	22 NSS/ NCC 101	NSS or NCC	0+1#	1#
11.	22 PED 101	Physical Education and Yoga Practices	0+1#	1#

#Registered in Semester I and Evaluation in Semester IV

### Semester III

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 201	Crop Production Technology I (Kharif Crops)	1+1	2
2.	22 AGR 202	Principles of Weed Management	1+1	2
3.	22 AEN 201	Fundamentals of Entomology	2+1	3
4.	22 PBG 201	Fundamentals of Genetics	2+1	3
5.	22 AEC 201	Farm Management, Production and Resource Economics	1+1	2
6.	22 FMP 211	Farm Machinery and Power	1+1	2
7.	22 HOR211	Production Technology for Fruit and Plantation Crops	1+1	2
8.	22 PAT 201	Fundamentals of Plant Pathology	2+1	3
9.	22 STA 211	Statistical Methods	1+1	2
10.	22 AMP 201	Livestock and Poultry Management	2+1	3
11.	22 AGR 203	Study Tour*	0+1*	1*
<b>Total</b>			<b>14+11</b>	<b>25</b>
12.	22 NSS/ NCC 101	NSS or NCC	0+1#	1#
13.	22 PED 101	Physical Education and Yoga Practices	0+1#	1#

#Registered in Semester I and Evaluation in Semester IV \* Non- gradial Course

### Semester IV

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 204	Crop Production Technology II (Rabi Crops)	1+1	2
2.	22 AGR 205	Rainfed Agriculture and Watershed Management	1+1	2
3.	22 COM 211	Agri-Informatics	1+1	2
4.	22 PBG 202	Fundamentals of Plant Breeding	2+1	3
5.	22 SAC 201	Problematic soils and their management	2+0	2
6.	22 AEN 202	Management of Beneficial and Harmful Insects	2+1	3
7.	22 ERG 211	Renewable Energy and Green Technology	1+1	2
8.	22 PAT 202	Principles of Plant Disease Management	1+1	2
9.	22 HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1	2
10.	22 AEX 201	Communication Skills and Personality Development	1+1	2
11.	22 ELC ***	Elective Course I	2+1	3
<b>Total</b>			<b>15+10</b>	<b>25</b>
12.	22 NSS/ NCC 101	NSS or NCC	0+1#	1#
13.	22 PED 101	Physical Education and Yoga Practices	0+1#	1#

#Registered in Semester I and Evaluation in Semester IV

### Semester V

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 301	Practical Crop Production I (Kharif Crops)	0+1	1
2.	22 AGR 302	Farming System and Sustainable Agriculture	1+0	1
3.	22 SST 301	Principles of Seed Technology	2+1	3
4.	22 SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1	3
5.	22 AEN 301	Pests of Crops and Stored Grain and their Management	2+1	3
6.	22 AEC 301	Agricultural Marketing Trade and Prices	2+1	3
7.	22 APE 311	Protected Cultivation and Secondary Agriculture	1+1	2
8.	22 PAT 301	Diseases of Field and Horticultural Crops and their Management I	2+1	3
9.	22 HOR 311	Post Harvest Management and Value Addition of Fruits and Vegetables	1+1	2
10.	22 ARM 301	Entrepreneurship Development and Business Communication	1+1	2
11.	22 ELC ***	Elective Course II	2+1	3
		<b>Total</b>	<b>16+10</b>	<b>26</b>

### Semester VI

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 303	Practical Crop Production II (Rabi Crops)	0+1	1
2.	22 AGR 304	Principles of Organic farming	1+1	2
3.	22 PBG 302	Crop Improvement	2+1	3
4.	22 AEC 302	Agricultural Finance and Co-operation	2+1	3
5.	22 PAT 302	Diseases of Field and Horticultural Crops and their Management II	2+1	3
6.	22 ABT 301	Plant Biotechnology	2+1	3
7.	22 RSG 301	Geo-informatics, Nanotechnology and Precision Farming	1+1	2
8.	22 ARM 302	Intellectual Property Rights	1+0	1
9.	22 ENS 301	Environmental Studies and Disaster Management	2+1	3
10.	22 ELC ***	Elective Course III	2+1	3
		<b>Total</b>	<b>15+9</b>	<b>24</b>

**Semester VII**

<b>S. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Total Credits</b>
1.	22 AEX 401	Rural Agricultural Work Experience and Agro- Industrial Attachment (RAW& AIA)	0+20	20
2.	22 AGR 401	Project Work	0+1	1
3.	22 AEX 402	All India Study Tour*	0+1*	1*
		<b>Total</b>	<b>0+22</b>	<b>22</b>

\* Non- gradial Course

**Semester VIII**

<b>S. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Total Credits</b>
1.	22 ELP ***	Experiential Learning Programme I	0+10	10
2.	22 ELP ***	Experiential Learning Programme II	0+10	10
		<b>Total</b>	<b>0+20</b>	<b>20</b>

**U.G. Degree - B.Sc. Agriculture 2022 batch**

**I Semester courses**

**Semester I**

<b>S. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Total Credits</b>
1.	22AGR101	Fundamentals of Agronomy and Agricultural Heritage	2+1	3
2.	22SAC101	Fundamentals of Soil Science	2+1	3
3.	22HOR111	Fundamentals of Horticulture	1+1	2
4.	22AEX101	Rural Sociology and Educational Psychology	2+0	2
5.	22BIC101	Fundamentals of Plant Biochemistry	1+1	2
6.	22FOR111	Introduction to Forestry	1+1	2
7.	22LAN101	Comprehension and Communication Skills in English	1+1	2
8.	22PBG101	Introduction to Agricultural Botany	1+1	2
9.	22 NSS/ NCC 101	NSS or NCC *	0+1*	1*
10.	22 PED 101	Physical Education and Yoga Practices*	0+1*	1*
		<b>Total</b>	<b>11+9</b>	<b>20</b>

\*Non- gradial courses

## **22AGR101 FUNDAMENTALS OF AGRONOMY & AGRICULTURAL HERITAGE(2+ 1)**

### **Course objectives**

- To have a general understanding of the Agronomy, seasons, crop and its classification
- To appraise the students about crops, planting/sowing, growth and factors influencing growth and crop nutrition and its general management
- To study the impact of weeds on crop production and its management

### **Course outcomes**

- Basics of crop characteristics and its classifications understood
- Fundamentals of growth, factors influencing and its relationship with nutrients studied
- Scientific knowledge on weeds its impacts on crop growth and the Integrated weed management studied

### **Theory**

#### **Unit - I: Importance of agriculture**

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

#### **Unit - II: Agricultural heritage**

Agriculture heritage - Agriculture in ancient India - Chronological agricultural technology development in India - Kautilya's Arthashastra - Sangam literature - Kambar Eazhupathu - Development of scientific Agriculture - National and International Agricultural Research Institutes in India - Indian agriculture.

#### **Unit - III: Agroclimatic zones, crops and soils**

Agronomy - Definition - Importance and scope - Agro-climatic zones of Tamil Nadu - Agro ecological zones of India - Crops and their classification - Economic and agronomic - Major crops of India and Tamil Nadu - Major soils of Tamil Nadu - Factors affecting crop production - climatic - edaphic - biotic - physiographic and socio economic factors.

#### **Unit - IV: Tillage and after cultivation**

Tillage - Definition - Types - Objectives - Modern concepts of tillage - Main field preparations - Seeds - seed rate - sowing methods - Crop establishment methods - Planting geometry and its effect on growth and yield - After cultivation -Thinning - Gap filling - Weeds - Definition - Weed control methods.

#### **Unit - V: Cropping and farming systems**

Manures and fertilizers (organic, in-organic, green manure) - time and method of application - Irrigation

- Principles and concepts - Cropping patterns and cropping systems - Sustainable agriculture - integrated farming systems - Organic agriculture - Principles and concepts - Dry farming - Principles and concepts.

### **Text books**

1. Sankaran, S. and Subbiah Mudaliar, V.T. 1991. Principles of Agronomy. Bangalore, Printing & Publishing Co., Bangalore
2. Chandrasekaran. B, Annadurai. K and Somasundaram. E. A textbook of agronomy 2010 reprint 2016. New international (P) limited, publishers, New Delhi

### **References**

1. Reddy. T.Y and Reddy, G.H.S.1995. Principles of Agronomy, Kalyani Publishers, Ludhiana.
2. Balasubramaniyan, P and Palaniappan, S.P. 2001. Principles and Practices of Agronomy. AgroBios (India) Ltd., Jodhpur.
3. De, G.C.1989. Fundamentals of Agronomy. Oxford & IBH Publishing Co., New Delhi.
4. Gupta, O.P. 2000. Weed Management - Principles and Practices. Agrobios (India) Ltd., Jodhpur
5. Havlin, J. L., Beaton, J. D., Tisdale, S.L., and Nelson, W.L. 2006. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (7<sup>th</sup> ed.). Pearson Education, Delhi.
6. Rao, V.S. 2000. Principles of Weed science. Oxford & IBH Publishing Co. NewDelhi.

\*\*\*\*\*

## 22SAC101 FUNDAMENTALS OF SOIL SCIENCE (2 + 1)

### Course Objectives:

- To impart knowledge about the soil forming process.
- To learn about physical properties of soil.
- To have a general understanding on soil chemical properties reactions.
- To study the impacts of soil pollution and the remediation measures.

### Course Outcomes:

- Knowledge gained about the soil forming process.
- Physical properties of soil studied.
- Various soil chemical properties and reactions understood.
- Impact of soil pollution and remediation measures learnt.

### Theory

#### Unit I

Soil as a natural body, Pedological and edaphological concepts of soil. Components of soil. Soil genesis: Composition of Earth's crust- soil forming rocks and minerals – Primary and secondary minerals. Weathering of rocks and minerals. Factors of soil formation. Soil forming processes. Soil Profile.

#### Unit II

Soil physical properties: Soil texture, structure, density and porosity, soil colour, consistence and plasticity. Soil water retention, movement and availability. Soil air, composition, gaseous exchange-problem and its effect on crop growth. Source, amount and flow of heat in soil, Soil temperature and crop growth.

#### Unit III

Soil physico chemical and chemical properties: Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability. Electrical conductivity. Soil colloids - inorganic and organic. Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation.

#### Unit IV

Soil organic matter: composition, properties and its influence on soil properties. Humic substances - nature and properties. Soil Biology: Soil organisms : macro and micro organisms, their beneficial and harmful effects. Soil enzymes. Soil pollution – Types and behaviour of pesticides. Inorganic contaminants. Prevention and mitigation of soil pollution.

### Text books

1. Das, D.K. 1997. Introductory Soil Science. Kalyani Publishers New Delhi

## **References**

1. Biswas, T.D. and Mukherjee, S.K. 1987. Text Book of Soil Science. Tata McGraw Hill Publishing Co., New Delhi
2. Black, C.A. 1982. Methods of Soil Analysis, Part I ASA, Madison, USA.
3. Brady, N.C. and Raymond, C.Weil. 2013. The Nature and Properties of Soils (14<sup>th</sup> Edition). Pearson Education, Inc. Publishing as Prentice Hall.

\*\*\*\*\*

## **22HOR111 FUNDAMENTALS OF HORTICULTURE (1 + 1)**

### **Course Objectives**

- To study the basics of horticulture and horticultural practices
- To expose the students to different horticulture divisions
- To impart knowledge on different types of plant propagation and propagating structures

### **Course Outcome**

- Basics of horticulture and classification of crops learned
- Different types of plant propagation techniques and propagating structures studied
- Gain practical knowledge in special horticultural practices

### **Theory**

#### **Unit I**

##### **History, evolution and scope of horticulture**

Origin of horticulture – history – evolution – definitions – scope and importance of horticulture – division and classification of horticultural crops – fruits, vegetables, spices and plantation crops, floriculture, landscaping, ornamental gardening, medicinal and aromatic crops – nutritive value and global and national scenario of horticultural crops.

#### **Unit II**

##### **Sexual propagation**

Sexual propagation – importance, advantages and disadvantages – methods of enhancement of seed viability – types of dormancy – seed invigoration – seed treatments

#### **Unit III**

##### **Asexual propagation**

Asexual propagation, importance, advantages and disadvantages - Asexual propagation types viz., Types of cutting, layering, grafting and budding. Use of specialized plant parts in propagation. Propagation structures and their role. Rootstock influence – stock / scion relationship in fruit crops. Scope and importance of micro propagation in horticultural crops. Direct and indirect organogenesis – media for micro propagation and hardening.

#### **Unit IV**

##### **Planting systems and pollination**

Principles of orchard establishment - Methods of planting systems including HDP and UHDP in horticultural crops – crop regulatory practices for horticultural crops – training, pruning, special operations in horticultural crops – off season production of horticultural crops. Flowering,

pollination, fruit set, fruit drop, parthenocarpy, fruit ripening and senescence – Unfruitfulness and its causes.

## **Unit V**

### **Principles and types of garden**

Principles and types of garden – principles and types of parks – principles of herbal garden

### **Text books**

1. Jitendra Singh, 2004. Basic of horticulture. Kalyani publishers, Ludhiana.
2. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil, TamilNadu.

### **References**

1. Sadhu, M.K.1989. Plant Propagation. Wiley Eastern Ltd., 4835/24, Ansari Road, Daryaganj, New Delhi- 110 002. Bose, T.K., S.K. Mitra, M. K. Sadhu and B. Mitra. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prakash 206, Bidhan Sarani, Calcutta-6, India. Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greeneve. 1997. Plant Propagation - Principles and Practices. Prentice Hall of India Private Ltd., New Delhi. Nanda, K.K and V.K. Kochhar. 1995. Vegetative Propagation of Plants. Kalyani Publishers, Ludhiana.
2. George Acquaah, 2002. Horticulture – principles and practices. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Hartman, H.T. and Kester, D.E. 1986. Plant propagation – Principles and Practices – Prentice Hall of India Ltd., New Delhi.
4. Jules Janick.1979. Horticultural Science. Surjeet Publications. New Delhi.

\*\*\*\*\*

## **22AEX101 RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY (2+ 0)**

### **Course objectives**

- To get an idea of sociological behaviour of rural population
- To familiarize the functions of rural society social stratification and social changes
- To understand the behaviour pattern and theories of motivation

### **Course outcomes**

- Students learnt the rural society and their behaviour pattern
- Students gained the practical knowledge of functions of social institution
- Familiarize the concept of agricultural extension practices

### **Theory**

#### **Unit I**

##### *Introduction to Sociology, Social groups, Culture and Social Values*

Sociology and Rural Sociology – definitions; Society – rural and urban, characteristics, differences and relationships, important characteristics of Indian rural society; Social groups – definition, classification, role of social groups in extension; Culture – concept, cultural traits, characteristics, functions, Ethnocentrism, Acculturation, Cultural lag, Cultural diffusion, Marginal man, Ethos. Social Values – definition, values and norms, characteristics of values, functions;

#### **Unit II**

##### *Social Structure, Social Stratification and Migration*

Structure of Rural Society – patterns of rural settlement, social institutions, social organizations, ecological entities (Region, Community, Neighbourhood, Family); Social Stratification – concept, functions, types, differences between class and caste system; Migration – concept, factors influencing migration.

#### **Unit III**

##### *Social Control, Social Customs*

Social Control – definition; Customs – conventions, folkways, mores, rituals, taboos; Social Interaction Process – definition, basic social processes; Social Change – concept, factors influencing social change, indicators of social change; Social development:

#### **Unit IV**

##### *Introduction to Educational Psychology, Intelligence, Teaching-Learning Process*

Education – Psychology – Educational Psychology – Social Psychology – definitions, importance in extension; Basic principles of Human behaviour – Sensation, Attention, Cognitive, affective, psychomotor domain Perception – meaning, characteristics; Intelligence – concept, types, measurement, factors affecting intelligence; Personality – concept, types, measurement, factors influencing personality; Teaching–Learning Process – Teaching – definition, meaning, principles of teaching, steps in extension teaching; Learning – definition, meaning, principles, types of learning, learning situation.

## **Unit V**

### *Motivation, Attitude*

Motivation – concept, Maslow’s hierarchy of needs, intrinsic and extrinsic motivation, techniques of motivation, importance in extension; Attitude – concept, factors influencing the development of attitudes.

### **Text books**

1. Chauhan, S.S. 2001. Advanced Educational Psychology, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Chitambar, J.B.1997. Introductory Rural Sociology, New Age International (P) Ltd., Publishers, New Delhi.

### **References**

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

\*\*\*\*\*

## 22BIC101 Fundamentals of Biochemistry (1+1)

### Theory

#### Unit I: Carbohydrates

Carbohydrates - occurrence and classification. Structure of monosaccharides, oligosaccharides and polysaccharides. Physical and chemical properties of carbohydrates – optical isomerism, optical activity, mutarotation, reducing property, reaction with acids and alkalies.

#### Unit II: Lipids

Lipids - occurrence and classification. Storage lipids - Fatty acids and triacyl glycerol. Essential fatty acids and phospholipids - types and importance; Sterols - basic structure and their importance. Physical and chemical constants of oils. Rancidity of oils.

#### Unit III: Proteins

Amino acids - Classification and properties, essential amino acids. Importance and classification of proteins based on functions and solubility. Structure of proteins. Properties and reactions of proteins.

#### Unit IV: Enzymes

Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors and isoenzyme Mechanism of enzyme action. Factors affecting enzyme activity. Allosteric enzymes.

#### Unit V: Nucleic acids

Nucleic acids: Function, classification, structure, replication, transcription and translation.

### References:

1. Berg JM, Tymoczko JL and Stryer L, (2007), Biochemistry, 7th Ed. Wiley Eastern Ltd. ISBN:0-7167-8724-5.
2. Thayumanavan, B, Krishnaveni, S and Parvathi, K, (2004), Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.
3. Lehninger, Nelson, D. L. and Michael, M. C. 2004. Principles of Biochemistry. Freeman Publishers.
4. Rameshwar, A. 2006. (3rd edit). Practical Biochemistry. Kalyani Publishers, New Delhi.
5. Sadasivam, S and Manickam, A. 1996. Biochemical methods for Agricultural sciences. Newage International publishers, New Delhi.

### E-References:

1. Cox, MM and Nelson, DL. (2011), Principles of Biochemistry, Fourth (Indian edition) Macmillan, Worth Publishers. <http://bcs.whfreeman.com/lehninger6e - Web links/> Tutorials/ Lecture companion Art
2. Harper's illustrated Biochemistry -[https:// freemedebooks. files.wordpress.com /2014/01/ harpers-illustrated-biochemistry-28th-edition.pdf](https://freemedebooks.files.wordpress.com/2014/01/harpers-illustrated-biochemistry-28th-edition.pdf)
3. J M Berg, J L Tymoczko and L Stryer , Biochemistry, Sixth Edition -

<http://www.irb.hr/users/>

precali/

Znanost.o.Moru/

Biokemija/Literatura/Lubert%20Stryer%20-%20Biochemistry.pdf

4. Sadasivam, S and Manickam, A. (2009), Biochemical Methods, 3rd Edn, New Age International.

5. Wilson, K. and Walker, J.M. (2000), Principles and techniques of Practical Biochemistry, 5thEdn. – Cambridge University Press.

6. [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)

\*\*\*\*\*

## 22FOR 111 INTRODUCTION TO FORESTRY (1 + 1)

### Course objectives

- To study the importance of forest and agroforestry systems in sustaining the land productivity
- To understand the crop tree interactions in different types of agroforestry systems
- To get an idea of the productive and protective functions of agroforestry

### Course outcome

- Students learnt about the concepts of agroforestry practiced in various agro ecosystems
- Basic understanding of the multipurpose trees in agroforestry systems
- Beneficial effects of agro forestry such as nitrogen fixing, soil conservation, litter dynamics and nutrient cycles will be studied

### Theory

#### UNIT I

##### Forest and Forestry

Introduction - Definition of Forest and Forestry - Role of Forest (Production, Protection and Amelioration) - Classification of Forest (Regeneration, Age, Composition, ownership, object of management, growing stock) - National Forest Policy 1988.

#### UNIT II

##### Silviculture and Forest plantation

Forest regeneration - Natural regeneration- Seeds and vegetative parts (Coppice , Root suckers) - Artificial regeneration , Objectives - Nurseries - Types of nurseries, Quality seedling production techniques - Silvicultural practices for *Eucalyptus spp*, *Casuarina equisetifolia*, *Tectona grandis*, *Ailanthus excelsa*, *Melia dubia*, *Leucaena leucocephala*. Tending operations - Weeding, Cleaning, Thinning and pruning.

#### UNIT III

##### Forest Mensuration

Forest Mensuration - Objectives- Diameter measurements, instruments used in diameter measurement-Height measurement, instrumental methods of height measurement - Tree form, form factor, Volume estimation of standing and felled trees.

#### UNIT IV

##### Social forestry and Agroforestry

Social Forestry and its branches - Extension Forestry, Urban forestry - Agroforestry, definition- Importance- Agroforestry systems - Shifting Cultivation, Taungya, Alley cropping, Wind break, Shelter belt, Home garden - Tree and crop combination in Agroforestry - Tree crop interaction in Agroforestry - National Agroforestry Policy 2014.

## **UNIT V**

### **Forest Utilization**

Forest Utilization - Definition - Wood products - solid wood and composite wood.- Non Wood Forest Products - fibres , floss, bamboo, tan, dye, resin, oleoresin.

### **Text books**

1. Puri, S and Panwar, P. (ed.). 2007. Agroforestry Systems and Practices. New India Publishing Agency, New Delhi, 643p

### **References**

2. Gupta, R.K. 1993. Multipurpose Trees for Agroforestry and Wasteland Utilization. Oxford and IBH, 562p
3. Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwere Academic Publications, Dordrecht, The Netherlands, 499p

\*\*\*\*\*

## 22LAN101 COMPREHENSION & COMMUNICATION SKILLS IN ENGLISH (1 +1)

### Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary-Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

### Text books

1. Sundararajan, N, Attentive Listening: How it Matters, University News, March 19-25, 2005.
2. Greenbaum Sidney, Oxford English Grammar, New Delhi, Oxford University Press. Peregoy, 2009.

### References

1. Goodale, Malcolm, Professional Presentations, Cambridge University, 2005.
2. Jones Daniel, English Pronouncing Dictionary, Cambridge University Press, 2006.
3. Lynch, Tony and Kenneth Anderson, Study Speaking, Cambridge University, 1992.
4. Martin Cutts, Oxford Guide to Plain English, Oxford University Press, 2004.
5. Sahaneya Wandy, et.al., IELTS, Preparation and Practice, Oxford University, 2005.

\*\*\*\*\*

## 22PBG101 INTRODUCTION TO AGRICULTURAL BIOLOGY (1 + 1)

### Course objectives

- To have a general understanding of the botanical names, crops and its systematic classification
- To appraise the students about crops, botanical importance and their floral parts
- To study the economic important parts of agricultural plants

### Course outcomes

- Basics of crop characteristics and its classifications understood
  - Fundamentals of growth, factors influencing and its relationship with nutrients studied
- Scientific knowledge on weeds its impacts on crop growth and the Integrated weed management studied

### Theory

#### Unit I

##### *Systems of classification and general morphological description*

Bentham and Hooker's classification of plant kingdom — International code of nomenclature and its major guidelines – author citation – Agricultural classification of crops; General morphology: Life span, habit, root, stem, leaf - petiole, leaf margin, leaf apex, leaf shape, venation and phyllotaxy; Modification of roots and leaf; Floral morphology: Kinds of bracts, inflorescence; Structure of flower, androecium, gynoecium, placentation, types of fruits.

#### Unit II

##### *Botanical description and economic uses of Poaceae*

List of cultivated crops, economic parts, chromosome number and family description of Poaceae: Key botanical features of Rice, Wheat, Sorghum, Maize, Pearl millet, Finger millet, list of small millets, Guinea grass, Napier grass, Cenchrus and Sugarcane

#### Unit III

##### *Botanical description and economic uses of Papilionaceae*

List of cultivated crops, economic parts, chromosome number and family description of Papilionaceae: Key botanical features of Red gram, Bengal gram, Soybean, Black gram, Green gram, Cowpea, Lablab, Horse gram, Groundnut, Lucerne, Stylosanthes, Clitoria, Agathi and Sunnhemp

#### Unit IV

*Botanical description and economic uses of Pedaliaceae, Asteraceae, Oleaceae, Brassicaceae, Euphorbiaceae, Arecaceae and Malvaceae*

List of cultivated crops, economic parts, chromosome number and family description of the following families and Key botanical features of the crops given against them: Pedaliaceae - Gingelly; Asteraceae - Sunflower, Safflower, Chrysanthemum; Oleaceae - Jasmine; Brassicaceae - Rapeseed and Mustard, Cabbage, Cauliflower; Euphorbiaceae: Castor; Jatropha and Tapioca; Arecaceae: Coconut, Arecanut, Oilpalm, Sugarpalm; Malvaceae: Cotton, Mesta and Bhendi.

### **Unit V**

*Botanical description and economic uses of Tiliaceae, Piperaceae, Chenopodiaceae, Solanaceae, Mimosae, Moraceae, Cucurbitaceae, Alliaceae, Musaceae, Rubiaceae, Theaceae*

List of cultivated crops, economic parts, chromosome number and family description of the following families and key botanical features of the crops given against them. Tiliaceae: Jute; Piperaceae: Betelvine; Chenopodiaceae: Sugar beet; Solanaceae: Tobacco, Potato, Chilli, Tomato and Brinjal; Mimosae: Desmanthes, Subabul and Acacia; Moraceae: Mulberry; Cucurbitaceae: Cucumber, Pumpkin, Ashgourd; Alliaceae: Onion and Garlic; Musaceae: Banana, Manila hemp; Rubiaceae: Coffee; Theaceae: Tea

### **Text books**

1. Sambamurthy, V.S. and N.S. Subramanian, 1989. Text Book of Economic Botany, Wiley Eastern, New Delhi
2. John Joel, A., C. Vanniarajan, T.S. Raveendran, and A. Gopalan 2006. Fundamentals of Crop Botany, Directorate of ODL, Tamil Nadu Agricultural University, Coimbatore-641 003.

### **References**

1. Purse glow, 1988. Tropical Crops - Monocotyledons. The English Language book Society and Longman Co., Singapore
2. Albert F. Hill and O.P. Sharma, 1996. Economic Botany. Tata McGraw - Hill Publishing Co. Ltd., New Delhi.
3. Daniel Sundararaj, D. and G. Thulasidas, 1993. Botany of field crops. MacMillan India Ltd., New Delhi.

\*\*\*\*\*

## 22NSS/NCC 101 (0 + 1) \*\* (non gradial)

### NATIONAL SERVICE SCHEME NSS

#### I Year

Orientation – NSS origin – motto – symbol – NSS administration at different levels – programme planning – Rural Projects – Urban projects – Government schemes – Career guidance – Self help groups – Environment protection – Use of natural energy – Conventional energy resources – Soil and Water conservation – Community health programmes – Women and child welfare – Education for all – National days – Commemorative days – NSS thematic programmes – literacy & computer awareness campaigns.

#### II Year

Popularization of agro techniques – Self employment opportunities – Animal health, Dairy and Poultry farming – Road safety – Training on First aid and emergency cell. Popularization of small savings – communal harmony and National integration – Care of Senior citizens – Personality development – meditation, Yoga Art of living – Activities on the preservation of National monuments, cultural heritage and folklore – special camp activities – National days – commemorative days – NSS thematic programmes – literacy & computer awareness campaigns.

Besides the above, NSS volunteers will attend work during important occasions like Convocation, Farmers day, Sports meet and other University / College functions.

NSS Volunteers will attend one special camp in the selected village for a duration of 10 days and undertake various activities based on the need of that village.

For all out door regular activities villages / slums nearby the campus may be selected to avoid transport cost (cycle able distance). Special camp activity will be conducted in a village situated within a radius of 15 – 20 KM.

#### Evaluation

A. Regular activities 60 marks	= I Semester	15 marks
	II Semester	15 marks
	III Semester	15 marks
	IV Semester	15 marks

(Written test 10 marks – participation in programmes and behavior 5 marks) 80% attendance is mandatory for attending special camp

B. Special camp activities

- a. Attendance in daily activities during special camp: 30 marks
- b. Special camp activity report : 5 marks
- c. Viva-voce on the 10<sup>th</sup> day of special camp : 5 marks

Total : 40 marks

\*\*\*\*\*

## NATIONAL CADET CORPS NCC

### I Year

General - Military History – Introduction to NCC – Aims of NCC – Principles of NCC, NCC organization, Duties of good citizen – system of NCC training – Foot drill – Arms drill – Guard of Honour – Ceremonial Drill – Weapon training – First aid – Rifle and Light machine gun – Map reading – Civil defence – Leadership.

### II Year

Drill – Weapon drill – Weapon training and firing – Introduction to National Integration – Historical – geographical – Religions back ground of India – Health and Sanitation – Aid to Civil Authorities – Civil defence – Ecology / Nature awareness – Map reading – Social service – Adventure Activities – Leadership qualities.

Besides the above schedule, NCC cadets will be involved during important occasions during convocation, Independence day, Republic day, etc.

### Evaluation:

		Sem I	Sem II	Sem III	Sem IV	Total
A.	Regular activities and Behaviour	10	10	10	10	40
B.	Participation in camps and special assignments	5	5	5	5	20
C.	Written test and viva	10	10	10	10	40
	<b>Total</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>100</b>

\*\*\*\*\*

## **22PED101 PHYSICAL EDUCATION AND YOGA PRACTICES (0 + 1)(non gradial)**

### Practical

(17 Practical classes – 2½ hours each class – 17 classes will be converted into 40 practical hours and 2½ hours for evaluation)

### I Semester (20 Hours)

Exercises for strength, agility, co-ordination, flexibility, co-operation, vital capacity endurance, speed and for various systems of our body and team spirit.

Exercise for Good Posture – Conditioning and calisthenics for various Athletic activities *i.e* (a) Before start – Arm stretch, hand stretch and cat stretch (b) Loosening up jogging, bending and twisting (c) Standing – Lateral Arc, triangle and hands to feet pose (d) Sitting – camel kneel, spinal twist and supine knee bend (e) Relaxation – The corpse pose, quick and deep relaxation. Basic gymnastic exercises – participation of athletic events – running, throwing and jumping events.

Skill development in any one of the following games

Warming up, suitable exercise, lead up games, advance skill for all the games.

Basket Ball : Dribbling, pass, two or three men pass, pivot, lay up shot, shooting, pass break, hook pass, screening, positional play, defence and offence tactics.

Volley Ball : Fingering, under arm pass, over head pass, setting, spiking, back pass, jump pass, stunts, elementary dive, flying dive, roll, blocking and various types of services.

Ball Badminton : Grip, service, foot work, fore hand stroke, back hand stroke, lob, smash, volley, wall practice, spin service and defence tactics.

Foot ball : Dribbling, passing, dodging, kicking, heading, screening, chest pass, throwing, dragging, goal kick, defence and offence tactics.

Hockey : Grip, bully, dribbling, hitting, drive, push strokes, scoop, flick, stopping, various types of passes, dodging, defence and offence tactics.

Kho-Kho : Quadra ped, bi-ped, how to given kho, taking a direction, recede, parallel toe method, bullet tow method, distal method, foot out, dive, ring game, chains and pursue and defence skills.

Chess : Moves, move of king, move of pawns, move of rooks, move of bishops, move of queen, move of knights, en passant, castling, check and notation.

Kabaddi : Raid, touch, cant, catch, struggle, various types of defence and offence tactics.

Cricket : Grip, bowling, spin, leg spin, off spin, medium, batting, dive, sweep, mode of delivery, fielding, rolling etc.

Tennis : Grip, forehand drive, back hand drive, stroke, backhand ground stroke, service, volley, smash, wall practice, foot work, defence and offence tactics.

Table Tennis : Grip, tossing and serving, spin serve, rally, smash, flick, defence and offence tactics.

Shuttle Badminton : Grip, foot work, service, setting, smash, volley, forehand and back hand stroke, back hand serve and defence.

Gymnastics : Balanced walk, execution, floor exercise, tumbling/acrobatics, grip, release, swinging, parallel bar exercise, horizontal bar exercise, flic-flac-walk and pyramids.

## ATHLETICS

- Sprint : Medium start, long start, bunch start, set, pick up, finish, upsweep, downsweep, placement, receiving and exchanging.
- Jumps : Western roll, belly roll, eastern cut off, fass ferry flop, approach, take off, straddle, hitch-kick, handging, clearance, landing, strides etc.
- Throws : Grip, momentum, pre shift, sub phase, the wind up, foot work, entry to the turn, shift, angle of release, follow throw, delivery, front cross step, rear cross step, hop step, fuck method pary obraine, discoput, rotation, carry and glide.
- Hurdles : Finding lead leg, use of lead leg and trial leg, flight, clearing, finish.

Lead up games, advance skills and game for any one of the above games.

II Semester (20+ 2 ½ hours)

Rules and regulations of anyone of the games and athletic events.

Aims and objectiaves of yoga – asanas : ie. padmasana, pujankasana, sarvangasana, chakrasana,dhanurasana, halasana, mayurasana and savasana, asanas for ailments, back pain, arthritis, abdominal problems, stress, fatiguel, Insomnia, obsity, circulation, hypertension, varicose veins, respiration, heart, digenstion, headaches, depression, addiction and eye problems.

Mental balance and importance – development of concentration suriyanamaskar – advance skills of any one of the games which were taught in the I semester.

## **METHOD OF EVALUATION:**

a.	Attendance	60 Marks
b.	Behavior	10 Marks
c.	Participation in Sports and Games	20 Marks
d.	Final <i>Viva Voce</i>	10 Marks

Marks will be awarded at the end of the IV Semester based on the above method of evaluation procedure. Final class grade chart of each student will be sent to the Dean of Agricultural Sciences, DSU.

\*\*\*\*\*

### **2022 Batch**

#### **II Semester courses**

#### **Semester II**

<b>S. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Total Credits</b>
1.	22 AGR 102	Introductory Agro-Meteorology and Climate Change	1+1	2
2.	22 AEC 101	Fundamentals of Agricultural Economics	2+0	2
3.	22 SWE 111	Soil and Water Conservation Engineering	2+1	3
4.	22 HOR 112	Production Technology for Vegetables and Spices	1+1	2
5.	22 FSN 111	Principles of Food Science and Nutrition	1+1	2
6.	22 AEX 102	Fundamentals of Agricultural Extension Education	2+1	3
7.	22 CRP 101	Fundamentals of Crop Physiology	2+1	3
8.	22 AGM 101	Fundamentals of Microbiology	2+1	3
9.	22 MAT 111	Elementary Mathematics	2+0	2
<b>Total</b>			<b>15+7</b>	<b>22</b>
10.	22 NSS/ NCC 101	NSS or NCC	0+1#	1#
11.	22 PED 101	Physical Education and Yoga Practices	0+1#	1#

#Registered in Semester I and Evaluation in Semester IV

#### **22 AGR 102 INTRODUCTORY AGRO-METEOROLOGY & CLIMATE CHANGE (1+1)**

#### **Course objectives:**

- Explain the importance of agro-meteorology and its uses in agricultural field
- Discuss about climate change and its impact on agriculture.

- Illustrate the relationship between crop and weather to predict various crop yields

**Course outcome:** Upon completion students will be able to

- Appreciate the importance of weather variables in agriculture
- Comprehend the role solar radiation in crop growth
- Analyze various forms of precipitation
- Interpret the role of weather hazards and climate change in crop growth
- Understand the correlation between weather and agriculture
- Measure weather parameters essential for crop growth

## **Theory**

### **Unit I- Climate and weather**

Meteorology - Agricultural Meteorology - Importance and scope in crop production - Coordinates of India and Tamil Nadu - Atmosphere - Composition and vertical layers of atmosphere (stratification) - Climate - Weather - Factors affecting climate and weather - Climatic types - Different agricultural seasons of India and Tamil Nadu and climatic characteristics of India.

### **Unit II- Solar radiation, RH and Wind**

Solar radiation - Light intensity, quality, direction and duration - Air and Soil temperature - Diurnal variation - importance in crop production. Heat unit and its importance in agriculture. Relative Humidity and its importance - vapor pressure deficit and its importance - Wind and its effect on crops.

### **Unit III- Atmospheric pressure and precipitation**

Atmospheric pressure - cyclones, anticyclones, tornado, hurricane and storms - Wind systems of the world -. Clouds - types and their classification. Precipitation - forms - monsoon - Seasons of India- rainfall variability drought, flood and their effect - Cloud seeding - Evaporation - transpiration - Evapotranspiration - PET.

### **Unit IV- Agroclimatic zones and remote sensing**

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

### **Unit V- Climate change**

Climate change- climate variability - definition and causes of climate change - Impact of climate change on Agriculture.

## **Practical:**

Site selection and layout for Agromet Observatory and calculation of local time. Measurements of solar radiation, sunshine hours, air and soil temperature, grass minimum thermometer, humidity wind direction and wind speed, atmospheric pressure, rainfall, evaporation . Heat Unit concept. Probability analysis of rainfall for crop planning. Synoptic charts and weather calendars. Length of growing periods using weekly rainfall data. Water balance studies. Identification of efficient cropping zone- RYI, RSI. Mapping of agro climatic Zones of India and Tamil Nadu and its characterization.

### **Lecture schedule**

1. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production.
2. Coordinates of India and Tamil Nadu. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
3. Climate and weather - Factors affecting climate and weather. Macroclimate - Meso climate - Microclimate - Definition and their importance - Different climates of India and Tamil Nadu and their characterization.
4. Solar radiation - Radiation balance - Wave length characteristics and their effect on crop production - Light - effect of intensity, quality, direction and duration on crop production.
5. Air temperature - Factors affecting temperature. Diurnal and seasonal variation in air temperature - Isotherm, Heat unit and its use - Heat and cold injuries.
6. Role of temperature in crop production. Soil temperature - Importance in crop production. Factors affecting soil temperature, diurnal and seasonal variation in soil temperature.
7. Humidity - Types - Dew point temperature - Vapour pressure deficit - Diurnal variation in Relative humidity and its effect on crop production - Wind and its role on crop production.
8. Atmospheric pressure, diurnal and seasonal variation - Isobar – cyclone, hurricane, tornado and storms.
9. **Mid Semester Examination.**
10. Wind systems of the world - wind speed in different seasons -. Clouds and their classification - Concepts of cloud seeding - present status.
11. Precipitation - Forms of precipitation - Isohyte - Monsoon - Different monsoons of India - Rainfall variability - Drought and flood - Impact on crop production.
12. Evaporation - Transpiration, evapotranspiration - Potential evapotranspiration - Definition and their importance in agricultural production. Agroclimatic zones of Tamil Nadu - Agroclimatic normals for field crops.
13. Weather forecasting - Types, importance, Agro Advisory Services - Synoptic chart - Crop weather calendar.
14. Remote sensing and its application in agriculture.
15. Effect of weather and climate on crop production, soil fertility and incidence of pest and diseases.

16. Climate change, climate variability - definition and causes of climate change.
17. Impact of climate change on Agriculture.

### **Practical schedule**

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

### **Text books**

1. Mahi, G.S. and Kingra, P.K. 2015. Fundamentals of Agrometeorology. Kalyani Publishers, New Delhi.
2. Reddy, S.R. and Reddy, D.S. 2014. Agrometeorology, Kalyani Publishers New Delhi.
3. John Warren Smith. 2007. Agricultural Meteorology: The Effect of Weather on Crops. Macmillan publishers, UK.
4. Sahu, DD. 2007. Agrometeorology and Remote Sensing: Principles and Practices, Agrobios, Jodhpur.
5. Mavi, HS and Tupper GJ. 2004. Agrometeorology: Principles and Application of Climate Studies in Agriculture, Haworth Press.

6. Varshneya, MC. and Balakrishana Pillai P. 2003. Textbook of Agricultural Meteorology, ICAR.

### **Reference books**

1. Latief, A., R.H.Kanth, S. Parvaze and S.S.Mahdi. 2017. Experimental Agrometeorology: A Practical Manual. Springer International Publishing AG.
2. Mote, B.M. and D.D. Sahu. 2014. Principles of Agricultural Meteorology. Scientific Publishers, Jodhpur.
3. Srivastava, A.K. and P. K. Tyagi. 2011. Practical Agricultural Meteorology. New India Publishing Agency, New Delhi.
4. Adaptation and mitigation of climate - Scientific Technical Analysis. 2006. Cambridge University Press, Cambridge.
5. Prasad, Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University, Press, Thrissur.
6. Variraju, R and Krishnamurty 1995. Practical Manual on Agricultural Meteorology, Kalyani publications, New Delhi.

### **Web references**

1. [www.tawn.tnau.ac.in](http://www.tawn.tnau.ac.in)
2. <http://www.fao.org/docrep/x5672e/x5672e09.htm>
3. [www.imd.gov.in](http://www.imd.gov.in)
4. <https://library.wmo.int>
5. [www.usbr.gov/pn/agri.met](http://www.usbr.gov/pn/agri.met)

## **22 AEC 101 FUNDAMENTALS OF AGRICULTURAL ECONOMICS (2+0)**

### **Course objectives:**

- To study the significance of agriculture in economic development.
- Expose the students to economics principles and their applications.
- Train the students in economics tools for agricultural decision making
- Students will use economic models in domestic and global contexts to analyze individual decision making, how prices and quantities are determined in product and factor markets, and macroeconomic outcomes.

### **Course outcome:**

- Students will gain knowledge in application of economics tools for agricultural decision making.
- Students will be able to understand the links between household behaviour and the economic models of demand
- Students will use data to describe the relationships among variables in order to analyze economic issues.

- Students will get knowledge of market activities and behaviour: production, distribution, selling, purchasing etc. in relation to agriculture.

### **Unit 1- Nature and scope of economics**

*Economics:* Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, classification and characteristics, desire, want - meaning and characteristics, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.

### **Unit 2-Theory of consumption**

*Demand:* meaning, kinds of demand, law of demand, demand schedule and demand curve, determinants; *Utility theory* - cardinal and ordinal utility; law of diminishing marginal utility, equi-marginal utility principle, Indifference curve analysis and properties - budget line: definition, assumptions, limitations and applications - consumer's equilibrium and derivation of demand curve. Concept of consumer surplus and its importance. *Elasticity of demand:* concept and measurement of price elasticity, income elasticity and cross elasticity. Factors influencing elasticity of demand - Importance of elasticity of demand – Standard of Living: Definition, Engel's Law of Family Expenditure.

### **Unit 3-Theory of production**

*Production:* process, creation of utility, factors of production definition and characteristics – Input Output Relationship. *Laws of returns:* Law of variable proportions and Law of returns to scale. *Cost:* Cost concepts, short run and long run cost curves. *Supply:* Stock versus supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.

### **Unit 4-Exchange and theory of distribution**

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. *Distribution theory:* meaning, factor market and pricing of factors of production - Concepts of Rent and Quasi rent - *Wages:* Real wage and money wage - *Interest:* Pure interest and gross interest – *Profit:* Meaning of economic profit.

### **Unit 5-Macroeconomic concepts**

*National income:* Meaning and importance, circular flow, concepts of national income - accounting and approaches to measurement, difficulties in measurement. *Population:* Importance, Malthusian and Optimum population theories, natural and socio-economic

determinants, current policies and programmes on population control. *Money*: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. *Agricultural and public finance*: meaning, micro versus macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT and GST. *Economic systems*: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

### **Theory schedule:**

1. *Economics*: Meaning, scope and subject matter, definitions, activities.
  2. Approaches to economic analysis; micro and macroeconomics, positive and normative analysis.
  3. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.
  4. Basic concepts: Goods and services - classification and characteristics, desire, want – meaning and characteristics, demand, utility, cost and price, wealth, capital, income and welfare.
  5. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development.
  6. Agricultural planning and development in the country.
  7. *Demand*: meaning, kinds of demand, law of demand, demand schedule and demand curve, determinants.
  8. *Utility theory* - cardinal and ordinal utility; law of diminishing marginal utility.
  9. Equi-marginal utility principle, Indifference curve analysis and properties - budget line - definition, assumptions, limitations and applications.
  10. Consumer's equilibrium and derivation of demand curve.
  11. Concept of consumer surplus, producer surplus and its importance.
  12. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Factors influencing elasticity of demand, Importance of elasticity of demand.
  13. Standard of Living: Definition, Engel's Law of Family Expenditure.
  14. *Production*: process, creation of utility, factors of production definition and characteristics - Input Output Relationship.
  15. *Laws of returns*: Law of variable proportions and law of returns to scale.
  16. *Cost*: Cost concepts, short run and long run cost curves.
- ### **17. Mid Semester Examination**
18. *Supply*: Stock versus supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.
  19. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets.

20. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points.
21. Distribution theory: meaning, factor market and pricing of factors of production.
22. Concepts of Rent and Quasi rent - *Wages*: Real wage and money wage.
23. *Interest*: Pure interest and gross interest –*Profit*: Meaning of economic profit.
24. *National income*: Meaning and importance, circular flow.
25. Concepts of national income - accounting and approaches to measurement, difficulties in measurement.
26. *Population*: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control.
27. *Money*: Barter system of exchange and its problems, evolution, meaning and functions of money
28. Classification of money, money supply and theories.
29. General price index, inflation and deflation.
30. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy.
31. *Agricultural and public finance*: meaning, micro versus macro finance, need for agricultural finance, public revenue and public expenditure.
32. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT and GST.
33. *Economic systems*: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies.
34. Economic Planning and elements of economic planning.

#### **Text books**

1. Dewett, K, K., 2004. Modern Economic Theory, New Delhi: Syamlal Charitable Trust. pp 1-1024
2. Samuelson, P., 2004. Economics, (18/e), New Delhi: Tata Mc-graw-Hill. pp 1-205

#### **Reference books**

1. Seth, M. L., 2005. Principles of Economics, New Delhi: Lakshmi Narain Agarwal Co., Agra, pp 1- 888
2. Subba Reddy, S., & Raghu Ram, P., 2011. Agricultural Finance and Management, New Delh: Oxford & IBH. pp 1-268

#### **Web-references**

1. [www.fp.unmas.ac.id/wp-content/uploads/2018/03/principles-of-agricultural-economics.pdf](http://www.fp.unmas.ac.id/wp-content/uploads/2018/03/principles-of-agricultural-economics.pdf)
2. [www.economicshelp.org/](http://www.economicshelp.org/)
3. [www.sparknotes.com/economics/](http://www.sparknotes.com/economics/)
- 4.

## **22 SWE 111 SOIL AND WATER CONSERVATION ENGINEERING 2 + 1**

### **Course objectives**

- To understand the water resources of the country and state
- To study the soil water plant relationship and soil moisture constant
- To introduce the concept of water requirement of crops and irrigation management

### **Course outcomes**

- Students learnt the estimation of the irrigation requirement by various methods
- Students gained the practical knowledge of implementation of surface, pressurized and micro irrigation
- Familiarize the concept of water productivity and principles of drainage

### **Theory**

#### **UNIT I**

##### ***SURVEYING***

Surveying and levelling – chain and compass – levelling – land measurement – difference in elevation.

#### **UNIT II**

##### ***SOIL EROSION***

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion – universal soil loss equation - water erosion - causes - stages of water erosion - splash, sheet, rill and gully erosion - ravines - land slides – wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

#### **UNIT III**

##### ***SOIL CONSERVATION AND WATERSHED MANAGEMENT***

Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping – cropping systems – vegetative barriers - windbreaks and shelterbelts - shifting cultivation - mechanical measures – contour bund – graded bund – broad beds and furrows – basin listing – random tie ridging – mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall – Rain water harvesting — Runoff computation - rational formula - water harvesting – farm ponds and percolation ponds -watershed concept – integrated approach and management

#### **UNIT IV**

##### ***IRRIGATION AND DRAINAGE***

Irrigation - measurement of flow in open channels - velocity area method - rectangular weir - Cippoletti weir - V notch - orifices - Parshall flume - duty of water - irrigation efficiencies - conveyance of irrigation water - surface irrigation methods - borders, furrows and check basins - drip and sprinkler irrigation component– agricultural drainage - surface and sub-surface drainage systems - drainage coefficient

#### **UNIT V**

##### ***WELLS AND PUMPS***

Types of wells– pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps

#### **PRACTICAL**

Study of survey instruments - chains and cross staff surveying - linear measurement - plotting and finding areas. Compass survey - observation of bearings - computation of angles- radiation, intersection. Levelling – fly levels – determination of difference in elevation – contouring. Design of contour bund and graded bund. Drip systems and Sprinkler irrigation systems. Problems on water measurement. Problems on duty of water, irrigation efficiencies. Problems on water requirement - agricultural drainage. Study of different types of wells and its selection.- Study of pumps and its selection- Measurement of irrigation water through flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Operation of sprinkler, drip and common micro irrigation systems; Visit to a water management research station. Visit to soil and water conservation areas

#### **Text books**

1. SankaraReddi, G.H. and Yellamananda Reddy, T. 2003. Efficient Use of Irrigation Water.Kalyani Publishers, Ludhiana.

#### **References**

1. Michael, A.M. 2007. Irrigation Theory and Practice (2nd Ed.). Vikas Publishing House Pvt.Ltd., New Delhi.
2. Lenka, D. 2005. Irrigation and Drainage (3rd Ed.). Kalyani Publishers, Ludhiana.

**22 HOR 112 PRODUCTION TECHNOLOGY OF VEGETABLES AND SPICES  
(1+1)**

**Course Objective:**

1. To impart knowledge on basic cultural practices of Vegetables, Fruits and Plantation Crops.
2. To insist on modern techniques to increase the yield and production.
3. To learn about the economic estimation of commercial Horticultural crops.

**Course Outcome:**

1. The student gains a thorough knowledge on basic production technology.
2. Familiarize on basic pruning and training techniques of fruits and plantation crops.
3. Acquaintance on commercial oriented cultural practices.

**Theory**

**Vegetables**

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

Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu-  
National economy- nutritive value of vegetables and human nutrition.

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

Origin - climate and soil – varieties and hybrids – seeds and sowing – transplanting – water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulators -physiological disorders - maturity indices –harvest – pest and diseases – seed production

**Crops:** Tomato, chilli, brinjal, bhendi, gourds (ash gourd, pumpkin, bitter gourd, ridge gourd, bottle gourd, snake gourd and watermelon) onion, cassava, amaranthus and moringa.

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

Origin -climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrient and plant growth regulators- physiological disorders- maturity indices – harvest – pest and diseases – seed production

**(Crops:** Cabbage, cauliflower, potato, carrot, radish, beetroot, peas and french beans, Protected cultivation of vegetables (tomato, capsicum and cucumber).

### **SPICES**

#### **Unit IV: Crop production techniques of major spices**

Spices- scope and importance - classification of spices - origin, area and production - role of commodityboards- export potential of spices.

Climate and soil - varieties - propagation - nursery management and planting – cropping systems- trainingpractices - nutrient, water and weed management - shade regulation - maturity indices - harvest and yield - pests and diseases - processing - value addition.

#### **Black pepper, Cardamom, Turmeric, Ginger and Garlic**

#### **Unit V: Crop production techniques in seed spices, tree spices and other spices**

Climate and soil- varieties - propagation, nursery management and planting- training , pruning canopy management- weed and water management- shade regulation- nutrient management including drip and fertigation – harvest and yield – pests and diseases – processing – value addition.

#### **Coriander, Fenugreek, Cumin, Fennel, Clove, Nutmeg, Cinnamon, Curry leaf, Tamarind and Herbalspices Practical Vegetables**

Layout of kitchen garden – seed sowing – nursery management – grafting in vegetables water and nutrient management – fertigation – weed management – practices in use of plant growth regulators - Special horticultural practices in vegetable production - study of maturity indices - Identification of physiological disorders - protected cultivation - visit to vegetable nursery unit/ protectedcultivation unit.

### **Spices**

Identification of spices –description of varieties-Propagation methods –rapid multiplication techniques seed collection and extraction - raising of nurseries - seed sowing- seed treatment- fertilizer application-harvesting –pests and diseases-processing-cost economics-visit to spice gardens

#### **Black pepper, Cardamom, Turmeric, Ginger, Coriander, Fenugreek, Curry leaf,**

## **Clove, Nutmeg and Cinnamon**

### **Lecture schedule**

1. Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu- National economy- nutritive value of vegetables and human nutrition .
2. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator -physiological disorders - maturity indices –harvest and yield – pest and diseases – seed production oftomato, chilli and brinjal
3. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrientmanagement–fertigation–weed management–use of micronutrients and plant growth regulator physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of bhendi andonion.
4. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator -physiological disorders - maturity indices –harvest and yield– pest and diseases – seed production of gourds (ashgourd, pumpkin, bittergourd, ridgegourd, bottlegourd, snake gourd and watermelon)
5. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator-physiological disorders - maturity indices –harvest and yield – pest and diseases – seed production ofcassava and potato
6. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator -physiological disorders - maturity indices –harvest and yield – pest and diseases – seed production of moringa andamaranthus.
7. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management–fertigation–weed management–use of micro nutrients and plant growth regulator physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of cabbage andcauliflower.
8. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator -physiological disorders - maturity indices –harvest and yield – pest and diseases – seed production ofcarrot , beetroot and radish.
9. **Mid -semester examination**
10. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator -physiological disorders - maturity indices –harvest and yield – pest and diseases – seed production offrench beans and peas .
11. Protected cultivation of vegetables (tomato, capsicum and cucumber)
12. **Spices**- scope and importance - classification of spices - origin, area and production - role of commodity boards- export potential of spices. Black pepper - climate and soil- varieties – propagation – rapid multiplication techniques - nursery management and planting- nutrient, water and weed management - special horticultural practices - role of growth regulators - shade regulation- maturity indices–harvest and yield - pests and diseases –post harvest practices-processing and value addition.
13. **Cardamom** - climate and soil - varieties - propagation - nutrient, water and weed

management- shade regulation- mulching - maturity indices - harvest and yield - pests and diseases –post harvestpractices- processing and value addition.

14. **Turmeric , Ginger and Garlic** - Climate and soil- varieties - propagation, nursery management and planting- nutrient, water and weed management- inter cropping- physiological disorders - maturity indices -harvest and yield - pests and diseases –post harvest practices- processing and value addition.
15. **Seed Spices**- climate and soil seed treatment/sowing – nutrient, water and weed management- intercropping - maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.(Coriander, Fenugreek, Cumin and Fennel)
16. **Tree spices** - climate and soil - varieties - propagation, nursery management and planting - nutrient, water and weed management- training and pruning practices- cropping system- special horticultural practices maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.(Clove, Nutmeg and Cinnamon)
17. **Tamarind, Curry leaf and herbal spices** - climate and soil- varieties - propagation,nursery management and planting- nutrient, water and weed management- canopy management- maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.

### **Practical schedule**

1. Layout of kitchen garden.
2. Seed treatment and sowing practices in direct sown vegetables
3. Nursery management of transplanted ,bulb and tuber vegetable crops
4. Grafting in vegetable crops
5. Water and nutrient management – fertigation in vegetable crops
6. Practices in use of plant growth regulators in vegetable crops
7. Special horticultural practices in vegetable production
8. Identification of physiological disorders in vegetable crops
9. Study of maturity standards and harvesting of vegetables
10. Practices in protected cultivation of vegetable crops
11. Visit to vegetable nurseries/protected vegetable cultivation unit
12. Black pepper and cardamom- identification and description of varieties – seed propagation and vegetative propagation – fertilizers application - preparation of plant bio regulators and application pests and diseases- harvest and post harvest practices.
13. Turmeric and ginger- identification and description of varieties- propagation, fertilizers application - preparation of plant bio regulators and application – pests and diseases- harvest and post harvestpractices.
14. Coriander and Fenugreek-identification and description of varieties- seed treatment, sowing fertilizer application - pests and diseases- harvest and post harvest practices.
15. Clove, Nutmeg and Cinnamon - identification and description of varieties – seed collection and extraction - propagation – fertilizer application – training and pruning – pests and diseases- harvest and post harvest practices.
16. Tamarind and curry leaf- identification and description of varieties –seed collection and extraction - propagation – fertilizer - application – canopy management – pests and diseases- harvest and post harvest practices.
17. Visit to spice gardens or commodity boards and working out cost economics of spice crops.

### **REFERENCES**

**Gopalakrishnan, T.R. 2007. Vegetable Crops. Horticultural Science Series (Series Editor**

K.V.Peter). New India Publishing Agency.

### E-References

1. <http://www.ihortscib.com>
2. <http://journal.ashspublications.org>
3. <http://www.actahort.org/>
4. <http://www.aphorticulture.com/crops.htm>
5. <http://cpcri.nic.in/> <http://indiancoffee.org>

## 22 FSN 111 PRINCIPLES OF FOOD SCIENCE AND NUTRITION (1+1)

### Course objectives

- To equip the students to study the various processes involved in the development of products.
- To understand the correct unit operation for each product.
- To acquire knowledge on selection of suitable equipments for product development.

### Course outcome

- The students will understand various processes involved in the development of products.
- The students will be able to identify suitable unit operation for processed product.
- The students will be able to evaluate selection of suitable equipments for product development.

### Theory

#### Unit I - Principles of food science and nutrition

Food Science - definition – classification of foods – functional and nutritional classification. Food groups and food pyramid. Methods of cooking - moist, dry and microwave - principles, merits and demerits. Importance and scope of nutrition – relation of nutrition to health.

#### Unit II - Carbohydrate, protein and fat

Carbohydrate – classification, functions, digestion and absorption, sources and Recommended Dietary allowance (RDA). Energy value of foods – determination. Protein – classification, functions digestion and absorption, sources and requirements. Protein quality of foods – supplementary value of protein. Fat - classification functions, digestion and absorption, sources and requirements. Rancidity – types of rancidity and prevention. Deficiency states of protein, carbohydrate and fat nutrition – signs and symptoms.

#### Unit III - Vitamin and mineral nutrition

Fat Soluble vitamins – A, D, E and K- functions, sources, requirements and deficiency. Water soluble vitamins – thiamine , riboflavin , niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid ascorbic acid – functions, sources, deficiency and requirements. Minerals - calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, deficiency and requirements. Importance of water – maintenance of electrolyte balance. Dietary fibre - importance, health benefits, sources and requirements.

#### **Unit IV- Food preservation and processing**

Introduction – preservation by sugar - processing of jam, squash, jelly, marmalade and beverages. Preservation by using salt, chemicals, dehydration technology, canning technology, preservation by low temperature and irradiation techniques. Processing of puffed, flaked and extruded products. Quality control of raw and processed products.

#### **Unit V Food quality and safety**

Food packaging materials – requirements- methods – nutrition labeling. Food adulterants and their detection methods. Food laws and regulations and quality control standards - FSSAI,ISO, EU standards, FDA, HACCP and Codex Alimentarius commission

#### **Practical:**

Cooking tests for cereals and pulses. Determination of energy value of food. Estimation of Moisture, Protein, Fat, Ascorbic acid, Iron and Crude fibre. Processing of Jam and Jelly, Processing of Squash and RTS. Puffing of pulses. Extrusion of cereals and millets. Canning of fruits and Vegetables. Processing of dehydrated fruit and vegetable products. Identification of common food adulterants. Visit to Food processing Unit and Quality control lab

#### **Lecture schedule**

1. Food Science - definition – classification of foods – functional and nutritional classification. Food groups and food pyramid.
2. Methods of cooking - moist, dry and microwave - principles, merits and demerits.
3. Importance and scope of nutrition – relation of nutrition to health.
4. Carbohydrate – classification, functions, digestion and absorption, sources and Recommended Dietary allowance (RDA), Deficiency. Energy value of foods – determination.
5. Protein – classification, functions digestion and absorption, sources and requirements. Protein quality of foods – supplementary value of protein. Deficiency
6. Fat - classification functions, digestion and absorption, sources and requirements. Rancidity – types of rancidity and prevention.
7. Fat Soluble vitamins – A, D, E and K- functions, sources, requirements and deficiency.
8. Water soluble vitamins – thiamine , riboflavin , niacin, pyridoxine, folic acid, cyanacobalamin, biotin, pantothenic acid ascorbic acid – functions, sources, deficiency and requirements.

#### **9. Mid Semester Examination**

10. Minerals - calcium, iron, phosphorus, iodine, magnesium, zinc, sodium, potassium, fluorine and chlorine – functions, sources, deficiency and requirements.
11. Importance of water – maintenance of electrolyte balance. Dietary fibre - importance, health benefits, sources and requirements
12. Preservation by sugar - processing of jam, squash, jelly, marmalade and beverages
13. Preservation by using salt, chemicals, dehydration technology, canning technology
14. Preservation by low temperature and irradiation techniques
15. Processing of puffed, flaked and extruded products. Quality control of raw and processed products. Food packaging materials – requirements - methods – nutrition labeling
16. Food adulterants and their detection methods.
  
17. Food laws and regulations and quality control standards - FSSAI, ISO, EU standards, FDA, HACCP and Codex Alimentarius commission

### **Practical schedule**

1. Cooking tests for cereals and pulses
2. Determination of energy value of food
3. Estimation of Moisture
4. Estimation of Protein
5. Estimation of Fat
6. Estimation of Ascorbic acid
7. Estimation of Iron
8. Estimation of Crude fibre
9. Processing of Jam and Jelly
10. Processing of Squash and RTS
11. Puffing of pulses
12. Extrusion of cereals and millets
13. Canning of fruits and Vegetables
14. Processing of dehydrated fruit and vegetable products
15. Identification of common food adulterants
16. Visit to Food processing Unit and Quality control lab

### **17. Final Practical Examination**

#### **Text books**

1. Gaurav Tewari and Vijay K. Juneja. (2007). Advances in Thermal and Non-Thermal Food Preservation. Blackwell Publishing, Ames, Iowa, USA.
2. James G. Brennan. (2006). Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, PP 1-602.
3. M. Shafiur Rahman. (2007). Handbook of Food Preservation, 2nd Ed. CRC Press, Boca Raton, FL, USA, PP 1-1088.
4. Marcus Karel and Darvl B. Lund. (2003). Physical Principles of Food Preservation, 2nd Ed. Marcel Dekker, Inc., NY, USA, PP 1-640.

5. Norman N. Potter and Joseph H. Hotchkiss. (1995). Food Science, 5th Ed. Chapman & Hall, NY, USA.
6. Srilakshmi, B. (2018). Food Science (7<sup>th</sup> Ed). New Age International Ltd, publishers, New Delhi, India, PP 1-512.
7. Stavros Yanniotis. (2008). Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA.

### **Reference books**

1. Potter, N. (2005). Food Science, CBS Publishers and Distributors, Delhi
2. Srilakshmi .B. (2015). Nutrition Science. New Age International Pvt. Ltd. New Delhi.
3. Vijaya Khader. (2001). Textbook of Food Science and Technology, Indian Council of Agricultural Research, New Delhi.

### **Web-references**

1. <http://www.ifis.org>
2. [http://www.fao.org/infoods/index\\_en.stm](http://www.fao.org/infoods/index_en.stm)
3. <https://fstjournal.org>

## **22 AEX 102 FUNDAMENTALS OF AGRICULTURE EXTENSION EDUCATION 2 + 1**

### **Unit I**

#### **Extension education and programme planning**

Education- meaning, definition & types; extension education –meaning, definition, scope and process; objectives and principles of extension education. Programme planning – definition, meaning, process, principles and steps in programme development

### **Unit II**

#### **Extension System in India**

Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development scheme, Gurgaon Experiment, etc.) Post – independence era (Etawah pilot project, Nilokheri Experiment, etc.,) Various extension/ agricultural development programmes launched by ICAR/Govt. of India(IADP, IAAP, HYVP,KVK, ORP, ND, NATP, NAIP etc.,)

### **Unit III**

#### **Rural Development, Administration, monitoring and evaluation**

Rural Development –Concept, meaning, definition: various rural development programmes launched by Govt. of India. Community development –meaning, definition, concepts and principles, physiology of community development. Rural leadership: concept and definition, types of leaders in rural context: extension administration: meaning, concept, principles and

functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes

## **Unit IV**

### **New Trends in Agricultural Extension**

New trends in agricultural extension –Privatization of extension, Cyber extension/ E-extension, (Internet, cyber cafes, video and teleconferencing, Interactive Multimedia Compact disk (IMCD), Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Village Knowledge Centre (VKC), DEMIC, Geographical Information System (GIS), market led extension, farmer led extension, expert systems etc.,

## **Unit V**

### **Transfer of Technology, Diffusion of Innovations and extension methods**

Transfer of technology concept, models, capacity building of extension personnel, extension teaching methods: meaning, classification, individual, group and mass contact methods, media mix strategies: communication: meaning, definition, models elements, characteristics and barriers to communication Agricultural Journalism: Agricultural journalism (Print media) - definition, principles, importance, ABC of news, types of news. Diffusion of Innovations – definition, elements; Innovation – definition, attributes; Adoption – meaning, steps in adoption process, adopter categories, factors influencing adoption of innovations; process and stages of adoption, adopter categories.

### **Practical**

To get acquainted with university extension system, group discussion- exercise, handling and use of audio visual equipments and digital camera and LCD projector: preparation and use of AV aids, preparation of extension literature-leaflet, booklet, folder, pamphlet newstories and success stories, Presentation skills exercise: micro teaching exercise: A visit to village to understand the problems being encountered by the villagers/ farmers : to study organization and functioning of DRDA and other development departments at district level: visit to NGO and learning from their experience in rural development: understanding PRA techniques and their application in village development planning: exposure to mass media; visit to community radio and television studio for understanding the process of programme production: Script writing, writing for print and electronic media, developing script for radio and television.

### **Text books:**

1. Dipak de, Basavaprabhu Jirli. 2010. A Handbook of Extension Education, Agrobios, India.
2. Katar Singh. 1999. Rural Development – Principles, Policies and Management, Sage Publications India Pvt. Ltd., New Delhi.

3. Kelsey, L.D and C.C. Hearne. 1967. Cooperative Extension Work, Cornell University Press, New York.
4. Manoharan Muthiah, P. and R. Arunachalam. 2003. Agricultural Extension, Himalaya Publishing House, Mumbai.
5. Narayanasamy, N. 2009. Participatory Rural Appraisal Principles, Methods and Application, Sage Publications India Pvt. Ltd., New Delhi.
6. Neela Mukherjee. 1993. Participatory Rural Appraisal: Methodology and Applications, Concept Publishing Co.

**References:**

1. Pandey, B.K. 2005. Rural Development, ISHA Books, New Delhi.
2. Pandey, V.C. 2003. Information Communication Technology and Education (The Changing World ICT Governance), Isha Publishers.
3. Ray, G.L. 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
4. Reddy Adivi, A. 1993. Extension Education, Shree Lakshmi Press, Bapatla, Andhra Pradesh.
5. Rishipal. 2011. Training and Development Methods, S.Chand and Co. Ltd., New Delhi.
6. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, New York.
7. Sagar Mondal and Ray, G.L. 2007. Text book of Rural Development, Kalyani Publishers, New Delhi.
8. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
9. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
10. Sanjay Prakash Sharma. 2006. Panchayat Raj, Vista International Publishing House, New Delhi.
11. Singh, A.K. 2012. Agricultural Extension, Agrobios, New Delhi.
12. Sivasudevaro, B and Rajannikanthu, G. 2007. Rural Development and Entrepreneurship Development, The Associated Publications, Ambala.
13. Supe, S.V. 1997. An Introduction to Extension Education, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
14. Van den Ban, A.W and H.S. Hawkins. 2002. Agricultural Extension, CBS Publishers & Distributors, New Delhi.

**22 CRP 101 FUNDAMENTALS OF CROP PHYSIOLOGY 2 + 1**

**Course Objectives:**

- To introduce the students to crop physiology and biochemical changes during crop development.

- To impart knowledge on transport system in plants, photosynthesis and respiration
- To understand growth and growth characteristics

**Course Outcome:**

- Knowledge gained on different aspects of crop physiology.
- Learned detailed understanding of the physiological mechanisms involved in the uptake and transport of water and the translocation of food by plants.
- Study growth pattern of plants and growth parameters in crop production.

**Theory**

**Unit I**

Introduction to Crop Physiology and importance of Crop Physiology in Agriculture – Plant cell: an overview, organelles- plasma membrane, chloroplast, mitochondria, peroxisome and vacuole, Structure and role of water, water potential and its components, diffusion and osmosis; imbibition, plasmolysis, Field Capacity and Permanent Wilting Point, Absorption of water, Mechanisms of water absorption, Pathways of water movement, Apoplast and symplast, Translocation of water, ascent of sap and its mechanisms - Transpiration and Stomatal physiology: structure of stomatal pore, mechanisms of stomatal opening and closing, guttation, antitranspirants.

**Unit II**

Mineral nutrition of plants: Criteria of essentiality, classification of nutrients, macro, micro, mobile, immobile and beneficial elements, Physiological functions and deficiency symptoms of nutrients, nutrient uptake mechanism; Hidden hunger, Foliar nutrition, root feeding and fertigation, sand culture, hydroponics and aeroponics.

**Unit III**

Photosynthesis: Light and dark reactions, Photosystems, red drop and Emerson enhancement effect, Photolysis of water and photophosphorylation, Z scheme, C3, C4 and CAM plants; Photosynthetic pathways of C3, C4 and CAM plants, difference between three pathways, Factors affecting photosynthesis, Photorespiration – pathway and its significance, Phloem transport, Münch hypothesis, Phloem loading and unloading, Source and sink strength and their manipulations. Respiration: Glycolysis, TCA cycle and electron transport chain; Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient. Fat metabolism: fatty acid synthesis and breakdown.

**Unit IV**

Plant growth regulators: physiological roles and agricultural uses, Hormones-classifications - Biosynthetic pathway and role of auxins, gibberellins, cytokinins, ethylene and ABA, Novel and new generation PGRs, Brassinosteroids and salicylic acid, Growth retardants, Commercial uses of PGRs. Photoperiodism - short, long and day neutral plants, Chailakhyan's theory of flowering, Forms of phytochrome, Pr and Pfr, regulation of flowering, Vernalisation - Theories of vernalisation, Lysenko theories, Seed germination - physiological and biochemical changes, seed dormancy and breaking methods, Senescence and abscission, physiological and biochemical changes, Physiology of fruit ripening, climacteric and non-climacteric fruits, factors affecting ripening, Manipulations. Physiological aspects of growth and development of major crops: growth analysis, role of physiological growth parameters in crop productivity.

**Unit V**

Classification of stresses - Physiological changes and adaptations to drought, flooding, high and low temperature, salinity and UV radiation – compatible osmolytes – membrane properties - compartmentalization – stress alleviation - Global warming – green house gases – physiological effects on crops - Carbon Sequestration.

### **Practical**

Study of plant cells, structure and distribution of stomata, imbibition, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO<sub>2</sub> assimilation by Infra Red Gas Analyser (IRGA).

### **Text books**

1. Pandey, S. N. and B. K. Sinha, 2006. Plant Physiology. Vikas Publishing House Private Limited, New Delhi.

### **References**

1. Jain, J.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
2. Ray Noggle, G. and Fritz, G. J., 1991. Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Taiz. L. and Zeiger. E., 2006. Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

## **22 AGM 101 FUNDAMENTALS OF MICROBIOLOGY 2 + 1**

### **Theory**

#### **Unit I Introduction**

Definition and scope of Microbiology. Milestones in Microbiology; biogenesis and abiogenesis theory; contributions of Antonie Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming and Waksman. Germ theory of diseases and fermentation.

#### **Unit II Microbiological Techniques**

General principles of light microscopy - magnification, resolving power and numerical aperture. Different types of light and electron microscopes; three dimensional imaging - Atomic force and Confocal scanning laser microscopy. Staining techniques - principle and types of stains; simple, negative, differential and structural staining. Sterilization and disinfection techniques; principles and methods of sterilization - physical methods – heat, filters and radiation; chemical methods. Isolation, enrichment and purification techniques of bacteria, yeast, molds and actinobacteria. Preservation of microbial cultures.

#### **Unit III Microbial World**

Evolutionary relationship among the living organisms. Whittaker's five kingdom concept of living organism and Carl Woese systems. Prokaryotic and eukaryotic microorganisms. Three domains of life – similarities and differences; Modern approach to the bacterial systematics. Bergey's Manual of Systematic Bacteriology. Bacteria – bacterial size, shape and arrangement; bacterial cell structure and function. Morphology of fungi and algae. General properties of viruses: different types; overview of

bacteriophages; morphology of bacteriophages: Lytic and lysogenic cycles; lytic and temperate phages.

#### **Unit IV Microbial Growth and Metabolism**

Bacterial growth- population growth- growth cycles of population; environment on growth – temperature, oxygen, pH and salts; nutritional classification – chemoautotrophy and photo autotroph. Energy generation in bacteria. Aerobic and anaerobic respiration and fermentation in bacteria.

#### **Unit V Microbial Genetics and Immunology**

Central dogma of life. Genetic elements of bacteria; bacterial chromosomal DNA, plasmids, IS elements and transposons; Mutation - types and mutagens. Genetic recombinations; transformation, transduction and conjugation. Genetic engineering – an introduction. Basic concepts of immunology – antigen – antibody reactions and vaccines.

#### **Practical**

Microbiological safety in the laboratory; introduction to microbiology laboratory and its equipments. Microscopes- handling with microscope. Micrometry. Methods of sterilization and equipments used for sterilization. Nutritional media and their preparations. Enumeration of microbial population - bacteria, fungi and actinobacteria. Methods of purification and preservation of microbial cultures. Staining and microscopic observations; simple and differential staining - spore staining. Measurement of bacterial growth. Identification of microorganisms - morphological identification of yeasts, molds and algae. Identification- cultural, physiological and biochemical tests for bacteria and actinobacteria. Isolation of bacteriophages. Isolation of mutants employing physical or chemical mutagens.

#### **Reference :**

1. [Michael T. Madigan , Kelly S. Bender Daniel H. Buckley , W. Matthew Sattley, David A. Stahl](#) 2017. Brock Biology of Microorganisms, 15<sup>th</sup> edition
2. ebook.: Prescott, Harley and Klein, 2013. Microbiology, 9<sup>th</sup> edition, McGraw Hill Publishing
3. ebook: Michael J. Leboffee and Burton E. Pierce 2011. A photographic Atlas for the Microbiology Laboratory 4<sup>th</sup> edition, Marton Publishing Company
4. Hans G. Schlegel, 2012. General Microbiology, 7<sup>th</sup> edition
5. Ronald M. Atlas, 1997. Principles of Microbiology, Second edition
6. Tortora, G.J., B.R. Funke and C.L. Case, 2009. Microbiology- An Introduction, 9<sup>th</sup> edition
7. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

### **22 MAT 111 ELEMENTARY MATHEMATICS ( 2+0)**

#### **Course objectives:**

1. Improving the mathematical knowledge of students who have come from a science background
2. Imparting higher secondary level mathematics so that they can understand mathematical formulas applicable for other courses
3. Interlinking mathematics with science

#### **Course outcome:**

1. Devise formulas for straight lines
2. Comprehend the use of Slope-Intercept
3. Apply the knowledge gained in designing fields
4. Acquire interest to utilize calculus in agriculture
5. Integrate product of functions and define matrices and determinants
6. Link mathematics with agricultural engineering

### **Unit I- Algebra**

Permutation and Combination -meaning of  $nPr$  and  $nCr$  (simple problems). Matrices- Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to  $3^{rd}$  order by adjoint method, Properties of determinants up to  $3^{rd}$  order and their evaluation.

### **Unit II-Analytical geometry in 2D**

Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines, Angles between two straight lines, Parallel lines, Perpendicular lines.

Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ .

### **Unit III- Differential calculus**

Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$  from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Partial differentiation with first and second order -Maxima and Minima of the functions of the form  $y = f(x)$  and  $y = f(x_1, x_2)$  (Simple problems based on it).

### **Unit –IV-Integral calculus**

Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

### **Unit V-Mathematical models**

Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.

**Lecture schedule:**

1. Permutation and Combination -meaning of  $nPr$  and  $nCr$ .
2. Simple problems in Permutation and Combination.
3. Matrices- Definition of Matrices- Types of Matrices- Addition, Subtraction, Multiplication, Transpose
4. Problems in Addition, Subtraction, Multiplication and Transpose of a matrix
5. Determinants-Properties of determinants -up to  $3^{rd}$  order evaluation and inverse up to  $3^{rd}$  order by adjoint method.
6. Problems in determinants and Inverse up to  $3^{rd}$  order by adjoint method.
7. Straight lines - Distance formula-section formula (internal and external division) - Change of axes (only origin changed) - Equation of co-ordinate axes- Equation of lines parallel to axes.
8. Problems in Straight lines using distance formula, section formula (internal and external division), Change of axes (only origin changed)- Equation of co-ordinate axes- Equation of lines parallel to axes.
9. Forms of equation of Line-Slope-intercept form -Slope one point form - Two point form - Intercept form.
10. Problems in Slope-intercept form of equation of line, Slope-point form of equation of line, two point forms of equation of line, Intercept form of equation of line.
11. Normal form of equation of line- General form of equation of line- Point of intersection of two straight lines.
12. Problems in Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines.
13. Angles between two straight lines- Parallel lines- Perpendicular lines- Angle of bisectors between two lines.
14. Problems in Angles between two straight lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines.
15. Circle-Equation of circle whose centre and radius is known- General equation of a circle- Equation of circle passing through three given points- Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ .
16. Problems in Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points  $(x_1, y_1)$  &  $(x_2, y_2)$ .
- 17. Mid Semester Examination**
18. Differential Calculus - Definition of function, limit and continuity- Simple problems on limit and continuity.
19. Simple problems in limit and continuity.

20. Differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$  from first principle-Derivatives of sum, difference, product and quotient of two functions- Differentiation using functions of function rule (Simple problem based on it)
21. Problems in differentiation of  $x^n$ ,  $e^x$ ,  $\sin x$  &  $\cos x$ , derivatives of sum, difference, product, quotient of two functions and differentiation of functions of functions.
22. Logarithmic differentiation (Simple problem based on it)- Differentiation by substitution method and simple problems based on it- Differentiation of Inverse Trigonometric functions
23. Simple problem based on Logarithmic differentiation and differentiation by substitution method.
24. Maxima and Minima of the functions of the form  $y=f(x)$  and  $y=f(x_1,x_2)$  (Simple problems based on it).
25. Problems in Maxima and Minima of the functions of the form  $y=f(x)$  and  $y=f(x_1,x_2)$
26. Integral Calculus - Integration of simple functions and Product of two functions- Definite Integral (simple problems based on it)
27. Problems in integration of simple functions and product of two functions using integration by parts-Definite Integral.
28. Integration by substitution method- Area under simple well-known curves (simple problems based on it).
29. Integration by substitution method-Problems in Area under simple well-known curves
30. Agricultural systems - Mathematical models - classification of mathematical models- Linear model.
31. Problems in fitting linear models to experimental data
32. Quadratic and Exponential models- applications of mathematical models in agriculture.
33. Problems in fitting Quadratic models to experimental data.
34. Problems in fitting Exponential models to experimental data.

### References books

1. Harikishan. 2006. *Coordinate Geometry of two dimensions*. Delhi: Atlantic Publisher. pp. 1-137
2. Manickavasagam, P. T. K. & Narayanan. S 1997. *Calculus*. Vol I Madras: Viswanathan Publications, pp. 1-433
3. Mehta, B. C. & G. M. K. Madnani. 2008. (9th ed.). *Mathematics for Economists*. New Delhi: Sultan Chand & Sons. pp.1 - 731
4. Sharma, A. K. 2004. *Textbook of Matrix*. New Delhi: Discovery Publishing House. pp. 1-333

### Web references

1. [www.mathsisfun.com](http://www.mathsisfun.com)
2. [www.mathinsight.org](http://www.mathinsight.org)
3. <https://youtu.be/WEUL1v1Mxv0>
4. <https://youtu.be/SSyZYWDX0Mo>
5. <https://youtu.be/IS2vyb3Fps8>
6. <https://youtu.be/lvLpNG1Ncg>

7. [https://youtu.be/Wm5a\\_Sa2GNY](https://youtu.be/Wm5a_Sa2GNY)

8. <https://youtu.be/Dsi7x-A89Mw>

**2022 Batch  
Semester III**

S. No	Course Code	Course Title	Credit Hours	Total Credits
1.	22 AGR 201	Crop Production Technology I (Kharif Crops)	1+1	2
2.	22 AGR 202	Principles of Weed Management	1+1	2
3.	22 AEN 201	Fundamentals of Entomology	2+1	3
4.	22 PBG 201	Fundamentals of Genetics	2+1	3
5.	22 AEC 201	Farm Management, Production and Resource Economics	1+1	2
6.	22 FMP 211	Farm Machinery and Power	1+1	2
7.	22 HOR211	Production Technology for Fruit and Plantation Crops	1+1	2
8.	22 PAT 201	Fundamentals of Plant Pathology	2+1	3
9.	22 STA 211	Statistical Methods	1+1	2
10.	22 AMP 201	Livestock and Poultry Management	2+1	3
11.	22 AGR 203	Study Tour*	0+1*	1*
<b>Total</b>			<b>14+11</b>	<b>25</b>
12.	22 NSS/ NCC 101	NSS or NCC	0+1#	1#
13.	22 PED 101	Physical Education and Yoga Practices	0+1#	1#

#Registered in Semester I and Evaluation in Semester IV \*Non- gradial Course

**Semester III**

**22AGR 201 CROP PRODUCTION TECHNOLOGY – I ( Kharif crops) ( 1+1)**

**Course objective:**

- Imparting the fundamentals of crop production technology of *kharif* crops
- Demonstrating practical applications of crop production
- Providing knowledge on the importance and practices followed in growing *kharif* crops

**Course outcome:** At the end of the course the student should be able to

- Comprehend the fundamentals of crop production of cereals
- Decide on the crops, fertilizers and irrigation measures for production of pulses
- Plan for sustainable crop production of oilseeds
- Explain the techniques involved in crop production of fibre and forage crops
- Correlate parameters involved in crop cultivation and practice *kharif* crop cultivation

**THEORY**

**Unit I- Cereals**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rice and Maize (from land preparation to harvest) and yield.

#### **Unit II- Millets**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet

#### **Unit III- Pulses**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Redgram, Blackgram, Greengram and Cowpea

#### **Unit IV- Oilseeds (Kharif)**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Groundnut, sesame and Soybean.

#### **Unit V- Fibre and forage**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Cotton, jute, fodder sorghum and cumbunapier

#### **PRACTICAL**

Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria. Practicing various nursery types and main field preparation for rice crop. Nursery and main field preparation for important millets, pulses and oilseeds. Acquiring skill in different seed treatment techniques in important kharif crops. Estimation of plant population per unit area for important kharif crops. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds. Acquiring skill in using seed drill for sowing operations. Acquiring skill in foliar nutrition for important field crops. Observations on growth parameters of cereals and millets. Observations on growth parameters of pulses and oilseeds. Study of yield parameters and estimation of yield in cereals and millets. Study of yield parameters and estimation of yield in pulses and oilseeds. Working out cost and returns of important cereals, millets, pulses and oilseeds crops. Visit to farmer's field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds. Visit to nearby Agricultural Research Station / Farmer's field.

#### **Lecture schedule:**

1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.
2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
3. Rice - Origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - yield - economic benefits.
5. Special type of Rice cultivation – SRI - and Hybrid rice cultivation.

6. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
9. **Mid Semester Examination**
10. Pigeonpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
11. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses.
12. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics.
13. Sesame and Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
14. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
15. Jute- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
16. Fodder sorghum- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
17. Cumbunapier- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

**Practical schedule:**

1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria.
2. Practicing various nursery types and main field preparation for rice crop.
3. Nursery and main field preparation for important millets, pulses and oilseeds.
4. Acquiring skill in different seed treatment techniques in important kharif crops.
5. Estimation of plant population per unit area for important kharif crops.
6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets.
7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
8. Acquiring skill in using seed drill for sowing operations.
9. Acquiring skill in foliar nutrition for important field crops.
10. Observations on growth parameters of cereals and millets.
11. Observations on growth parameters of pulses and oilseeds.
12. Study of yield parameters and estimation of yield in cereals and millets.

13. Study of yield parameters and estimation of yield in pulses and oilseeds.
14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
15. Visit to farmer's field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds.
16. Visit to nearby Agricultural Research Station / Farmer's field.
17. **Final Practical Examination.**

**Text books:**

1. Chidda Singh, Prem Singh and Rajbir Singh. 2018. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co Pvt.Ltd; 2nd edition. New Delhi.
2. Rajendra Prasad. 2016. Textbook of Field Crops Production (Volume 1 & 2). Indian Council of Agricultural Research (ICAR), New Delhi.
3. Mukund Joshi., 2015. Text Book of Field Crops. PHI Learning Private limited. New Delhi.
4. Reddy. S.R. 2014. Principles of Crop Production. Kalyani Publishers, Ludhiana.
5. Ahlawat,I.P.S., Om Prakash and G.S. Saini. 2010. Scientific Crop Production in India. Rama publishing House, Meerut.

**Reference books:**

1. Crop Production Guide. 2020. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
2. Reddy, S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
3. Singh. S.S. 2015. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.
4. Srinivasan Jeyaraman. 2018. Field crops production and management (Volume I & 2). Oxford and IBH Publishers. India.
5. Yellamanda Reddy, T. and G.H. Sankara Reddy. 2017. Principles of Agronomy, Kalyani publishers, Ludhiana.

**Web references**

1. [www.crida.org](http://www.crida.org)
2. [www.cgiar.org](http://www.cgiar.org)
3. [www.tnau.ac.in/agriporal](http://www.tnau.ac.in/agriporal)
4. [www.rkmp.irri.org](http://www.rkmp.irri.org).
5. <https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-field-crops.pdf>

**22AGR 202 PRINCIPLES OF WEED MANAGEMENT (1+1)**

**Course objective:** The course is aimed at

- Identifying major weeds affecting farming ecosystems
- Imparting knowledge on organic and inorganic herbicides
- Introducing solutions to manage herbicide resistance

**Course outcome:** At the end of the course the student should be able to

- Gain knowledge on weeds affecting ecosystems
- Explain the mode of action of herbicides
- Understand the role of allelochemicals and the applications of bio-herbicides
- Analyse herbicide compatibility
- Cite ways of overcoming herbicide resistance
- Recommend weed management strategies

## **THEORY:**

### **Unit I- Introduction to weeds**

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination - Weed biology and ecology - Weed seed dormancy - Weed seed bank - Crop weed association - Crop weed competition and allelopathy effect.

### **Unit II- Weed control methods**

Concepts of weed prevention, control and eradication - Methods of weed control: physical, cultural, chemical and biological methods - Non chemical weed management - Integrated weed management (IWM).

### **Unit III- Herbicides**

Herbicides: Classification, characteristics, formulations, methods of application, advantages and equipment's – Adjuvants – Herbicide mixture - Advantages and limitation of herbicide usage in India.

### **Unit IV- Herbicide selectivity**

Selectivity of herbicides; Herbicide absorption and translocation - Compatibility of herbicides and other agro inputs - Mode of action of herbicides and their selectivity - Herbicide residue management - Persistence and degradation of herbicides in soil and plants - Herbicide resistant weeds - Herbicide resistant GM crops.

### **Unit V- Weed management in crops**

Weed management in major field and horticultural crops - weed shift - weed control in non-cropped areas - Parasitic, aquatic and problematic weeds and their control.

## **PRACTICAL:**

Identification, classification and characterization of terrestrial weeds, aquatic weeds and parasitic weeds. Weed survey and weed vegetation analysis - density, frequency, SDR and IVI. Study on biology of nut sedge and Bermuda grass, parthenium and celosia. Practicing skill development on cultural and non-chemical weed management. Identification, classification and characterization of herbicides. Practicing skill development on herbicide application techniques. Practicing skill development on spray equipment 's and spray fluid calibration. Practicing skill development on herbicide weed management in lowland, upland and rainfed ecosystems. Calculation of herbicide quantity and recommendation for different eco systems. Study on phytotoxicity symptoms of herbicides in different crops. Herbicide residue determination by bioassay techniques. Herbicide residue determination by volumetric, spectro-photometric methods and chromatographic methods. Economic analysis of different weed management methods in crops and cropping systems. Visit to Problem and parasitic weed infestation areas/ herbicide industries

**Lecture schedule:**

1. Weeds - Definition, classification and characteristics, harmful and beneficial effect of weeds.
2. Weed biology and ecological adaptation to different agro ecosystems.
3. Classification and characteristics of weeds of different agro ecosystems-lowland weeds, irrigated upland and rainfed land weeds.
4. Classification and characteristics of weeds - Aquatic, parasitic and obnoxious weeds.
5. Life cycle of weeds, weed migration, weed seed distribution,
6. Dormancy, germination, establishment and perennation of weeds in different ecosystems.
7. Crop weed interactions - Critical crop weed competition, competitive and allelopathic effects of weeds and crops.
8. Principles and methods of weed management: Preventive, cultural, mechanical.

**9. Mid-Semester Examination**

10. Principles and methods of weed management: chemical, biological and alternate methods.
11. Classification and characteristics of herbicides and herbicide formulations - History and Development.
12. Herbicide Use Efficiency - Adjuvants, herbicide protectants and antidotes - Herbicide and herbicide mixtures in India - Interaction with moisture, fertilizer and other agrochemicals.
13. Mode of action of herbicides and their selectivity - Mechanism of action of herbicides and their selectivity.
14. Herbicide persistence and degradation in plants and soils-Herbicide residue and management.
15. Herbicide resistant weeds and their impact on weed management.
16. IWM in crops and cropping systems-Agricultural Crops, Horticultural Crops.
17. Weed shift: Causes and management options for weed shift in crop production.

**Practical schedule:**

1. Identification, classification and characterization of terrestrial weeds
2. Identification, classification and characterization of aquatic weeds
3. Identification, classification and characterization of problem and parasitic weeds
4. Weed survey and weed vegetation analysis - density, frequency, SDR and IVI
5. Study on biology of nut sedge and Bermuda grass, parthenium and celosia
6. Practicing skill development on cultural and non-chemical weed management
7. Identification, classification and characterization of herbicides
8. Practicing skill development on herbicide application techniques
9. Practicing skill development on spray equipment 's and spray fluid calibration
10. Practicing skill development on herbicide weed management in lowland, upland and rainfed ecosystems
11. Calculation of herbicide quantity and recommendation for different eco systems
12. Study on phyto-toxicity symptoms of herbicides in different crops
13. Herbicide residue determination by bioassay techniques

14. Herbicide residue determination by volumetric, spectro-photometric methods and chromatographic methods.
15. Economic analysis of different weed management methods in crops and cropping systems
16. Visit to Problem and parasitic weed infestation areas/ herbicide industries
17. **Final Practical Examination**

#### **Reference books**

1. Das, T.K. 2008. Weed Science - Basics and Applications. Jain Brothers, New Delhi
2. Gupta, O.P. 2007. Weed Management - Principles and Practices. Agrobios.
3. Jayakumar, R. and R. Jagannathan, R. 2003. Weed Science Principles, Kalyani Publishers, Ludhiana.
4. Rao, V.S. 2000. Principles of Weed Science. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 555p.
5. Subramanian, S. A. Mohammed Ali and R. Jayakumar. 1997. All about Weed Control. Kalyani Publishers, New Delhi.
6. Walia, U.S. 2003. Weed Management. Kalyani Publishers, Ludhiana

#### **Web references**

1. <http://erec.ifas.ufl.edu/weeds/powerpoints/Basic%20Principles%20of%20Weed%20Management.pdf>.
2. <http://www.agrisk.umn.edu/cache/ARL02964.htm>
3. <http://www.eolss.net/sample-chapters/c10/E1-05A-31-00.pdf>
4. <http://www.fao.org/docrep/006/y5031e/y5031e00.htm#Contents>
5. <http://www.fao.org/docrep/006/y5031e/y5031e0j.htm>
6. <http://www.omafra.gov.on.ca/english/crops/pub811/12crop.htm>

## 22PBG 201 FUNDAMENTALS OF GENETICS (2+1)

### Course objective:

- Paraphrase the history and evolution of genetics and cytogenetics
- Understand the Chromosome behaviour and effects of their irregularities
- Explain Mendel's principles of heredity
- Recognize the importance of genetics in crop improvement

### Course outcome:

- Describe the architecture of the chromosome and its functions.
- Interpret the relationship between genotype and phenotype.
- Apply the principles of chromosome transmission to predict patterns of inheritance.
- Analyse the modern concept of genetics and mutation
- Evaluate scientific data using the rules of probability

## THEORY

### UNIT I- Cytology and cytogenetics

Definition of genetics, heredity, inheritance, cytology, cytogenetics. History of genetics. Cell division – mitosis- meiosis and their significance – Gametogenesis and syngamy in Plants. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere. Structural and numerical variations in chromosome and their implications. Use of haploids, dihaploids and doubled haploids in Genetics. Special types of chromosomes.

### UNIT II- Mendelian genetics and heredity

Heredity's Fundamental Characteristics; Pre and Post Mendelian concepts of heredity; Mendelian principles of heredity. Chromosomal theory of inheritance. Mendel's experiments and laws of inheritance - Law of Segregation, Law of Independent Assortment and Law of Dominance. Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1), ii.) Recessive epistasis (9:3:4), iii.) Duplicate and additive epistasis (9:6:1), iv.) Duplicate dominant epistasis (15:1), v) Duplicate recessive epistasis (9:7), vi.) Dominant and recessive epistasis (13:3). Pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Non - Mendelian inheritance – cytoplasmic inheritance.

### UNIT III- Quantitative inheritance, linkage and crossing over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits. Linkage and genetic mapping, Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's

experiments, single cross over, multiple cross over, two-point cross, three-point cross, map distances, gene order, interference and co-efficient of coincidence.

#### **UNIT IV- Sex determination and elements of biometry**

Sex determination and sex linkage, sex limited and sex influenced traits. Sample and Sampling, Collection and Representation of Data, Measures of Central Tendency - Mean, Median and Mode. Measures of Dispersion - Variance and Standard deviation. Test of Hypothesis - Chi square Test. Probability - Definition and rules.

#### **UNIT V- Modern concepts of genetics and mutation**

Gene concept: Gene structure, function and regulation. Transcription and translational mechanism of genetic material - protein synthesis. Lac and Trp operons. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Genetic disorders. Nature, structure & replication of genetic material.

#### **PRACTICAL**

Study of Microscopy. Study of cell structure and function. Preparation of Slide for Mitosis study. Preparation of Slide for Meiosis study. Monohybrid Ratio and its Modification. Dihybrid Ratio and its Modification. Study of Trihybrid Ratio and back cross methods. Experiments on probability and Chi-square test. Gene Interaction. Estimation of Linkage: Two Point Test Cross. Estimation of Linkage: Three Point Test Cross. Simple interaction of genes-comb character in fowls; Dominant epistasis. Recessive epistasis, Duplicate and additive epistasis. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis. Multiple alleles and polygenic inheritance. Studies on sex linked inheritance in Humans and Drosophila.

#### **Lecture schedule**

1. Definition of genetics, heredity, inheritance, cytology, cytogenetic; Brief history of developments in genetics and cytogenetics.
2. Physical basis of heredity: Structure and function of cell and cell organelles –
3. Differences between Prokaryotes and Eukaryotes. Cell division – mitosis
4. Cell division - meiosis and their significance
5. Gametogenesis and syngamy in Plants-identical and fraternal twins
6. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram
7. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes -polytene, lampbrush, B chromosomes, ring and isochromosomes.
8. Chromosomal aberration: Variation in chromosome structure –deletion, duplication, inversion and translocation – genetic and cytological implications.
9. Chromosomal aberration: Variation in chromosome number– euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome.

10. Polyploid- autoandallopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, Brassica
11. Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.
12. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
13. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.
14. Chromosomal theory of inheritance. Allelic interactions –Dominance vs recessive, complete dominance, codominance, incomplete dominance, threshold characters
15. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio –i.) Dominant epistasis (12:3:1)
16. Recessive epistasis (9:3:4) Duplicate and additive epistasis (9:6:1). iv.) Duplicate dominant epistasis (15:1)
17. **Mid Semester Examination**
18. Duplicate recessive epistasis (9:7) vi.)Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i)to (vi).
19. Lethalgenes, Pleiotrophy, penetrance and expressivity, Multiplealleles, bloodgroupin humans, coat colourin rabbits, selfincompatibility in plants; pseudo alleles,isoalleles.
20. Quantitativeinheritance–Multiplefactorhypothesis– NilssonEhleexperimentonwheatkernelcolour.
21. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers;
22. Linkage - coupling and repulsion; Experiment on Bateson and Punnet
23. Chromosomaltheoryoflinkage ofMorgan–Complete andincomplete linkage,Linkage group.
24. Crossingover– significance of crossingover; cytologicalprooffor crossingover- Stern's experiment; Factors controlling crossing over.
25. Strength oflinkage and recombination; Twopointandthree pointtest cross.
26. Double cross over, interference and coincidence; genetic map, physical map.
27. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - differenttypes – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – Melandrium, papaya, maize.
28. Genic balance theory of Bridges - Gynandromorphs
29. Sexlinked inheritance– criss cross inheritance –reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
30. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium

31. DNA, the genetic material –Griffith’s experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material– Frankel, Conrat and Singer experiment.
32. Structure of DNA – Watson and Crick model Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA –Protein synthesis
33. Regulation of gene expression – Operon model of Jacob and Monad – Lac and Trp operons. Cistron, muton and recon.
34. Mutation – characteristics of mutation – micro and macro mutation – CIB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

### **Practical schedule**

1. Study of Microscopy.
2. Study of cell structure and function.
3. Preparation of Slide for Mitosis study.
4. Preparation of Slide for Meiosis study.
5. Monohybrid Ratio and its Modification.
6. Dihybrid Ratio and its Modification.
7. Study of Trihybrid Ratio and back cross methods.
8. Experiments on probability and Chi-square test.
9. Gene Interaction.
10. Estimation of Linkage: Two Point Test Cross.
11. Estimation of Linkage: Three Point Test Cross.
12. Simple interaction of genes-comb character in fowls; Dominant epistasis.
13. Recessive epistasis, Duplicate and additive epistasis.
14. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
15. Multiple alleles and polygenic inheritance.
16. Studies on sex linked inheritance in Humans and Drosophila.
- 17. Final Practical examination.**

### **Text books**

1. Gupta P.K. 2007. Cytogenetics. Meerut: Rastogi Publications.
2. Verma, P.S. and Agarwal V.K. 2007. Genetics. S. Chand and Company Ltd., New Delhi.
3. Russel, P.J. 2000. Fundamentals of genetics. Addition Wesley Longman Publishers, USA.
4. Singh, B.D. 2004. Fundamentals of genetics. Chennai: Kalyani Publishers.
5. Pundhansingh, 2014. Elements of Genetics. Kalyani Publishers.

### **Reference books**

1. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin & Jeffrey H. Miller. 2002. Modern Genetic Analysis (Second Edition). United States: W. H. Freeman.

2. Benjamin Lewin. 2007. Genes IX. Oxford: Oxford University Press.
3. Daniel Sundararaj, Thulasidas, G. & Stephen Dorairaj, M. 1997. Introduction to Cytogenetics and Plant Breeding. Chennai: Popular Book Depot.
4. Singh, R.J. 2002. Plant cytogenetics. USA: CRC Press.
5. Gardner E. J., Simmons M. J., & Peter Snustad, D. 2015. Principles of Genetics. USA: John Wiley and Sons.
6. Satguru Prasad. (2018). Elements of Biostatistics. Rastogi Publication

#### **Web-references**

1. <https://www.cliffsnotes.com/study-guides/biology/biology/classical-mendelian-genetics/principles-of-genetics>
2. <https://www.jax.org/education-and-learning/clinical-and-continuing-education/ccep-non-cancer-resources/core-principles-in-genetics-2004>
3. [https://www2.palomar.edu/anthro/mendel/mendel\\_1.htm](https://www2.palomar.edu/anthro/mendel/mendel_1.htm)
4. <https://www.youtube.com/watch?v=2ycwGQUjmJY&list=PLKIDmF-ilyAkT0rhgMzSvGmqQz5licCMs>

### **22AEN 201 FUNDAMENTALS OF ENTOMOLOGY (2+1)**

#### **Course objective:**

- To define entomology and list the contributions of entomologist
- To compare insects with other arthropods of animal kingdom
- To describe insect morphology and anatomy
- To organise insects into different taxonomic categories

#### **Course outcome:** Through this course students should be able to

- Recall the basics of entomology and history of entomology in India
- Discuss the position of insects in the animal kingdom
- Explain insect morphology and anatomy
- Appraise insect taxonomy and systematics and analyse different characters of insect orders

### **THEORY**

#### **Unit I- Introduction to entomology and insect morphology**

History of Entomology in India. factors responsible for insect dominance, introduction and classification of phylum arthropoda and class insecta, Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus.

#### **Unit II- Insect morphology and anatomy**

Metamorphosis and diapause in insects. Types of eggs, larvae and pupae. Major sensory organs – Photoreceptors (simple and compound eyes), chemoreceptors and Mechanoreceptors. Structure and functions of digestive system, excretory system, circulatory system and respiratory system of insects

#### **Unit III- Insect anatomy**

Structure and functions of nervous, and reproductive system, in insects. Types of reproduction.

Glandular system in insects

#### **Unit IV- Insect taxonomy and systematics – apterygote and exopterygote orders**

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, and emphasis of families of agricultural importance. Apteriygote orders and Exopterygote orders: Ephemeroptera, Odonata, Plecoptera, Grilloblatodia, Orthoptera (Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae), Phasmida, Dermaptera, Embioptera, Dictyoptera (Mantidae, Blattidae), Isoptera, Zoraptera, Psocoptera, Mallophaga, Siphonculata, Hemiptera (Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae), Thysanoptera

#### **Unit V- Endopterygote orders**

Classification of Pterygote orders of insects with special emphasis to orders and families of Agricultural importance like Neuroptera (Chrysopidae); Lepidoptera (Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae); Coleoptera (Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae); Hymenoptera: (Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae).

### **PRACTICAL**

External features of Grasshopper/cockroach. Methods of collection and preservation of insects including immature stages. Types of insect antennae. Types of insect mouthparts. Types of insect legs. Types of insect Wing venation, types of wings and wing coupling apparatus. Types of insect eggs, larvae and pupae. Dissection of digestive system in insects. Dissection of male and female reproductive systems in insects. Dissection of nervous system in insects. Dissection of Circulatory system in insects. Dissection of respiratory system in insects. Study of taxonomic characters of orders Lepidoptera, Coleoptera, Hemiptera, Diptera, Orthoptera, Dictyoptera, Isoptera, Odonata, Thysanoptera, Neuroptera and Hymenoptera.

#### **Lecture schedule:**

1. Study of insects and their importance in Agriculture.
2. History of Entomology in India
3. Position of insects in the Animal Kingdom and relationship with members of Arthropoda.
4. Insect dominance: structural, morphological and physiological factors responsible for dominance.
5. Insect body wall: its structure and function
6. Moulting process in insects.
7. Structure of insect head, its orientation appendages and functions.
8. Structure of insect thorax, appendages and their functions.

9. Structure of insect abdomen, abdominal appendages and their functions.
10. Metamorphosis and diapause in insects.
11. Types of egg, larvae and pupae.
12. Major sensory organs — types of sensilla – photoreceptors (simple and compound eyes), chemoreceptors and mechanoreceptors.
13. Digestive system in insects – structure of alimentary canal, modifications in certain groups, enzymes, digestion and absorption of nutrients.
14. Excretory system in insects – malpighian tubules – accessory excretory organs – physiology of excretion.
15. Circulatory system in insects – haemocoel and dorsal vessel – circulation of blood – composition of haemolymph – blood plasma – haemocytes and their functions.
16. Respiratory system in insects – structure of trachea – tracheoles – types of respiratory system – types of spiracles – respiration in aquatic and endoparasitic insects.
17. **Mid Semester Examination**
18. Nervous system in insects – structure of neuron – central nervous system – conduction of nerve impulses – axonic and synaptic transmission.
19. Male and female reproductive systems in insects – their structures – types of reproduction – oviparous, viviparous, paedogenesis, polyembryony and parthenogenesis.
20. Structure of exocrine glands and their location and simple function – effect on metamorphosis and reproduction.
21. Structure of endocrine glands and their location and simple function – effect on metamorphosis and reproduction.
22. Classification and nomenclature of insects.
23. Important characters of Apterygota
24. Important characters of Exopterygote orders: Ephemeroptera, Odonata, Plecoptera, Grylloblattid.
25. Important characters of Exopterygote orders: Phasmida, Dermaptera, Embioptera,
26. Important characters of Exopterygote orders – Orthoptera and Dictyoptera
27. Important characters of Exopterygote orders – Isoptera, Zoraptera,
28. Important characters of Exopterygote orders - Psocoptera, Mallophaga, Siphonculata
29. Important characters of Exopterygote orders – Hemiptera and Thysanoptera
30. Important characters of Endopterygota order- Neuroptera
31. Important characters of Endopterygota order– Lepidoptera and families of agricultural importance with significant characters.
32. Important characters of Endopterygota orders – Coleoptera and families of agricultural importance with significant characters.
33. Important characters of Endopterygota order- Diptera and families of agricultural importance with significant characters.
34. Important characters of Endopterygota order- Hymenoptera and families of agricultural importance with significant characters.

### **Practical schedule:**

1. External features of Grasshopper/cockroach
2. Methods of collection and preservation of insects including immature stages
3. Types of insect antennae
4. Types of insect mouthparts
5. Types of insect legs
6. Types of insect Wing venation, types of wings and wing coupling apparatus
7. Types of insect eggs, larvae and pupae
8. Dissection of digestive system in insects
9. Dissection of male and female reproductive systems in insects
10. Dissection of nervous system in insects
11. Dissection of Circulatory system in insects
12. Dissection of respiratory system in insects
13. Study of taxonomic characters of orders Lepidoptera and Coleoptera
14. Study of taxonomic characters of orders Hemiptera and Diptera
15. Study of taxonomic characters of orders Orthoptera, Dictyoptera Isoptera and Odonata
16. Study of taxonomic characters of orders Thysanoptera, Neuroptera and Hymenoptera
17. **Final Practical Examination.**

### **Text books**

1. Shanthi. M., Senguttuvan. T., Suresh. K., Kavitha. Z. 2020. Text book on Fundamental Entomology. Agrobios (India).
2. Ragumoorthi K.N., Balasubramani. V., Srinivasan. M. R., Natarajan N. 2017. Insecta: An Introduction..A.E. Publications.

### **Reference books**

1. Chapman, R.F. 1981. The Insects: Structure and function. Edward Arnold (Publishers) Ltd, London, 919p.
2. Snodgrass, R.E. 2001. Principles of Insect Morphology. CBS Publishers and Distributors, New Delhi
3. Richards, O.W. and. Davies. R.G. 1977. Imm's general text book of entomology, Vol.1&2, Chapman and Hall Publication, London, 1345p.
4. Gullan, P.J. and Cranston, P.S. 2001. The insects- An outline of entomology, II edition, Chapman & Hall, Madras, 491p.

### **Web references:**

1. <https://genent.cals.ncsu.edu/bug-bytes/>
2. <https://genent.cals.ncsu.edu/>
3. <https://genent.cals.ncsu.edu/insect-identification/thumbnail-view/>
4. <http://ecoursesonline.iasri.res.in/course/view.php?id=142>

## **22AEC 201 FARM MANAGEMENT, PRODUCTION, AND RESOURCE ECONOMICS**

**(1+1)**

### **Course objective:**

- To impart knowledge on risks in agricultural production and management of resources.

### **Course outcomes:**

- Explain the importance of farm management in agriculture
- Comprehend the benefits and costs involved in farm management
- Analyze farm business
- Devise plans to overcome risks and manage farm resources
- Manage a farm

### **THEORY**

#### **Unit 1- Production economics and farm management - nature and scope**

Meaning and concept of farm management, objectives, and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms. Types of farming: Specialized, Diversified, and Mixed farming–Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Cooperative Farming.

#### **Unit 2- Factor – product, factor – factor and product – product relationships**

Principles of farm management: Concept of production function and its characteristics and its type, use of production function in decision-making on a farm. Factor-Product relationship. Meaning, Definition – Laws of Returns. Meaning and concept of cost, types of costs, cost curves – and their inter-relationship-shutdown and break-even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family Labor income and farm business income. Economies of Scale–Economies of Size Determination of Optimum Input and Output – Physical and Economic Optimum. Factor – Factor relationship: Least Cost Combination of inputs; Product – Product relationship: Optimum Combination of Products – Principle of Equi – Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.

#### **Unit 3- Farm planning and budgeting**

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

#### **Unit 4- Risk and uncertainty in agriculture production**

Concept of risk and uncertainty occurrences in agriculture production, nature and sources of risks and their management strategies, Crop / livestock/ machinery insurance. Weather based crop insurance - Features and determinants of compensations.

#### **Unit 5- Resource economics**

Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources. Natural Resources - Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions; Important tissues in economics and management of common property resources of land, water, pasture and forest resources.

### **PRACTICAL**

Practical Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns / opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crops – Estimation of costs and returns of livestock products. Preparation of farm plan and budget, farm records and accounts and profit and loss accounts. Break – even analysis- Graphical solution to Linear Programming problem. Collection and analysis of data on various resources in India.

### **Lecture schedule**

1. Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms.
2. Types of farming: Specialized, Diversified, and Mixed farming– Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.
3. Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm
4. Factor- Product relationship: Meaning, Definition – Laws of Returns: Classical production function and its characteristics.
5. Meaning and concept of cost, types of costs, cost curves – and their inter-relationship - shutdown and break even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family Labor income and farm business income.
6. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum.
7. Factor – Factor relationship: Least Cost Combination of inputs
8. Product – Product relationship: Optimum Combination of Products – Principle of Equi – Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.
- 9. Mid Semester Examination**
10. Farm business analysis: meaning and concept of farm income and profitability, technical

and economic efficiency measures in crop and livestock enterprises.

11. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts.
12. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.
13. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies.
14. Crop / livestock/machinery insurance. Weather based crop insurance - Features and determinants of compensations.
15. Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources.
16. Natural Resources Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights – Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture,
17. Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources.

### **Practical schedule**

1. Preparation of farm layout. Determination of cost of fencing of a farm.
2. Computation of depreciation and cost of farm assets: Valuation of assets by different methods
3. Application of equi-marginal returns/opportunity cost principle in allocation of farm resources.
4. Determination of most profitable level of inputs use in a farm production process.
5. Determination of least cost combination of inputs.
6. Selection of most profitable enterprise combination
7. Application of cost principles including CACP concepts in the estimation of cost of cultivation and cost of production of agricultural crops.
8. Estimation of cost of cultivation and cost of production of perennial crops /horticultural crops.
9. Estimation of cost of returns of livestock products.
10. Preparation of farm plan and budget.
11. Farm records and accounts: Usefulness, types of farm records: farm production records and farm financial records.
12. Preparation of Cash flow statement
13. Preparation and Analysis of Net worth Statement and Profit and Loss statement
14. Estimation of Break – even analysis.

15. Graphical solution to Linear Programming problem
16. Collection and analysis of data on various resources in India
17. Final Practical Examination

#### **Text books**

1. Johl, S, S., & Kapoor, T, R., 2009. Fundamentals of Farm Business Management. New Delhi, Kalyani Publishers. pp.1-255.
2. Mohanty, S, K., 2007. Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd. pp.1-272
3. Panda, S, C., 2007. Farm Management and Agricultural Marketing. India, Ludhiana: Kalyani Publishers. pp. 10-150.
4. Raju, V, T., 2017. Economics of Farm Production and Management. New Delhi: Oxford & IBH Publishing. pp.1-207

#### **Reference books**

1. Debertin, D, L., 2012. Agricultural Production Economics. New York: Create Space Independent Publishing Platform. pp. 1-98.
2. Sankayan, P, L., 1983. Introduction to Farm Management. New Delhi: Tata McGraw Hill Publishing Company Ltd. pp. 1-86.

#### **Web – references**

1. [www.ediindia.org](http://www.ediindia.org)
2. [www.iie.nic.in](http://www.iie.nic.in)
3. [www.msme.gov.in](http://www.msme.gov.in)
4. [www.niesbudtraining.org](http://www.niesbudtraining.org)
5. [www.nimsme.org](http://www.nimsme.org)
6. [www.nsic.co.in](http://www.nsic.co.in)
7. [www.nabard.org](http://www.nabard.org)
8. [www.uky.edu/~deberti/agprod5.pdf](http://www.uky.edu/~deberti/agprod5.pdf)
9. [www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/lectures/AgEcon122FSM.pdf](http://www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/lectures/AgEcon122FSM.pdf)

### **22FMP 211 FARM MACHINERY AND POWER (1+1)**

#### **Course objective**

The course aims to enable the students to understand the basic principles and parts of internal combustion engine and different tillage, sowing, intercultural, plant protection equipment ,working principles of threshers, harvesting of field and horticultural crops

#### **Course outcomes**

- To understand the working principle of different systems and parts of internal combustion engines.
- To equip the students with technical knowledge and skills required for the operation of Tillage, Sowing and intercultural and plant protection machinery needed for agricultural farms.

- To train the students with skills required for the operation, maintenance and evaluation of harvesting, threshing machinery needed for agricultural farms.

## **THEORY**

### **Unit I- Farm power and IC engines**

Status of Farm Power in India, Sources of Farm Power, I.C. engines, working principles of IC engines, comparison of two stroke and four stroke cycle engines , Study of different components of IC engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply.

### **Unit-II- Tractor and functional components**

Hydraulic control system of a tractor, Familiarization with Power transmission system clutch, gear box, differential and final drive of a tractor, Tractor types, Cost analysis of tractor power and attached implement.

### **Unit –III- Tillage implements**

Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture.

### **Unit-IV- Sowing and intercultural implements**

Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, implement for intercultural operations.

### **Unit-V- Plant protection and harvesting equipments**

Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

## **PRACTICAL**

Study of different components of I.C. engine - To study air cleaning and cooling system of engine - Familiarization with clutch – Transmission - Differential and final drive of a tractor- Familiarization with lubrication and fuel supply system of engine - Familiarization with brake – Steering -Hydraulic control system of engine - Learning of tractor driving - Familiarization with operation of power tiller- Implements for hill agriculture - Familiarization with different types of primary and secondary tillage implements – Mould board plough - Disc plough and disc harrow - Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration - Planters and transplanter- Familiarization with different types of sprayers and dusters – Familiarization with different inter-cultivation equipment- Familiarization with harvesting and threshing machinery.

## **Lecture schedule**

1. Farm power in India - sources of farm power and their use in agriculture
2. Working principles of IC Engines-Two stroke and Four stroke engines - applications – comparison-Engine terminology.
3. Components of IC engine and systems of IC engine – air cleaning, cooling, lubricating and fuel supply systems.

4. Tractors- types - transmission system- clutch, gearbox, differential and final drive - hydraulic system.
5. Cost analysis of tractor with attached implement.
6. Tillage, objectives, types –ploughing methods. Primary tillage-mould board plough, disc plough, chisel plough and sub soil plough - components and functions, types, advantages and disadvantages
7. Secondary tillage equipment– cultivators, harrows, levelers, and forming equipment– rotovators –puddlers –manure trawlers and cage wheels, Implements for Hill agriculture.
8. Sowing methods - seed drills and planters- seed cum fertilizer drills - components and functions-Calibration.

### **9. Mid Semester Examination**

10. Paddy transplanters, types, working principle, field and nursery requirements
11. Implements for inter cultural operations –cultivators, sweep, junior hoe, manual weeders and power operated weeders for wetland and garden land
12. Sprayers and their functions, classification, manually operated sprayers, terminology, Nozzle types.
13. Power operated sprayers – Tractor operated boom sprayer, Knapsack mist blower cum duster – Tall tree sprayer-dusters, types and uses.
14. Tools for horticultural crops – propagation tools, planters and harvesting tools and machinery
15. Threshing of crop, thresher and its principles of operation - threshing losses.
16. Harvesting equipment– reapers - mowers and combine harvesters –types, construction and operation-Balers.
17. Harvesting machinery for groundnut, tuber crops, Cotton and sugarcane

### **Practical schedule**

1. Study of working of two and four stroke IC Engines and their systems with solved problems.
2. Study of Tractor clutch, gearbox, differential and final drive. Study of brake, steering and hydraulic control.
3. Learning driving of tractor and power tiller
4. Study of tractors and power tillers – their operation and maintenance
5. Study of mould board plough, - methods of ploughing- with solved problems.
6. Disc plough and sub soiler and their components- Hitching and adjustment of plough - field operation of different tractor drawn primary tillage machinery.
7. Study of cultivator, disc harrows, Rotavator, bund former, ridger, leveler and puddling implements and their operation.
8. Study of seed drills, planters and seed-cum-fertilizer drills and their components and metering mechanisms -calibration- simple problems on calibration.
9. Study and operation of machinery for rice cultivation –puddling implements- rotary puddlers and cage wheels, tray seeder for rice nursery, transplanters -types operation and maintenance- Drum seeder, cono weeder, power weeder and finger type weeder.

10. Study of different inter- cultivation equipment for uplands -manual, animal drawn, power operated -tractor and power tiller operated -field operation
11. Study of plant protection equipment– manually operated sprayers and dusters, knapsack mist blower cum duster, tractor operated sprayers- their operation, adjustment, calibration and safety requirements
12. Study of tools for Hill agriculture and horticultural crops – propagation tools, vegetable transplanter, harvesting tools –lawn mower, hole diggers, tree climber, shredders for crop residue.
13. Threshing machinery for paddy and identification of its components- different threshing drums - calculation of efficiency and losses.
14. Study of paddy reaper and paddy combine-their systems, method of operation and adjustment.
15. Study of harvesters for root crops - turmeric and tapioca and groundnut diggers
16. Problems on cost of operation of tractor operated machinery.

### **17. Final Practical Examination**

#### **Text books**

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

#### **Reference books**

1. Ojha, T.P and A.M. Michael. 2005. Principles of Agricultural Engineering Vol-I. Jain Brothers, New Delhi. ISBN: 978-8186321638.
2. Nakra C.P 1970. Farm Machinery and Equipment,,: Dhanpat Rai Publishing Company Ltd, New Delhi ISBN: 978-8187433231.
3. Jain, S.C. and C.R.Rai. Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak,. Delhi- 110006
4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
5. S.C. Jain & Grace Philip, Farm Machinery- An approach, Standard publishers Delhi

#### **Web references**

1. <https://www.agroengineering.org>
2. <https://www.sciencedirect.com › journal › journal-of-agricultural-engineering>.
3. <https://publons.com › journal › journal-of-agricultural-engineering-and-technology>
4. <https://www.agriculturejournals.cz>
5. <https://ecourses.icar.gov.in/>
6. <https://nptel.ac.in/courses>
7. <https://ciae.nic.in>
8. <https://cmeri.res.in>

**22HOR 211 PRODUCTION TECHNOLOGY FOR FRUIT AND PLANTATION CROPS**

**(1+1)**

**Course objective:**

- To impart knowledge on basic cultural practices of Fruits and Plantation crops.
- To insist on modern and advanced techniques to increase the yield and production.
- To learn about the economic estimation of commercial Horticultural crops.

**Course outcome:**

- The student gains a thorough knowledge on basic and advance production technology.
- Familiarize on basic pruning, training and special techniques of fruits and plantation crops.
- Acquaintance on commercial oriented cultural practices.

**THEORY****Unit I- Production status of fruit and plantation crops**

Importance and scope of fruit and plantation crop industry in India – Nutritional value of fruit crops- Classification of fruit crops - Area, production, productivity and export potential of fruit and plantation crops.

**UNIT II- Crop production techniques in tropical fruit crops**

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

Fruit crops: mango, banana, papaya, guava, sapota

**UNIT III- Crop production techniques in subtropical fruit crops**

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

Fruit crops: citrus, grape, litchi, pineapple, pomegranate, jackfruit and minor fruits

**UNIT IV- Crop production techniques temperate fruit crops**

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

Fruit crops: apple, pear, peach, strawberry, nut crops.

## **UNIT V- Crop production techniques in palms and plantation crops**

Climate and soil requirements - varieties - propagation - nursery management - planting and - planting systems - cropping systems - after care - water, nutrient and weed management - intercropping - multi- tier cropping system - mulching- special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition.

**Palms:** Coconut, Areca nut, Oil palm and Palmyra

Climate and soil requirements - varieties - propagation - nursery management - planting and - planting systems - cropping systems - after care - water, nutrient and weed management - intercropping - multi- tier cropping system - mulching- special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition.

Plantation crops: Tea, Coffee, Cocoa, Cashew, Rubber

### **PRACTICAL**

Propagation methods for fruit crops - description and identification of varieties - preparation of plant bio regulators & their uses – nutrient deficiency and disorders of fruit crops - fertilizers- application - pests and diseases- micro propagation in fruit crops- Visit to commercial orchard. Fruit crops: Mango, banana, papaya, guava, sapota, grapes, citrus (Mandarin and acid lime), pomegranate and jackfruit

Propagation methods for plantation crops - description and identification of plantation crops- preparation of plant bio regulators & their uses - nutritional disorders of plantation crops - fertilizers- application - pests and diseases- cost economics of plantation crops. Visit to plantations and plantation industries. Palms and plantation crops: Coconut, Areca nut, Cashew, Tea, Coffee, Rubber andCocoa

### **Lecture schedule:**

1. Importance and scope of fruit and plantation crop industry in India – nutritional value of fruit crops
2. Classification of fruit crops – area, production, productivity and export potential of fruit and plantation crops
3. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning- top working - water, nutrient and weed management- canopy management - plant growth regulation - important disorders–maturity indices and harvest - post harvest management of Mango
4. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- water and nutrient management – fertigation - Weed control - Plant growth regulation - important disorders–maturity indices and harvest- post harvest management of Banana
5. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation- important disorders – maturity indices and harvest - post harvest management of Papaya, Guava and Sapota

6. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation – nutrient deficiencies and important disorders–maturity indices and harvest- post harvest management of Citrus (Sweet orange, Mandarin and Acid Lime)
7. Climate and soil – varieties - propagation methods - planting and cropping systems-after care – systems of training and pruning and bud forecasting - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Grapes**
8. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - plant growth regulation- important disorders – maturity indices and harvest - post harvest management of Pineapple and Litchi
- 9. Mid Semester Examination**
10. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Pomegranate, Jackfruit and minor fruits
11. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of Apple and Pear
12. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Peach and Strawberry, nut crops
13. Climate and soil requirements -varieties-propagation-nursery management-planting systems planting density -nutrient, water and weed management - intercropping at various ages of plantation -multitier cropping - shade management - nutritional disorders - maturity indices - harvest and yield-pests and diseases -grading -processing and value addition of Coconut Areca nut and Cocoa .
14. Climate and soil requirements - varieties - propagation - nursery management - planting and planting density - HDP - UHDP - nutrient, water and weed management - cover cropping - tapping - use of plant growth regulators - top working - maturity indices- harvest and yield , latex yield and processing - pests and diseases - grading - processing and value addition Rubber and Cashew .
15. Climate and soil requirements- varieties – propagation - nursery management - planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of Tea.
16. Climate and soil requirements-varieties-propagation-nursery management- planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems -

shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of Coffee.

17. Climate and soil requirements-varieties-propagation-nursery management- planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of Oil palm and Palmyra.

### **Practical schedule**

1. Propagation techniques, selection of planting material, varieties, important cultural practices for Mango
2. Propagation techniques, selection of planting material, varieties, important cultural practices for Banana
3. Propagation techniques, selection of planting material, varieties, important cultural practices for Papaya
4. Propagation techniques, selection of planting material, varieties, important cultural practices for Guava
5. Propagation techniques, selection of planting material, varieties, important cultural practices for Sapota
6. Propagation techniques, selection of planting material, varieties, important cultural practices for Grapes
7. Propagation techniques, selection of planting material, varieties, important cultural practices for Citrus (Mandarin and Acid lime)
8. Propagation techniques, selection of planting material, varieties, important cultural practices for Pomegranate
9. Propagation techniques, selection of planting material, varieties, important cultural practices for Jackfruit
10. Preparation and application of PGR's for propagation.
11. Micro propagation, protocol for mass multiplication and hardening of fruit crops.
12. Identification and description of varieties- mother palm and seed nut selection- nursery practices- seedling selection – fertilizers - application - nutritional disorders - pests and diseases of Coconut
13. Identification and description of varieties- mother palm and seed nut selection- nursery practices- seedling selection – fertilizers - application - nutritional disorders - pests and diseases of Arecanut and Cocoa
14. Identification and description of varieties - nursery practices – training and pruning - pests and diseases – processing of Tea and Coffee.
15. Identification and description of varieties, clones - bud wood nursery practices - propagation techniques - top working – preparation of plant bio regulators and its uses- pests and diseases - processing of Rubber and Cashew

16. Visit to commercial orchard and plantation industries.

**17. Final Practical Examination.**

**Reference books**

1. N Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
2. M Kavino, V Jegadeeswari, R M Vijayakumar and S Balakrishnn, 2019. Production Technology for Fruits and Plantation Crops, Narendra Publishing

**E – references**

1. <http://www.jhortscib.com>
2. <http://journal.ashspublications.org>
3. <http://www.actahort.org/>
4. <http://www.aphorticulture.com/crops.htm>
5. <http://cpcricri.nic.in/>

**22PAT 201 FUNDAMENTALS OF PLANT PATHOLOGY (2+1)**

**Course objective:**

- Detailed study and identification of plant diseases caused by fungal, bacterial and viral pathogens.

**Course outcome:**

- To study about different plant diseases caused by biotic factors.
- To study morphology, symptoms, life cycle, reproductive and resting structures of Fungal, bacterial and viral pathogens causing plant disease.
- To study the mode of interaction between plant and pathogens.
- To identify the plant diseases and their causes.

**THEORY**

**Unit I - Plant pathogenic organisms**

Introduction- Definition, History of plant pathology, Economic importance of plant diseases. Terms and concepts of Plant Pathology. Classification of plant disease, Factors affecting disease development. Plant Pathogenic organisms: Protozoa, Phytomonas, Chromista, Fungi, Bacteria, *Candidatus phytoplasma*, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites.

**Unit II – Pathogenesis**

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

**Unit III - General characters and taxonomy of protozoa, chromista and fungi**

General characters definition of fungus, somatic structures, types of fungal thalli, fungal tissues, Resting spores, modifications of thallus, reproduction (asexual and sexual) and symptoms caused by plant pathogenic fungi. Nomenclature: Binomial system of nomenclature, rules of

nomenclature, classification of fungi. divisions, sub-divisions, orders and classes. Kingdom: Protozoa, Phylum: *Plasmodiophoromycota*, *Plasmodiophora brassicae.*, Kingdom: Chromista, Phylum: Oomycota; *Pythium*, *Phytophthora*, *Sclerospora*, *Peronosclerospora* and *Albugo* Kingdom: Fungi; Phylum: *Chytridiomycota*- *Synchytrium*; Phylum: *Zygomycota*; *Mucor*, *Rhizopus*

#### **Unit IV - General characters and taxonomy of fungi - ascomycota and basidiomycota**

Phylum: Ascomycota and Basidiomycota *Taphrina*, *Capnodium*, *Mycosphaerella*, *Helminthosporium*, *Macrophomina*, *Venturia*, *Lewia*, *Sclerotium*, *Eurotium*, *Talaromyces*, *Erysiphe*, *Leveillula*, *Claviceps*, *Glomerella*, *Magnaporthe* *Gibberella*, *Verticillium*, *Puccinia*, *Uromyces*, *Ustilago*, *Tilletia*, *Ustilaginoidea*. *Hemelia*, *Rhizoctonia*, *Exobasidium*, *Ganoderma*, *Agaricus*, *Pleurotus* and *Calocybe*.

#### **Unit V - Bacteria, phytoplasma, virus, viroid, algae, phanerogams, and abiotic disorders**

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

#### **PRACTICAL**

Working principle and uses of various laboratory tools and equipment's. Fungi- definition. Study of different morphological structures and fruiting bodies of fungi. Study of symptoms of various plant diseases caused by fungi, bacteria, virus, viroids, algae, phytoplasma, etc. Important characters of representative fungal genera of *Oomycota*- *Sclerospora*, *Plasmopara* and *Albugo*, *Plasmodiophoromycota* and *Oomycota*- *Pythium* and *Phytophthora*, *Zygomycota*-*Rhizopus*, *Mucor*, *Ascomycota*-*Taphrina*, *Capnodium*, *Cercospora*, *Botryodiplodia*, *Drechslera* and *Alternaria*, *Ascomycota*-*Eurotium*, *Penicillium*, *Fusarium*, *Claviceps* and *Verticillum*, *Ascomycota*- *Erysiphe*, *Leveillula*, *Phyllactina*, *Uninula*, *Podosphaera* and *Sphaerotheca*, *Ascomycota*-*Colletotrichum*, *Pestalotia*, *Pyricularia*, *Sarocladium* and *Macrosporium*, *Basidiomycota*- *Puccinia*, *Uromyces* and *Hemileia*, *Basidiomycota*- *Ustilago*, *Spacelotheca*, *Tolyposporium* and *Exobasidium*. Study of bacterial diseases –leaf blight, leaf streak, canker, scab, crown gall, wilt and soft rot. Symptoms and vectors of viral diseases mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis, ring spot, vein clearing, leaf crinkle, rosette and bunched top. Transmission of plant viruses. Plant phanerogamic parasites. Field visit

#### **Lecture schedule**

1. Plant Pathology - Introduction, definition, and history
2. Terms and concepts of plant pathology.
3. Classification of plant diseases and factors affecting disease development.
4. Plant Pathogenic organisms: Protozoa, Chromista, Fungi, Bacteria, and Phytoplasma, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites.
5. Host pathogen interaction, Mode of infection, pre-penetration, penetration and post penetration

6. Survival and dispersal of plant pathogens
7. Effect of Pathogen on physiological functions of the plants
8. Role of enzymes
9. Role of toxins
10. General characters of fungi
11. Different morphological structures of fungi
12. Mode of nutrition in fungi
13. Asexual Reproduction in fungi
14. Sexual Reproduction in fungi
15. Parasitism in fungi, Mode of nutrition
16. Classification of *Plasmodiophoromycota- Plasmodiophora brassicae*
17. **Mid Semester Examination**
18. Classification of *Chromista- Oomycota; Pythium, Phytophthora, Sclerospora, Peronosclerospora* and *Albugo*
19. Classification, general characters symptoms and life cycle of *Chytridiomycota-Synchytrium*
20. Classification, general characters symptoms and life cycle of *Zygomycota - Mucor, Rhizopus*
21. Classification, general characters symptoms and life cycle of *Taphrina, Capnodium, Mycosphaerella, Helminthosporium, Macrophomina, Venturia,*
22. Classification, general characters symptoms and life cycle of *Ascomycota Lewia, Sclerotium, Eurotium, Talaromyces*
23. Classification, general characters symptoms and life cycle of *Ascomycota Erysiphe, Leveillula* and *Phyllactina*
24. Classification, general characters symptoms and life cycle of *Ascomycota Claviceps, Glomerella, Magnaporthe Gibberella, Verticillium, Ustilaginoidea.*
25. Classification, general characters symptoms and life cycle of *Basidiomycota- Puccinia, Uromyces, Ustilago, Tilletia,*
26. Classification, general characters symptoms and life cycle of *Basidiomycota- Agaricus, Pleurotus and Calocybe.*
27. Classification, general characters symptoms and life cycle of *Basidiomycota -Rhizoctonia, Exobasidium, Ganoderma,*
28. Classification of bacteria, General characters of bacteria and their symptoms.
29. Phytoplasma, spiroplasma, fastidious vascular bacteria and their symptoms.
30. General characters and Properties of virus
31. Symptoms of viruses.
32. General characters and symptoms of viroids
33. General characters and symptoms of Phanerogamic parasites.and algae.
34. Abiotic factors and their symptoms.

### **Practical schedule**

1. Working principle and uses of various laboratory tools and equipment's.

2. Fungi- definition. Study of different morphological structures and fruiting bodies of fungi.
  3. Study of symptoms of various plant diseases caused by fungi, bacteria, virus, viroids, algae, phytoplasma, etc.
  4. Important characters of representative fungal genera of *Oomycota- Sclerospora, Plasmopara and Albugo*
  5. Important characters of representative fungal genera of *Plasmodiophoromycota* and *Oomycota- Pythium and Phytophthora*
  6. Important characters of representative fungal genera *Zygomycota-Rhizopus, Mucor*
  7. Important characters of representative fungal genera of *Ascomycota.-Taphrina, Capnodium, Cercospora, Botryodiplodia, Drechslera and Alternaria*
  8. Important characters of representative fungal genera of *Ascomycota.-Eurotium, Penicillium, Fusarium, Claviceps and Verticillium*
  9. Important characters of representative fungal genera of *Ascomycota.- Erysiphe, Leveillula, Phyllactina, Uninula, Podosphaera and Sphaerootheca*
  10. Important characters of representative fungal genera of *Ascomycota.-Colletotrichum, Pestalotia, Pyricularia, Sarocladium and Macrosporium*
  11. Important characters of representative fungal genera of *Basidiomycota- Puccinia, Uromyces and Hemileia*
  12. Important characters of representative fungal genera of *Basidiomycota- Ustilago, Spacelotheca, Tolyposporium and Exobasidium.*
  13. . Study of bacterial diseases –leaf blight, leaf streak, canker, scab, crown gall, wilt and soft rot.
  14. Symptoms and vectors of viral diseases mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis, ring spot, vein clearing, leaf crinkle, rosette and bunchy top. Transmission of plant viruses.
  15. Plant phanerogamic parasites.
  16. Field visit
  17. **Final Practical Examination**
- Note:** Students should submit fifty well preserved disease specimens

#### **Text books**

1. Agrios, G.N. 2005. *Plant Pathology* (5<sup>th</sup> Ed). New York: Academic Press. pp. 1-922.
2. Alice, D., & Jeyalakshmi, C. (2014). *Plant Pathology*. Coimbatore: A.E Publications. pp. 1-375.
3. Dube, H.C. 2013. *An introduction to Fungi*. India: Scientific publisher. pp. 1-603.
4. Singh, R.P. 2012. *Plant pathology*. India: Kalyani publishers. pp. 1-724.

#### **Reference books**

1. John Webster & Ronald Weber. 2007. *Introduction to fungi*. UK: Cambridge University Press. pp. 1-841.
2. Kirk, P.M. et al. 2008. *Ainsworth and Bisby's Dictionary of the Fungi* (10<sup>th</sup> ed.). Oxon, U.K: C.A.B International. pp.1-771.

3. Paul et al. 2009. *Bergey's Manual of Systematic Bacteriology*. New York: Springer-Verlag.
4. Richard N. Strange. 2003. *Introduction of Plant Pathology*. London: John Wiley & Sons Ltd. pp.1-480.

### **Web-references**

1. <http://www.biologydiscussion.com>
2. [www.mycology.net](http://www.mycology.net)
3. [www.bspp.org.uk](http://www.bspp.org.uk)
4. <https://www.microscopemaster.com/fungi>
5. <https://talk.ictvonline.org/taxonomy/>
6. [www.apsnet.org/edcenter](http://www.apsnet.org/edcenter)
7. [www.Tolweb.org](http://www.Tolweb.org)
8. <http://www.hillagric.ac.in/edu/coa/ppath/lectures.htm>
9. <http://ecoursesonline.iasri.res.in/course/view.php?id=143>
10. [www.ucmp.berkeley.edu/fungi](http://www.ucmp.berkeley.edu/fungi)
11. [www.ictv.org](http://www.ictv.org)
12. [www.vivo.library.cornell.edu](http://www.vivo.library.cornell.edu).
13. <https://www.youtube.com/c/MTutorEdu/search?query=plant+pathology>.
14. <https://www.youtube.com/channel/UCsgovy3Llp-dB8pMxU2VZ7A>

## **22STA 211 STATISTICAL METHODS (1+1)**

### **Course objective:**

The purpose of learning this course is to understand the fundamental concepts and skills. To calculate mathematical models applicable to field trails and to apply sampling theory in all problems of agricultural sciences.

### **Course outcome:**

- Define the basics of probability and statistics
- Choose the model and analyze the system using random variables
- Apply the testing of hypothesis
- Apply the statistical models in the field
- Explain the techniques related in sampling
- Identify the fundamentals difference between discrete and continuous distribution

### **THEORY**

#### **Unit I- Descriptive statistics**

Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency distribution tables. Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode – merits and demerits. Measures of

dispersion: range, quartile deviation, mean deviation, standard deviation, and coefficient of variation – skewness and kurtosis – merits and demerits.

### **Unit II- Probability distributions and sampling theory**

Probability – basic concepts – additive and multiplicative laws (without proof). Probability distributions – Discrete distributions: Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties. Sampling theory – population – sample – parameter and statistic – sampling distribution – sampling vs complete enumeration – Types of sampling – simple random sampling – selection of simple random sample using random number tables.

### **Unit III- Testing of hypotheses**

Null and alternative hypothesis – types of errors – critical region and level of significance – degrees of freedom. Large sample test – single proportion and difference between two proportions – single mean and difference between two means. Small sample tests – F-test – t-test for testing the significance of single mean – independent t test and paired t test – chi square test for goodness of fit – chi square test for testing the association of attributes by  $m \times n$  contingency table –  $2 \times 2$  contingency table – Yates' correction for continuity.

### **Unit IV- Correlation and regression**

Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

### **Unit V- Analysis of variance and experimental designs**

Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) – lay out, analysis, merits and demerits of the above mentioned designs.

## **PRACTICAL**

Formation of frequency distribution tables – Diagrammatic and graphical representation. Computation of different measures of central tendency and computation of various measures of dispersion for raw and grouped data – calculation of coefficient of variation (CV) – measures of skewness and kurtosis. Simple problems in Binomial distribution, Poisson and Normal distribution – Selection of simple random sampling. Large sample test for single proportion and difference between two proportions and Large sample test for single mean and difference between two means. t-test for single mean – t-test for testing the significance of two means for independent and paired samples – chi square test for goodness of fit and test for independence of two attributes in a contingency table – Yates correction for continuity – calculation of the correlation coefficient – fitting of simple linear regression equation – One way and two way ANOVA – completely randomized design (CRD) – randomized block design (RBD) – Latin square design (LSD).

## **Lecture schedule**

1. Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits
2. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis
3. Diagrammatic representation of data; One, Two and Three dimensional diagrams with applications. Graphical representation of data; Histogram, frequency polygon, frequency curve, ogives.
4. Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling selection using random numbers Stratified - Systematic sampling
5. Probability distributions – Discrete distributions: Bernoulli
6. Binomial and Poisson distribution,
7. Continuous distribution: Normal distribution
8. Null and alternative hypothesis – types of errors - critical region and tests of significance - Large sample test – single mean and difference between two means.
9. **Mid-Semester Examination**
10. Single proportion and difference between two proportions
11. Small sample tests – F-test - t-test for testing the significance of single mean
12. Independent and paired t test
13. Chi square test for testing the association of r x c contingency table
14. Correlation – Scatter diagram - Karl Pearson's correlation coefficient – Spearman's rank Correlation - computation and properties
15. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.
16. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs
17. Completely Randomized Design (CRD) – Randomized Block Design (RBD)

### **Practical schedule**

1. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode
2. Computation of range, standard deviation, variance, coefficient of variance
3. Histogram, frequency polygon, frequency curve, ogives.
4. Selection of sample using simple random sampling method, Simple problems in Bernoulli distribution
5. Simple problems in Binomial distribution and Poisson distribution
6. Simple problems in Normal distribution
7. Large sample test – test for single proportion and difference between two proportions
8. Large sample test – test for single mean and difference between two means
9. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only)

10. Paired t-test
11. Chi square test
12. Computation of Karl Pearson's correlation coefficient
13. Fitting of simple linear regression equation  $y$  on  $x$  – correlation and regression
14. Analysis of Completely Randomised Design (CRD) – for equal replications only
15. Analysis of Randomised Block Design (RBD) and FRBD
16. Analysis of Split plot design and Latin Square Design (LSD)
17. **Final Practical Examination**

#### **Text books**

1. Chandel S. R. S. 2014. *A Handbook of Agricultural Statistics*. Kanpur: Achal Prakashan Mandir. pp. 1-87
2. Gupta, S.P. 2004. *Statistical Method*. New Delhi: Sultan chand and sons. pp. 1-1476.
3. Nageswara Rao, G. 2007. *Statistics for Agricultural Sciences*. Hyderabad: B.S. Publications. pp. 1- 512
4. Panse, V.G. & Sukhatme, P. V. 1954. *Statistical Methods for Agricultural Workers*. India: Indian Council of Agricultural Research. pp. 1- 361
5. Vittal P. R. 2012. *Mathematical Statistics*. Chennai: Margham Publications. pp. 1 – 950

#### **References books**

1. Agrawal B.L. 2005. *Basic Statistics*. New Delhi: New age International Ltd. pp. 1- 656
2. Dhamu, K.P. & Ramamoorthy, K. 2009. *Fundamentals of Agricultural Statistics*. India: Scientific Publishers. pp. 1- 130
3. Gupta, S.P. 1978. *Elementary Statistical Method*. New Delhi: Sultan chand and sons. pp. 1- 438
4. Kailasam, G. & Gangaiselvi, R. 2010. *Applied Statistics*. New Delhi: Kalyani Publishers. pp. 1 -200
5. Vijay K. Rohatgi, Ehsanes Saleh A.K.M.D. 2008. *An Introduction to Probability and Statistics*, (2<sup>nd</sup> ed.). New Jersey: John Wiley and sons Inc. pp.1 - 631

#### **Web references**

1. [www.statisticshowto.com](http://www.statisticshowto.com)
2. [www.mathisfun.com](http://www.mathisfun.com)
3. [www.mathinsight.org](http://www.mathinsight.org)
4. <http://www.statistics.com/resources/glo.ssary/>
5. [www.statsoft.com](http://www.statsoft.com)
6. [http://www.iasri.res.in/ebook/EB\\_SMAR/index.html](http://www.iasri.res.in/ebook/EB_SMAR/index.html)
7. [www.statsci.org/jourlist.html](http://www.statsci.org/jourlist.html)

### **22AMP 201 LIVESTOCK AND POULTRY MANAGEMENT (2+1)**

#### **Course objective:**

- Explain the contributions of different types of livestock and Poultry
- Summarize Animal Population and rearing system in livestock and Poultry
- Outline the information on diversified Poultry
- Explain different livestock management systems
- Describe feed formulation and nutritional management in livestock and poultry
- Describe the management and bio security measures

**Course outcome:**

- Illustrate skills on different rearing system of livestock
- Explain the management of different age group animals
- Describe the poultry sector
- Demonstrate animal handling
- Discuss clean milk production and Milk processing methods
- Outline entrepreneurship skills

**THEORY**

**Unit I- Introduction to livestock management**

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry census – Different livestock development programs of Government of India and Tamil Nadu-Variety systems of livestock production extensive – semi intensive -intensive- mixed-Integrated and specialized farms.

**Unit II- Dairy cattle management**

Important White and Black cattle breeds-classification-indigenous and exotic – Breed characteristics – Breeding - Cross breeding- Upgrading - Economic traits of cattle –Culling - Estrus Cycle – Artificial Insemination –Introduction to Embryo transfer–Housing –Space requirement calf and adult stock –System and types of housing - Feeding and Management of Calf, Heifer, Pregnant, Milch animal and working animals – Nutrition – Ration – Balanced Ration - Characteristics of ration and classification of feed and fodder–Total Mixed Ration – composition of concentrate mixture for different stage - Milking methods - Clean milk production – Factors affecting milk composition – Common diseases of cattle – classification – symptoms - preventing and control measures.

**Unit III- Sheep and goat management**

Breeds –Sheep and goat classification —Economic traits - system of rearing -Housing Management–Floor spacerequirement-CareandManagementofyoungandadultstock–Nutrition–FeedandfoddersofSmall ruminants – Flushing - Common diseases – prevention and control.

**Unit IV- Management of swine**

Classification of breeds –Economic traits -Housing -Nutrition – creep feeding -Care and Management of Adult and Young Stock - Common disease- prevention and control.

**Unit V- Poultry management**

Classification of breeds - Commercial Strains of broilers and layers – Housing – brooding – deep litter and cage system – care and Management of broilers and layers -Nutrition of Chick, grower, Layer and broiler– Incubation and Hatching of Eggs -Common Diseases -Control and prevention.

**PRACTICAL**

Study of external parts of Livestock - Identification of livestock and poultry-Tattooing-ear tags-wing and leg bands-Common restraining methods-Disbudding (or) Dehorning-Different methods of castration-Dentition Study of type design of animal and poultry houses-Selection of dairy cow and work bullock-Determination of specific gravity, fat percentage and total solids of milk-Demonstration of cream separation,-Identification of feeds and fodder- Economics Dairy, Goat and Swine farming - Study of external parts of Fowl - Preparation of Brooder House - Brooder management-Identification of layer and non layer- Debeaking, delousing and deworming of poultry-Vaccination schedule for broiler and layer-Dressing of broiler chicken - Economics of Broiler and Layer Farming – Visit to a modern Dairy and commercial layer and broiler farms - Demonstration of incubator and setter.

### **Lecture schedule:**

1. Significance of livestock and poultry in Indian economy-livestock and poultry census. Different livestock development programmes of Government of India and Tamil Nadu.
2. Various systems of livestock production-extensive– semi intensive, intensive-mixed integrated and specialized farms.
3. Definition of breed-classification of indigenous white and black cattle-breed characteristics of Tamil Nadu cattle breeds and Indian breeds.
4. Breed-characteristicsofexoticcattle-JerseyandHolsteinFriesian–IndianBuffaloes-Murrah, Surti and Toda.
5. Breeding-cross breeding-upgrading-economic traits of cattle-culling importance and methods.
6. Estrous cycle – signs of estrous – artificial insemination-merits and demerits-Principles and outline of embryo transfer.
7. Housing management farm site selection and floors pace requirement for calves, heifer, milch animal and work bullocks.
8. Systems of housing-single row system-double row system- head to head and tail to tail-merits and demerits - Type design of house.
9. Care and management of new born calf and heifers.
10. Care and management of pregnant animal and lactating animals.
11. Care and management of dry cows and work bullock.
12. Nutrition- definition- ration- balanced ration-desirable characteristics of a ration. Classification of feed stuffs-concentrate and roughage-comparison, Total Mixed Ration.
13. Model composition of concentrate mixture of young and adult stock-age wise feed and fodder requirement-Importance of green fodder.
14. Milking methods-clean milk production-factors affecting milk yield and composition.
15. Diseases-classification-viral, bacterial and metabolic-general control and preventive measures.
16. Viral diseases-foot and mouth disease, bacterial diseases, anthrax, hemorrhagic septicemia- black quarter - metabolic-tympanites, acidosis, ketosis and milk fever.

### **17. Mid Semester Examination**

18. Sheep and goat farming-classification of breeds of Indian and exotic origin – economic traits.
19. Systems of rearing housing management- type design-floor diagram-space requirement for adult and young stock.
20. Care and management of ram, ewe and lamb-nutrition- feeds and fodder for small ruminants.
21. Care and management of buck, doe and kid- nutrition- flushing.
22. Common ailments of sheep and goat-sheep pox-foot and mouth-blue tongue- PPR-enterotoxaemia Ecto and endo parasites.
23. Swine husbandry –Common breeds of exotic origin-Large White Yorkshire, Landrace and Duroc - economic traits- housing of Swine.
24. Care and management of sow, boar and piglets-nutrition- creep feeding.
25. Disease prevention and control of swine diseases –hog cholera, foot and mouth, ecto and endo parasites.
26. Classification of breeds - commercial strains of layer and broiler.
27. Care and management of Chicks-brooder management.
28. Systems of housing-deep litter and cage system-floor spacerequirement-commonlittermateriallittermanagement-meritsanddemerits.
29. Care and management of Grower and Layers- vaccination schedule.
30. Care and management of broilers –vaccination schedule.
31. Incubation and hatching of eggs.
32. Nutrition-feed formulation-composition of chick, grower, layer broiler- starter and Finisher mashes Feed Conversion Ratio /dozen egg or kg of meat production.
33. Classification of disease –viral– bacterial- protozoan- causative organisms, symptoms and prevention – viral diseases- Ranikhet – IBD-avian flu.
34. Bacterial disease-E.coli-coryza-salmonellosis-protozoan–coccidiosis-casulative organism, symptoms and preventive measures. Management of dead birds and manure.

### **Practical schedule**

1. Study of external parts of livestock
2. Identification of livestock and poultry
3. Common restraining methods of livestock
4. Disbudding, Dehorning, Castration and Dentition of livestock
5. Study of type design of animal and poultry houses
6. Selection of dairy cow and work bullock
7. Determination of specific gravity, fat %, total solids, solids not fat
8. Demonstration of cream separation
9. Identification of feed & fodder
10. Economics of dairy, goat and swine Farming
11. Study of external parts off owl. Preparation of brooder house

12. Identification of layer and non-layer
13. Debeaking, delousing, deworming of poultry Vaccination schedule for broiler and layer
14. Demonstration of dressing of broiler. Economics of layer and broiler farming
15. Visit to a modern dairy and commercial layer and broiler farms
16. Demonstration of incubator and setter

### **17. Final Practical examination**

#### **Text book**

1. CAR. 2002. *Handbook of Animal Husbandry* (4<sup>th</sup> ed). New Delhi: ICAR. pp.1-1549.
2. G.C. Banerjee. 2013. *A Text Book of Animal Husbandry* (8<sup>th</sup> ed).New Delhi : Oxford and IBH Publishing Company Private Limited.pp.1-1079
3. Lesson,S and Summers, J.D. 2001. *A text book of Scott Nutrition of the chicken* (4<sup>th</sup> ed). Canada: University books.pp.1-586
4. Reddy,D.V. 2001. *Principles of animal nutrition and feed technology* (2<sup>nd</sup> ed). Oxford and New Delhi: IBH Publishing Company Private Limited.pp.1-425

#### **Reference books**

1. Sastry, N.S.R and Thomas, C.K. 2005. *Livestock Production Management*. (3<sup>rd</sup> ed). Ludhiana: Kalyani Publishers.pp.1-850
2. Gopalakrishnan, C.A., and Lal, D.M.M. 1992. *Livestock and Poultry Enterprises for Rural Development*. Ghaziabad, Uttar Pradesh: Vikas Publications Private Limited.pp.1-1096
3. Sreenivasaiah, P.V. 2006. *Scientific Poultry Production* (3<sup>rd</sup> ed).Lucknow :International Book Distributing Co. pp- 1-1487.

#### **Web-references**

1. <https://www.drvt.in/p/e-books.html>
2. <https://www.coursera.org/lecture/livestock-farming/1-3-farming-101-the-basics-of-livestock-production-wfhyL>
3. <http://www.tanuv.ac.in/e-learning/objectivities.html>
4. <https://ecourses.icar.gov.in/>

### **Study tour (0+1)**

The students will undertake the short tour during third semester for seven days covering KVK's, Research stations and ICAR institutes in the southern part of Tamil Nadu. The study tour will provide an exposure to the students to know about the soil, climatic conditions and cropping patterns in the respective agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

2022 Batch

Semester III

S. No	Course Code	Course Title	Credit Hours	Total Credits		
1.	22 AGR 201	Crop Production Technology I (Kharif Crops)	1+1	2		
2.	22 AGR 202	Principles of Weed Management	1+1	2		
3.	22 AEN 201	Fundamentals of Entomology	2+1	3		
4.	22 PBG 201	Fundamentals of Genetics	2+1	3		
5.	22 AEC 201	Farm Management, Production and Resource Economics				1+1
	2					
6.	22 FMP 211	Farm Machinery and Power	1+1	2		
7.	22 HOR211	Production Technology for Fruit and Plantation Crops	1+1	2		
8.	22 PAT 201	Fundamentals of Plant Pathology	2+1	3		
9.	22 STA 211	Statistical Methods	1+1	2		
10.	22 AMP 201	Livestock and Poultry Management	2+1	3		
11.	22 AGR 203	Study Tour*	0+1*	1*		
Total	14+11	25				
12.	22 NSS/ NCC 101	NSS or NCC	0+1#	1#		
13.	22 PED 101	Physical Education and Yoga Practices	0+1#	1#		

#Registered in Semester I and Evaluation in Semester IV \*Non- gradial Course

Semester III

22AGR 201 CROP PRODUCTION TECHNOLOGY – I ( Kharif crops) ( 1+1)

Course objective:

- Imparting the fundamentals of crop production technology of kharif crops
- Demonstrating practical applications of crop production
- Providing knowledge on the importance and practices followed in growing kharif crops

Course outcome: At the end of the course the student should be able to

- Comprehend the fundamentals of crop production of cereals
- Decide on the crops, fertilizers and irrigation measures for production of pulses
- Plan for sustainable crop production of oilseeds
- Explain the techniques involved in crop production of fibre and forage crops
- Correlate parameters involved in crop cultivation and practice kharif crop cultivation

## THEORY

### Unit I- Cereals

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rice and Maize (from land preparation to harvest) and yield.

### Unit II- Millets

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet

### Unit III- Pulses

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Redgram, Blackgram, Greengram and Cowpea

### Unit IV- Oilseeds (Kharif)

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Groundnut, sesame and Soybean.

### Unit V- Fibre and forage

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Cotton, jute, fodder sorghum and cumbunapier

## PRACTICAL

Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria. Practicing various nursery types and main field preparation for rice crop. Nursery and main field preparation for important millets, pulses and oilseeds. Acquiring skill in different seed treatment techniques in important kharif crops. Estimation of plant population per unit area for important kharif crops. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping

situations for pulses and oilseeds. Acquiring skill in using seed drill for sowing operations. Acquiring skill in foliar nutrition for important field crops. Observations on growth parameters of cereals and millets. Observations on growth parameters of pulses and oilseeds. Study of yield parameters and estimation of yield in cereals and millets. Study of yield parameters and estimation of yield in pulses and oilseeds. Working out cost and returns of important cereals, millets, pulses and oilseeds crops. Visit to farmer's field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds. Visit to nearby Agricultural Research Station / Farmer's field.

Lecture schedule:

1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.
2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
3. Rice - Origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - yield - economic benefits.
5. Special type of Rice cultivation – SRI - and Hybrid rice cultivation.
6. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
9. Mid Semester Examination
10. Pigeonpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
11. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses.
12. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics.
13. Sesame and Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

14. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
15. Jute- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
16. Fodder sorghum- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
17. Cumbunapier- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

Practical schedule:

1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria.
2. Practicing various nursery types and main field preparation for rice crop.
3. Nursery and main field preparation for important millets, pulses and oilseeds.
4. Acquiring skill in different seed treatment techniques in important kharif crops.
5. Estimation of plant population per unit area for important kharif crops.
6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets.
7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
8. Acquiring skill in using seed drill for sowing operations.
9. Acquiring skill in foliar nutrition for important field crops.
10. Observations on growth parameters of cereals and millets.
11. Observations on growth parameters of pulses and oilseeds.
12. Study of yield parameters and estimation of yield in cereals and millets.
13. Study of yield parameters and estimation of yield in pulses and oilseeds.
14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
15. Visit to farmer's field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds.

16. Visit to nearby Agricultural Research Station / Farmer's field.
17. Final Practical Examination.

Text books:

1. Chidda Singh, Prem Singh and Rajbir Singh. 2018. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co Pvt.Ltd; 2nd edition. New Delhi.
2. Rajendra Prasad. 2016. Textbook of Field Crops Production (Volume 1 & 2). Indian Council of Agricultural Research (ICAR), New Delhi.
3. Mukund Joshi., 2015. Text Book of Field Crops. PHI Learning Private limited. New Delhi.
4. Reddy. S.R. 2014. Principles of Crop Production. Kalyani Publishers, Ludhiana.
5. Ahlawat, I.P.S., Om Prakash and G.S. Saini. 2010. Scientific Crop Production in India. Rama publishing House, Meerut.

Reference books:

1. Crop Production Guide. 2020. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
2. Reddy, S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
3. Singh. S.S. 2015. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.
4. Srinivasan Jeyaraman. 2018. Field crops production and management (Volume I & 2). Oxford and IBH Publishers. India.
5. Yellamanda Reddy, T. and G.H. Sankara Reddy. 2017. Principles of Agronomy, Kalyani publishers, Ludhiana.

Web references

1. [www.crida.org](http://www.crida.org)
2. [www.cgiar.org](http://www.cgiar.org)
3. [www.tnau.ac.in/agriporal](http://www.tnau.ac.in/agriporal)
4. [www.rkmp.irri.org](http://www.rkmp.irri.org).
5. <https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-field-crops.pdf>

## 22AGR 202 PRINCIPLES OF WEED MANAGEMENT (1+1)

Course objective: The course is aimed at

- Identifying major weeds affecting farming ecosystems
- Imparting knowledge on organic and inorganic herbicides
- Introducing solutions to manage herbicide resistance

Course outcome: At the end of the course the student should be able to

- Gain knowledge on weeds affecting ecosystems
- Explain the mode of action of herbicides
- Understand the role of allelochemicals and the applications of bio-herbicides
- Analyse herbicide compatibility
- Cite ways of overcoming herbicide resistance
- Recommend weed management strategies

### THEORY:

#### Unit I- Introduction to weeds

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination - Weed biology and ecology - Weed seed dormancy - Weed seed bank - Crop weed association - Crop weed competition and allelopathy effect.

#### Unit II- Weed control methods

Concepts of weed prevention, control and eradication - Methods of weed control: physical, cultural, chemical and biological methods - Non chemical weed management - Integrated weed management (IWM).

#### Unit III- Herbicides

Herbicides: Classification, characteristics, formulations, methods of application, advantages and equipment's – Adjuvants – Herbicide mixture - Advantages and limitation of herbicide usage in India.

#### Unit IV- Herbicide selectivity

Selectivity of herbicides; Herbicide absorption and translocation - Compatibility of herbicides and other agro inputs - Mode of action of herbicides and their selectivity - Herbicide residue management - Persistence and degradation of herbicides in soil and plants - Herbicide resistant weeds - Herbicide resistant GM crops.

#### Unit V- Weed management in crops

Weed management in major field and horticultural crops - weed shift - weed control in non-cropped areas - Parasitic, aquatic and problematic weeds and their control.

#### PRACTICAL:

Identification, classification and characterization of terrestrial weeds, aquatic weeds and parasitic weeds. Weed survey and weed vegetation analysis - density, frequency, SDR and IVI. Study on biology of nut sedge and Bermuda grass, parthenium and celosia. Practicing skill development on cultural and non-chemical weed management. Identification, classification and characterization of herbicides. Practicing skill development on herbicide application techniques. Practicing skill development on spray equipment 's and spray fluid calibration. Practicing skill development on herbicide weed management in lowland, upland and rainfed ecosystems. Calculation of herbicide quantity and recommendation for different eco systems. Study on phyto-toxicity symptoms of herbicides in different crops. Herbicide residue determination by bioassay techniques. Herbicide residue determination by volumetric, spectrophotometric methods and chromatographic methods. Economic analysis of different weed management methods in crops and cropping systems. Visit to Problem and parasitic weed infestation areas/ herbicide industries

#### Lecture schedule:

1. Weeds - Definition, classification and characteristics, harmful and beneficial effect of weeds.
2. Weed biology and ecological adaptation to different agro ecosystems.
3. Classification and characteristics of weeds of different agro ecosystems-lowland weeds, irrigated upland and rainfed land weeds.
4. Classification and characteristics of weeds - Aquatic, parasitic and obnoxious weeds.
5. Life cycle of weeds, weed migration, weed seed distribution,
6. Dormancy, germination, establishment and perennation of weeds in different ecosystems.
7. Crop weed interactions - Critical crop weed competition, competitive and allelopathic effects of weeds and crops.

8. Principles and methods of weed management: Preventive, cultural, mechanical.
9. Mid-Semester Examination
10. Principles and methods of weed management: chemical, biological and alternate methods.
11. Classification and characteristics of herbicides and herbicide formulations - History and Development.
12. Herbicide Use Efficiency - Adjuvants, herbicide protectants and antidotes - Herbicide and herbicide mixtures in India - Interaction with moisture, fertilizer and other agrochemicals.
13. Mode of action of herbicides and their selectivity - Mechanism of action of herbicides and their selectivity.
14. Herbicide persistence and degradation in plants and soils-Herbicide residue and management.
15. Herbicide resistant weeds and their impact on weed management.
16. IWM in crops and cropping systems-Agricultural Crops, Horticultural Crops.
17. Weed shift: Causes and management options for weed shift in crop production.

Practical schedule:

1. Identification, classification and characterization of terrestrial weeds
2. Identification, classification and characterization of aquatic weeds
3. Identification, classification and characterization of problem and parasitic weeds
4. Weed survey and weed vegetation analysis - density, frequency, SDR and IVI
5. Study on biology of nut sedge and Bermuda grass, parthenium and celosia
6. Practicing skill development on cultural and non-chemical weed management
7. Identification, classification and characterization of herbicides
8. Practicing skill development on herbicide application techniques
9. Practicing skill development on spray equipment 's and spray fluid calibration
10. Practicing skill development on herbicide weed management in lowland, upland and rainfed ecosystems
11. Calculation of herbicide quantity and recommendation for different eco systems

12. Study on phyto-toxicity symptoms of herbicides in different crops
13. Herbicide residue determination by bioassay techniques
14. Herbicide residue determination by volumetric, spectro-photometric methods and chromatographic methods.
15. Economic analysis of different weed management methods in crops and cropping systems
16. Visit to Problem and parasitic weed infestation areas/ herbicide industries
17. Final Practical Examination

#### Reference books

1. Das, T.K. 2008. Weed Science - Basics and Applications. Jain Brothers, New Delhi
2. Gupta, O.P. 2007. Weed Management - Principles and Practices. Agrobios.
3. Jayakumar, R. and R. Jagannathan, R. 2003. Weed Science Principles, Kalyani Publishers, Ludhiana.
4. Rao, V.S. 2000. Principles of Weed Science. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 555p.
5. Subramanian, S. A. Mohammed Ali and R. Jayakumar. 1997. All about Weed Control. Kalyani Publishers, New Delhi.
6. Walia, U.S. 2003. Weed Management. Kalyani Publishers, Ludhiana

#### Web references

1. <http://erec.ifas.ufl.edu/weeds/powerpoints/Basic%20Principles%20of%20Weed%20Management.pdf>.
2. <http://www.agrisk.umn.edu/cache/ARL02964.htm>
3. <http://www.eolss.net/sample-chapters/c10/E1-05A-31-00.pdf>
4. <http://www.fao.org/docrep/006/y5031e/y5031e00.htm#Contents>
5. <http://www.fao.org/docrep/006/y5031e/y5031e0j.htm>
6. <http://www.omafra.gov.on.ca/english/crops/pub811/12crop.htm>

## 22PBG 201 FUNDAMENTALS OF GENETICS (2+1)

### Course objective:

- Paraphrase the history and evolution of genetics and cytogenetics
- Understand the Chromosome behaviour and effects of their irregularities
- Explain Mendel's principles of heredity
- Recognize the importance of genetics in crop improvement

### Course outcome:

- Describe the architecture of the chromosome and its functions.
- Interpret the relationship between genotype and phenotype.
- Apply the principles of chromosome transmission to predict patterns of inheritance.
- Analysis the modern concept of genetics and mutation
- Evaluate scientific data using the rules of probability

## THEORY

### UNIT I- Cytology and cytogenetics

Definition of genetics, heredity, inheritance, cytology, cytogenetics. History of genetics. Cell division – mitosis- meiosis and their significance – Gametogenesis and syngamy in Plants. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere. Structural and numerical variations in chromosome and their implications. Use of haploids, dihaploids and doubled haploids in Genetics. Special types of chromosomes.

### UNIT II- Mendelian genetics and heredity

Heredity's Fundamental Characteristics; Pre and Post Mendelian concepts of heredity; Mendelian principles of heredity. Chromosomal theory of inheritance. Mendel's experiments and laws of inheritance - Law of Segregation, Law of Independent Assortment and Law of Dominance. Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1), ii.) Recessive epistasis (9:3:4), iii.) Duplicate and additive epistasis (9:6:1), iv.) Duplicate dominant epistasis (15:1), v) Duplicate recessive epistasis (9:7), vi.) Dominant and recessive epistasis (13:3). Pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Non - Mendelian inheritance – cytoplasmic inheritance.

### UNIT III- Quantitative inheritance, linkage and crossing over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits. Linkage and genetic mapping, Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's experiments, single cross over, multiple cross over, two-point cross, three-point cross, map distances, gene order, interference and co-efficient of coincidence.

### UNIT IV- Sex determination and elements of biometry

Sex determination and sex linkage, sex limited and sex influenced traits. Sample and Sampling, Collection and Representation of Data, Measures of Central Tendency - Mean, Median and Mode. Measures of Dispersion - Variance and Standard deviation. Test of Hypothesis - Chi square Test. Probability - Definition and rules.

### UNIT V- Modern concepts of genetics and mutation

Gene concept: Gene structure, function and regulation. Transcription and translational mechanism of genetic material - protein synthesis. Lac and Trp operons. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Genetic disorders. Nature, structure & replication of genetic material.

### PRACTICAL

Study of Microscopy. Study of cell structure and function. Preparation of Slide for Mitosis study. Preparation of Slide for Meiosis study. Monohybrid Ratio and its Modification. Dihybrid Ratio and its Modification. Study of Trihybrid Ratio and back cross methods. Experiments on probability and Chi-square test. Gene Interaction. Estimation of Linkage: Two Point Test Cross. Estimation of Linkage: Three Point Test Cross. Simple interaction of genes-comb character in fowls; Dominant epistasis. Recessive epistasis, Duplicate and additive epistasis. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis. Multiple alleles and polygenic inheritance. Studies on sex linked inheritance in Humans and Drosophila.

### Lecture schedule

1. Definition of genetics, heredity, inheritance, cytology, cytogenetic; Brief history of developments in genetics and cytogenetics.
2. Physical basis of heredity: Structure and function of cell and cell organelles –
3. Differences between Prokaryotes and Eukaryotes. Cell division – mitosis
4. Cell division - meiosis and their significance
5. Gametogenesis and syngamy in Plants-identical and fraternal twins

6. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram
7. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes -polytene, lampbrush, Bchromosomes, ring and isochromosomes.
8. Chromosomal aberration: Variation in chromosome structure –deletion, duplication, inversion and translocation – genetic and cytological implications.
9. Chromosomal aberration: Variation in chromosome number– euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome.
10. Polyploid- autoandallopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, Brassica
11. Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.
12. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
13. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.
14. Chromosomal theory of inheritance. Allelic interactions –Dominance vs recessive, complete dominance, codominance, incomplete dominance, threshold characters
15. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio –i.) Dominant epistasis (12:3:1)
16. Recessive epistasis (9:3:4) Duplicate and additive epistasis (9:6:1). iv.) Duplicate dominant epistasis (15:1)
17. Mid Semester Examination
18. Duplicate recessive epistasis (9:7) vi.)Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i)to (vi).
19. Lethalgenes, Pleiotrophy, penetrance and expressivity, Multiplealleles, bloodgroupin humans, coat colourin rabbits, selfincompatibility in plants; pseudo alleles,isoalleles.
20. Quantitativeinheritance–Multiplefactorhypothesis– NilssonEhleexperimentonwheatkernelcolour.
21. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers;

22. Linkage - coupling and repulsion; Experiment on Bateson and Punnett
23. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.
24. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
25. Strength of linkage and recombination; Two point and three point test cross.
26. Double cross over, interference and coincidence; genetic map, physical map.
27. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – Melandrium, papaya, maize.
28. Genic balance theory of Bridges - Gynandromorphs
29. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
30. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium
31. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
32. Structure of DNA – Watson and Crick model Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA – Protein synthesis
33. Regulation of gene expression – Operon model of Jacob and Monod – Lac and Trp operons. Cistron, muton and recon.
34. Mutation – characteristics of mutation – micro and macro mutation – CIB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

#### Practical schedule

1. Study of Microscopy.
2. Study of cell structure and function.
3. Preparation of Slide for Mitosis study.
4. Preparation of Slide for Meiosis study.
5. Monohybrid Ratio and its Modification.

6. Dihybrid Ratio and its Modification.
7. Study of Trihybrid Ratio and back cross methods.
8. Experiments on probability and Chi-square test.
9. Gene Interaction.
10. Estimation of Linkage: Two Point Test Cross.
11. Estimation of Linkage: Three Point Test Cross.
12. Simple interaction of genes-comb character in fowls; Dominant epistasis.
13. Recessive epistasis, Duplicate and additive epistasis.
14. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
15. Multiple alleles and polygenic inheritance.
16. Studies on sex linked inheritance in Humans and Drosophila.
17. Final Practical examination.

#### Text books

1. Gupta P.K. 2007. Cytogenetics. Meerut: Rastogi Publications.
2. Verma, P.S. and Agarwal V.K. 2007. Genetics. S. Chand and Company Ltd., New Delhi.
3. Russel, P.J. 2000. Fundamentals of genetics. Addison Wesley Longman Publishers, USA.
4. Singh, B.D. 2004. Fundamentals of genetics. Chennai: Kalyani Publishers.
5. Pundhansingh, 2014. Elements of Genetics. Kalyani Publishers.

#### Reference books

1. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin & Jeffrey H. Miller. 2002. Modern Genetic Analysis (Second Edition). United States: W. H. Freeman.
2. Benjamin Lewin. 2007. Genes IX. Oxford: Oxford University Press.
3. Daniel Sundararaj, Thulasidas, G. & Stephen Dorairaj, M. 1997. Introduction to Cytogenetics and Plant Breeding. Chennai: Popular Book Depot.
4. Singh, R.J. 2002. Plant cytogenetics. USA: CRC Press.
5. Gardner E. J., Simmons M. J., & Peter Snustad, D. 2015. Principles of Genetics. USA: John Wiley and sons.

6. Satguru Prasad. (2018). Elements of Biostatistics. Rastogi Publication

#### Web-references

1. <https://www.cliffsnotes.com/study-guides/biology/biology/classical-mendelian-genetics/principles-of-genetics>
2. <https://www.jax.org/education-and-learning/clinical-and-continuing-education/ccep-non-cancer-resources/core-principles-in-genetics-2004>
3. [https://www2.palomar.edu/anthro/mendel/mendel\\_1.htm](https://www2.palomar.edu/anthro/mendel/mendel_1.htm)
4. <https://www.youtube.com/watch?v=2ycwGQUjmJY&list=PLKIDmF-ilyAkT0rhgMzSvGmqQz5licCMs>

#### 22AEN 201 FUNDAMENTALS OF ENTOMOLOGY (2+1)

##### Course objective:

- To define entomology and list the contributions of entomologist
- To compare insects with other arthropods of animal kingdom
- To describe insect morphology and anatomy
- To organise insects into different taxonomic categories

##### Course outcome: Through this course students should be able to

- Recall the basics of entomology and history of entomology in India
- Discuss the position of insects in the animal kingdom
- Explain insect morphology and anatomy
- Appraise insect taxonomy and systematics and analyse different characters of insect orders

#### THEORY

##### Unit I- Introduction to entomology and insect morphology

History of Entomology in India. factors responsible for insect dominance, introduction and classification of phylum arthropoda and class insecta, Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of

Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus.

#### Unit II- Insect morphology and anatomy

Metamorphosis and diapause in insects. Types of eggs, larvae and pupae. Major sensory organs – Photoreceptors (simple and compound eyes), chemoreceptors and Mechanoreceptors. Structure and functions of digestive system, excretory system, circulatory system and respiratory system of insects

#### Unit III- Insect anatomy

Structure and functions of nervous, and reproductive system, in insects. Types of reproduction. Glandular system in insects

#### Unit IV- Insect taxonomy and systematics – apterygote and exopterygote orders

Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, and emphasis of families of agricultural importance. Apterogote orders and Exopterygote orders: Ephemeroptera, Odonata, Plecoptera, Grilloblatodia, Orthoptera (Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae), Phasmida, Dermaptera, Embioptera, Dictyoptera (Mantidae, Blattidae), Isoptera, Zoraptera, Psocoptera, Mallophaga, Siphonculata, Hemiptera (Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae), Thysanoptera

#### Unit V- Endopterygote orders

Classification of Pterygote orders of insects with special emphasis to orders and families of Agricultural importance like Neuroptera (Chrysopidae); Lepidoptera (Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae); Coleoptera (Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae); Hymenoptera: (Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae).

#### PRACTICAL

External features of Grasshopper/cockroach. Methods of collection and preservation of insects including immature stages. Types of insect antennae. Types of insect mouthparts. Types of insect legs. Types of insect Wing venation, types of wings and wing coupling apparatus. Types of insect eggs, larvae and pupae. Dissection of digestive system in insects. Dissection of male and female reproductive systems in insects. Dissection of nervous system in insects. Dissection of Circulatory system in insects. Dissection of respiratory system in insects. Study of taxonomic characters of orders Lepidoptera, Coleoptera,

Hemiptera, Diptera, Orthoptera, Dictyoptera, Isoptera, Odonata, Thysanoptera, Neuroptera and Hymenoptera.

Lecture schedule:

1. Study of insects and their importance in Agriculture.
2. History of Entomology in India
3. Position of insects in the Animal Kingdom and relationship with members of Arthropoda.
4. Insect dominance: structural, morphological and physiological factors responsible for dominance.
5. Insect body wall: its structure and function
6. Moulting process in insects.
7. Structure of insect head, its orientation appendages and functions.
8. Structure of insect thorax, appendages and their functions.
9. Structure of insect abdomen, abdominal appendages and their functions.
10. Metamorphosis and diapause in insects.
11. Types of egg, larvae and pupae.
12. Major sensory organs — types of sensilla — photoreceptors (simple and compound eyes), chemoreceptors and mechanoreceptors.
13. Digestive system in insects — structure of alimentary canal, modifications in certain groups, enzymes, digestion and absorption of nutrients.
14. Excretory system in insects — malpighian tubules — accessory excretory organs — physiology of excretion.
15. Circulatory system in insects — haemocoel and dorsal vessel — circulation of blood — composition of haemolymph — blood plasma — haemocytes and their functions.
16. Respiratory system in insects — structure of trachea — tracheoles — types of respiratory system — types of spiracles — respiration in aquatic and endoparasitic insects.
17. Mid Semester Examination
18. Nervous system in insects — structure of neuron — central nervous system — conduction of nerve impulses — axonic and synoptic transmission.

19. Male and female reproductive systems in insects – their structures – types of reproduction – oviparous, viviparous, paedogenesis, polyembryony and parthenogenesis.
20. Structure of exocrine glands and their location and simple function – effect on metamorphosis and reproduction.
21. Structure of endocrine glands and their location and simple function – effect on metamorphosis and reproduction.
22. Classification and nomenclature of insects.
23. Important characters of Apterygota
24. Important characters of Exopterygote orders: Ephemeroptera, Odonata, Plecoptera, Grylloblattid.
25. Important characters of Exopterygote orders: Phasmida, Dermaptera, Embioptera,
26. Important characters of Exopterygote orders – Orthoptera and Dictyoptera
27. Important characters of Exopterygote orders – Isoptera, Zoraptera,
28. Important characters of Exopterygote orders - Psocoptera, Mallophaga, Siphonculata
29. Important characters of Exopterygote orders – Hemiptera and Thysanoptera
30. Important characters of Endopterygota order- Neuroptera
31. Important characters of Endopterygota order– Lepidoptera and families of agricultural importance with significant characters.
32. Important characters of Endopterygota orders – Coleoptera and families of agricultural importance with significant characters.
33. Important characters of Endopterygota order- Diptera and families of agricultural importance with significant characters.
34. Important characters of Endopterygota order- Hymenoptera and families of agricultural importance with significant characters.

Practical schedule:

1. External features of Grasshopper/cockroach
2. Methods of collection and preservation of insects including immature stages
3. Types of insect antennae

4. Types of insect mouthparts
5. Types of insect legs
6. Types of insect Wing venation, types of wings and wing coupling apparatus
7. Types of insect eggs, larvae and pupae
8. Dissection of digestive system in insects
9. Dissection of male and female reproductive systems in insects
10. Dissection of nervous system in insects
11. Dissection of Circulatory system in insects
12. Dissection of respiratory system in insects
13. Study of taxonomic characters of orders Lepidoptera and Coleoptera
14. Study of taxonomic characters of orders Hemiptera and Diptera
15. Study of taxonomic characters of orders Orthoptera, Dictyoptera Isoptera and Odonata
16. Study of taxonomic characters of orders Thysanoptera, Neuroptera and Hymenoptera
17. Final Practical Examination.

#### Text books

1. Shanthi. M., Senguttuvan. T., Suresh. K., Kavitha. Z. 2020. Text book on Fundamental Entomology. Agrobios (India).
2. Ragumoorthi K.N., Balasubramani. V., Srinivasan. M. R., Natarajan N. 2017. Insecta: An Introduction..A.E. Publications.

#### Reference books

1. Chapman, R.F. 1981. The Insects: Structure and function. Edward Arnold (Publishers) Ltd, London, 919p.
2. Snodgrass, R.E. 2001. Principles of Insect Morphology. CBS Publishers and Distributors, New Delhi
3. Richards, O.W. and. Davies. R.G. 1977. Imm's general text book of entomology, Vol.1&2, Chapman and Hall Publication, London, 1345p.

4. Gullan, P.J. and Cranston, P.S. 2001. The insects- An outline of entomology, II edition, Chapman & Hall, Madras, 491p.

Web references:

1. <https://genent.cals.ncsu.edu/bug-bytes/>
2. <https://genent.cals.ncsu.edu/>
3. <https://genent.cals.ncsu.edu/insect-identification/thumbnail-view/>
4. <http://ecoursesonline.iasri.res.in/course/view.php?id=142>

## 22AEC 201 FARM MANAGEMENT, PRODUCTION, AND RESOURCE ECONOMICS (1+1)

Course objective:

- To impart knowledge on risks in agricultural production and management of resources.

Course outcomes:

- Explain the importance of farm management in agriculture
- Comprehend the benefits and costs involved in farm management
- Analyze farm business
- Devise plans to overcome risks and manage farm resources
- Manage a farm

## THEORY

### Unit 1- Production economics and farm management - nature and scope

Meaning and concept of farm management, objectives, and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms. Types of farming: Specialized, Diversified, and Mixed farming—Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Cooperative Farming.

### Unit 2- Factor – product, factor – factor and product – product relationships

Principles of farm management: Concept of production function and its characteristics and its type, use of production function in decision-making on a farm. Factor-Product relationship. Meaning, Definition – Laws of Returns. Meaning and concept of cost, types of costs, cost curves –and their inter-relationship-

shutdown and break-even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Economies of Scale– Economies of Size Determination of Optimum Input and Output – Physical and Economic Optimum. Factor – Factor relationship: Least Cost Combination of inputs; Product – Product relationship: Optimum Combination of Products – Principle of Equi – Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.

#### Unit 3- Farm planning and budgeting

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

#### Unit 4- Risk and uncertainty in agriculture production

Concept of risk and uncertainty occurrences in agriculture production, nature and sources of risks and their management strategies, Crop / livestock/ machinery insurance. Weather based crop insurance - Features and determinants of compensations.

#### Unit 5- Resource economics

Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources. Natural Resources -Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights: Common Property Resources (CPRs): meaning and characteristics of CPRs – Externalities: meaning and types - positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions; Important issues in economics and management of common property resources of land, water, pasture and forest resources.

#### PRACTICAL

Practical Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns / opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crops – Estimation of costs and returns of livestock products. Preparation of farm plan and budget, farm records and accounts and profit and loss accounts. Break – even analysis- Graphical solution to Linear Programming problem. Collection and analysis of data on various resources in India.

#### Lecture schedule

1. Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factors determining types and size of farms.
2. Types of farming: Specialized, Diversified, and Mixed farming– Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.
3. Principles of farm management: concept of production function and its characteristics and its type, use of production function in decision-making on a farm
4. Factor- Product relationship: Meaning, Definition – Laws of Returns: Classical production function and its characteristics.
5. Meaning and concept of cost, types of costs, cost curves – and their inter-relationship - shutdown and break even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family Labor income and farm business income.
6. Economies of Scale – Economies of Size - Determination of Optimum Input and Output – Physical and Economic Optimum.
7. Factor – Factor relationship: Least Cost Combination of inputs
8. Product – Product relationship: Optimum Combination of Products – Principle of Equi –Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage.
9. Mid Semester Examination
10. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.
11. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts.
12. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting - linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.
13. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies.
14. Crop / livestock/machinery insurance. Weather based crop insurance - Features and determinants of compensations.
15. Resource Economics: Concepts, Classification, differences between Natural Resource Economics (NRE) and agricultural economics, unique properties of natural resources.

16. Natural Resources Issues – Scarcity of resources – Factors mitigating scarcity – Property Rights – Common Property Resources (CPRs): meaning and characteristics of CPRs –Externalities: meaning and types - positive and negative externalities in agriculture,

17. Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources.

#### Practical schedule

1. Preparation of farm layout. Determination of cost of fencing of a farm.
2. Computation of depreciation and cost of farm assets: Valuation of assets by different methods
3. Application of equi-marginal returns/opportunity cost principle in allocation of farm resources.
4. Determination of most profitable level of inputs use in a farm production process.
5. Determination of least cost combination of inputs.
6. Selection of most profitable enterprise combination
7. Application of cost principles including CACP concepts in the estimation of cost of cultivation and cost of production of agricultural crops.
8. Estimation of cost of cultivation and cost of production of perennial crops /horticultural crops.
9. Estimation of cost of returns of livestock products.
10. Preparation of farm plan and budget.
11. Farm records and accounts: Usefulness, types of farm records: farm production records and farm financial records.
12. Preparation of Cash flow statement
13. Preparation and Analysis of Net worth Statement and Profit and Loss statement
14. Estimation of Break – even analysis.
15. Graphical solution to Linear Programming problem
16. Collection and analysis of data on various resources in India
17. Final Practical Examination

#### Text books

1. Johl, S, S., & Kapoor, T, R., 2009. Fundamentals of Farm Business Management. New Delhi, Kalyani Publishers. pp.1-255.
2. Mohanty, S, K., 2007. Fundamentals of Entrepreneurship. New Delhi: Prentice Hall India Ltd. pp.1-272
3. Panda, S, C., 2007. Farm Management and Agricultural Marketing. India, Ludhiana: Kalyani Publishers. pp. 10-150.
4. Raju, V, T., 2017. Economics of Farm Production and Management. New Delhi: Oxford & IBH Publishing. pp.1-207

#### Reference books

1. Debertin, D, L., 2012. Agricultural Production Economics. New York: Create Space Independent Publishing Platform. pp. 1-98.
2. Sankayan, P, L., 1983. Introduction to Farm Management. New Delhi: Tata McGraw Hill Publishing Company Ltd. pp. 1-86.

#### Web – references

1. [www.ediindia.org](http://www.ediindia.org)
2. [www.iie.nic.in](http://www.iie.nic.in)
3. [www.msme.gov.in](http://www.msme.gov.in)
4. [www.niesbudtraining.org](http://www.niesbudtraining.org)
5. [www.nimsme.org](http://www.nimsme.org)
6. [www.nsic.co.in](http://www.nsic.co.in)
7. [www.nabard.org](http://www.nabard.org)
8. [www.uky.edu/~deberti/agprod5.pdf](http://www.uky.edu/~deberti/agprod5.pdf)
9. [www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/lectures/AgEcon122FSM.pdf](http://www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/lectures/AgEcon122FSM.pdf)

22FMP 211 FARM MACHINERY AND POWER (1+1)

Course objective

The course aims to enable the students to understand the basic principles and parts of internal combustion engine and different tillage, sowing, intercultural, plant protection equipment ,working principles of threshers, harvesting of field and horticultural crops

#### Course outcomes

- To understand the working principle of different systems and parts of internal combustion engines.
- To equip the students with technical knowledge and skills required for the operation of Tillage, Sowing and intercultural and plant protection machinery needed for agricultural farms.
- To train the students with skills required for the operation, maintenance and evaluation of harvesting, threshing machinery needed for agricultural farms.

#### THEORY

##### Unit I- Farm power and IC engines

Status of Farm Power in India, Sources of Farm Power, I.C. engines, working principles of IC engines, comparison of two stroke and four stroke cycle engines , Study of different components of IC engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply.

##### Unit-II- Tractor and functional components

Hydraulic control system of a tractor, Familiarization with Power transmission system clutch, gear box, differential and final drive of a tractor, Tractor types, Cost analysis of tractor power and attached implement.

##### Unit –III- Tillage implements

Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture.

##### Unit-IV- Sowing and intercultural implements

Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, implement for intercultural operations.

##### Unit-V- Plant protection and harvesting equipments

Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

#### PRACTICAL

Study of different components of I.C. engine - To study air cleaning and cooling system of engine - Familiarization with clutch – Transmission - Differential and final drive of a tractor- Familiarization with lubrication and fuel supply system of engine - Familiarization with brake – Steering -Hydraulic control system of engine - Learning of tractor driving - Familiarization with operation of power tiller- Implements for hill agriculture - Familiarization with different types of primary and secondary tillage implements – Mould board plough - Disc plough and disc harrow -Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration - Planters and transplanter- Familiarization with different types of sprayers and dusters –Familiarization with different inter-cultivation equipment- Familiarization with harvesting and threshing machinery.

#### Lecture schedule

1. Farm power in India - sources of farm power and their use in agriculture
2. Working principles of IC Engines-Two stroke and Four stroke engines - applications – comparison- Engine terminology.
3. Components of IC engine and systems of IC engine – air cleaning, cooling, lubricating and fuel supply systems.
4. Tractors- types - transmission system- clutch, gearbox, differential and final drive - hydraulic system.
5. Cost analysis of tractor with attached implement.
6. Tillage, objectives, types –ploughing methods. Primary tillage-mould board plough, disc plough, chisel plough and sub soil plough - components and functions, types, advantages and disadvantages
7. Secondary tillage equipment– cultivators, harrows, levelers, and forming equipment– rotovators – puddlers –manure trammers and cage wheels, Implements for Hill agriculture.
8. Sowing methods - seed drills and planters- seed cum fertilizer drills - components and functions- Calibration.
9. Mid Semester Examination
10. Paddy transplanters, types, working principle, field and nursery requirements
11. Implements for inter cultural operations –cultivators, sweep, junior hoe, manual weeders and power operated weeders for wetland and garden land
12. Sprayers and their functions, classification, manually operated sprayers, terminology, Nozzle types.
13. Power operated sprayers – Tractor operated boom sprayer, Knapsack mist blower cum duster – Tall tree sprayer-dusters, types and uses.

14. Tools for horticultural crops – propagation tools, planters and harvesting tools and machinery
15. Threshing of crop, thresher and its principles of operation - threshing losses.
16. Harvesting equipment– reapers - mowers and combine harvesters –types, construction and operation-Balers.
17. Harvesting machinery for groundnut, tuber crops, Cotton and sugarcane

#### Practical schedule

1. Study of working of two and four stroke engines and their systems with solved problems.
2. Study of Tractor clutch, gearbox, differential and final drive. Study of brake, steering and hydraulic control.
3. Learning driving of tractor and power tiller
4. Study of tractors and power tillers – their operation and maintenance
5. Study of mould board plough, - methods of ploughing- with solved problems.
6. Disc plough and sub soiler and their components- Hitching and adjustment of plough - field operation of different tractor drawn primary tillage machinery.
7. Study of cultivator, disc arrows, Rotavator, bund former, ridger, leveler and puddling implements and their operation.
8. Study of seed drills, planters and seed-cum-fertilizer drills and their components and metering mechanisms -calibration- simple problems on calibration.
9. Study and operation of machinery for rice cultivation –puddling implements- rotary puddlers and cage wheels, tray seeder for rice nursery, transplanters -types operation and maintenance- Drum seeder, cono weeder, power weeder and finger type weeder.
10. Study of different inter- cultivation equipment for uplands -manual, animal drawn, power operated - tractor and power tiller operated -field operation
11. Study of plant protection equipment– manually operated sprayers and dusters, knapsack mist blower cum duster, tractor operated sprayers- their operation, adjustment, calibration and safety requirements
12. Study of tools for Hill agriculture and horticultural crops – propagation tools, vegetable transplanter, harvesting tools –lawn mower, hole diggers, tree climber, shredders for crop residue.

13. Threshing machinery for paddy and identification of its components- different threshing drums - calculation of efficiency and losses.

14. Study of paddy reaper and paddy combine-their systems, method of operation and adjustment.

15. Study of harvesters for root crops - turmeric and tapioca and groundnut diggers

16. Problems on cost of operation of tractor operated machinery.

17. Final Practical Examination

#### Text books

1. Senthilkumar, T., R. Kavitha and V.M.Duraisamy 2015. A Text Book of Farm Machinery, Thannambikkai Publications, Coimbatore . ISBN: 978-9381102305

2. Jagadishwar Sahay, 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN: 978-8180140440

#### Reference books

1. Ojha, T.P and A.M. Michael. 2005. Principles of Agricultural Engineering Vol-I. Jain Brothers, New Delhi. ISBN: 978-8186321638.

2. Nakra C.P 1970. Farm Machinery and Equipment,; Dhanpat Rai Publishing Company Ltd, New Delhi ISBN: 978-8187433231.

3. Jain, S.C. and C.R.Rai. Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak,. Delhi- 110006

4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi

5. S.C. Jain & Grace Philip, Farm Machinery- An approach, Standard publishers Delhi

#### Web references

1. <https://www.agroengineering.org>

2. <https://www.sciencedirect.com › journal › journal-of-agricultural-engineering>.

3. <https://publons.com › journal › journal-of-agricultural-engineering-and-technology>

4. <https://www.agriculturejournals.cz>

5. <https://ecourses.icar.gov.in/>

6. <https://nptel.ac.in/courses>

7. <https://ciae.nic.in>

8. <https://cmeri.res.in>

## 22HOR 211 PRODUCTION TECHNOLOGY FOR FRUIT AND PLANTATION CROPS (1+1)

Course objective:

- To impart knowledge on basic cultural practices of Fruits and Plantation crops.
- To insist on modern and advanced techniques to increase the yield and production.
- To learn about the economic estimation of commercial Horticultural crops.

Course outcome:

- The student gains a thorough knowledge on basic and advance production technology.
- Familiarize on basic pruning, training and special techniques of fruits and plantation crops.
- Acquaintance on commercial oriented cultural practices.

### THEORY

#### Unit I- Production status of fruit and plantation crops

Importance and scope of fruit and plantation crop industry in India – Nutritional value of fruit crops- Classification of fruit crops - Area, production, productivity and export potential of fruit and plantation crops.

#### UNIT II- Crop production techniques in tropical fruit crops

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

Fruit crops: mango, banana, papaya, guava, sapota

#### UNIT III- Crop production techniques in subtropical fruit crops

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

Fruit crops: citrus, grape, litchi, pineapple, pomegranate, jackfruit and minor fruits

#### UNIT IV- Crop production techniques temperate fruit crops

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

Fruit crops: apple, pear, peach, strawberry, nut crops.

#### UNIT V- Crop production techniques in palms and plantation crops

Climate and soil requirements - varieties - propagation - nursery management - planting and - planting systems - cropping systems - after care - water, nutrient and weed management - intercropping - multi-tier cropping system - mulching- special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition.

Palms: Coconut, Areca nut, Oil palm and Palmyra

Climate and soil requirements - varieties - propagation - nursery management - planting and - planting systems - cropping systems - after care - water, nutrient and weed management - intercropping - multi-tier cropping system - mulching- special horticultural practices - maturity indices, harvest and yield - pests and diseases - processing - value addition.

Plantation crops: Tea, Coffee, Cocoa, Cashew, Rubber

#### PRACTICAL

Propagation methods for fruit crops - description and identification of varieties - preparation of plant bio regulators & their uses – nutrient deficiency and disorders of fruit crops - fertilizers- application - pests and diseases- micro propagation in fruit crops- Visit to commercial orchard. Fruit crops: Mango, banana, papaya, guava, sapota, grapes, citrus (Mandarin and acid lime), pomegranate and jackfruit

Propagation methods for plantation crops - description and identification of plantation crops- preparation of plant bio regulators & their uses - nutritional disorders of plantation crops - fertilizers- application - pests and diseases- cost economics of plantation crops. Visit to plantations and plantation industries. Palms and plantation crops: Coconut, Areca nut, Cashew, Tea, Coffee, Rubber and Cocoa

Lecture schedule:

1. Importance and scope of fruit and plantation crop industry in India – nutritional value of fruit crops
2. Classification of fruit crops – area, production, productivity and export potential of fruit and plantation crops

3. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning- top working - water, nutrient and weed management- canopy management - plant growth regulation - important disorders–maturity indices and harvest - post harvest management of Mango
4. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- water and nutrient management – fertigation - Weed control - Plant growth regulation - important disorders –maturity indices and harvest- post harvest management of Banana
5. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation- important disorders – maturity indices and harvest - post harvest management of Papaya, Guava and Sapota
6. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - crop regulation – nutrient deficiencies and important disorders–maturity indices and harvest- post harvest management of Citrus (Sweet orange, Mandarin and Acid Lime)
7. Climate and soil – varieties - propagation methods - planting and cropping systems-after care – systems of training and pruning and bud forecasting - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Grapes
8. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - plant growth regulation- important disorders – maturity indices and harvest - post harvest management of Pineapple and Litchi
9. Mid Semester Examination
10. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Pomegranate, Jackfruit and minor fruits
11. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of Apple and Pear
12. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of Peach and Strawberry, nut crops
13. Climate and soil requirements -varieties-propagation-nursery management-planting systems planting density -nutrient, water and weed management - intercropping at various ages of plantation -

multitier cropping - shade management - nutritional disorders - maturity indices -harvest and yield- pests and diseases -grading - processing and value addition of Coconut Areca nut and Cocoa .

14. Climate and soil requirements - varieties - propagation - nursery management - planting and planting density - HDP - UHDP - nutrient, water and weed management - cover cropping - tapping - use of plant growth regulators - top working - maturity indices- harvest and yield , latex yield and processing - pests and diseases - grading - processing and value addition Rubber and Cashew .

15. Climate and soil requirements- varieties – propagation - nursery management - planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of Tea.

16. Climate and soil requirements-varieties-propagation-nursery management- planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of Coffee.

17. Climate and soil requirements-varieties-propagation-nursery management- planting density and systems of planting - nutrient, water and weed management - mulching - cropping systems - shade regulation - training and pruning - role of growth regulators - nutritional disorders - maturity indices - harvest and yield - pests and diseases - grading - processing and value addition of Oil palm and Palmyra.

#### Practical schedule

1. Propagation techniques, selection of planting material, varieties, important cultural practices for Mango
2. Propagation techniques, selection of planting material, varieties, important cultural practices for Banana
3. Propagation techniques, selection of planting material, varieties, important cultural practices for Papaya
4. Propagation techniques, selection of planting material, varieties, important cultural practices for Guava
5. Propagation techniques, selection of planting material, varieties, important cultural practices for Sapota
6. Propagation techniques, selection of planting material, varieties, important cultural practices for Grapes
7. Propagation techniques, selection of planting material, varieties, important cultural practices for Citrus (Mandarin and Acid lime)

8. Propagation techniques, selection of planting material, varieties, important cultural practices for Pomegranate
9. Propagation techniques, selection of planting material, varieties, important cultural practices for Jackfruit
10. Preparation and application of PGR's for propagation.
11. Micro propagation, protocol for mass multiplication and hardening of fruit crops.
12. Identification and description of varieties- mother palm and seed nut selection- nursery practices- seedling selection – fertilizers - application - nutritional disorders - pests and diseases of Coconut
13. Identification and description of varieties- mother palm and seed nut selection- nursery practices- seedling selection – fertilizers - application - nutritional disorders - pests and diseases of Arecanut and Cocoa
14. Identification and description of varieties - nursery practices – training and pruning - pests and diseases – processing of Tea and Coffee.
15. Identification and description of varieties, clones - bud wood nursery practices - propagation techniques - top working – preparation of plant bio regulators and its uses- pests and diseases - processing of Rubber and Cashew
16. Visit to commercial orchard and plantation industries.
17. Final Practical Examination.

#### Reference books

1. N Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
2. M Kavino, V Jegadeeswari, R M Vijayakumar and S Balakrishnn, 2019. Production Technology for Fruits and Plantation Crops, Narendra Publishing

#### E – references

1. <http://www.jhortscib.com>
2. <http://journal.ashspublications.org>
3. <http://www.actahort.org/>
4. <http://www.aphorticulture.com/crops.htm>
5. <http://cpcricri.nic.in/>

## 22PAT 201 FUNDAMENTALS OF PLANT PATHOLOGY (2+1)

Course objective:

- Detailed study and identification of plant diseases caused by fungal, bacterial and viral pathogens.

Course outcome:

- To study about different plant diseases caused by biotic factors.
- To study morphology, symptoms, life cycle, reproductive and resting structures of Fungal, bacterial and viral pathogens causing plant disease.
- To study the mode of interaction between plant and pathogens.
- To identify the plant diseases and their causes.

## THEORY

### Unit I - Plant pathogenic organisms

Introduction- Definition, History of plant pathology, Economic importance of plant diseases. Terms and concepts of Plant Pathology. Classification of plant disease, Factors affecting disease development. Plant Pathogenic organisms: Protozoa, Phytomonas, Chromista, Fungi, Bacteria, Candidatus phytoplasma, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites.

### Unit II – Pathogenesis

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

### Unit III - General characters and taxonomy of protozoa, chromista and fungi

General characters definition of fungus, somatic structures, types of fungal thalli, fungal tissues, Resting spores, modifications of thallus, reproduction (asexual and sexual) and symptoms caused by plant pathogenic fungi. Nomenclature: Binomial system of nomenclature, rules of nomenclature, classification of fungi. divisions, sub-divisions, orders and classes. Kingdom: Protozoa, Phylum: Plasmodiophoromycota, Plasmodiophora brassicae., Kingdom: Chromista, Phylum: Oomycota; Pythium, Phytophthora, Sclerospora, Peronosclerospora and Albugo Kingdom: Fungi; Phylum: Chytridiomycota-Synchytrium; Phylum: Zygomycota; Mucor, Rhizopus

### Unit IV - General characters and taxonomy of fungi - ascomycota and basidiomycota

Phylum: Ascomycota and Basidiomycota Taphrina, Capnodium, Mycosphaerella, Helminthosporium, Macrophomina, Venturia, Lewia, Sclerotium, Eurotium, Talaromyces, Erysiphe, Leveillula, Claviceps, Glomerella, Magnaporthe Gibberella, Verticillium, Puccinia, Uromyces, Ustilago, Tilletia, Ustilagoidea. Hemelia, Rhizoctonia, Exobasidium, Ganoderma, Agaricus, Pleurotus and Calocybe.

Unit V - Bacteria, phytoplasma, virus, viroid, algae, phanerogams, and abiotic disorders

General characters and symptoms- phytopathogenic bacteria, Candidatus Phytoplasma, Spiroplasma, Fastidious vascular bacteria, viruses, viroids, algae, Phanerogams – Abiotic disorders.

## PRACTICAL

Working principle and uses of various laboratory tools and equipment's. Fungi- definition. Study of different morphological structures and fruiting bodies of fungi. Study of symptoms of various plant diseases caused by fungi, bacteria, virus, viroids, algae, phytoplasma, etc. Important characters of representative fungal genera of Oomycota- Sclerospora, Plasmopara and Albugo, Plasmodiophoromycota and Oomycota- Pythium and Phytophthora, Zygomycota-Rhizopus, Mucor, Ascomycota.-Taphrina, Capnodium, Cercospora, Botryodiplodia, Drechslera and Alternaria, Ascomycota.-Eurotium, Penicillium,Fusarium,Claviceps and Verticillum, Ascomycota.- Erysiphe, Leveillula, Phyllactina, Uninula, Podosphaera and Sphaerotheca, Ascomycota.-Colletotrichum, Pestalotia, Pyricularia, Sarocladium and Macrosporium, Basidiomycota- Puccinia, Uromyces and Hemileia, Basidiomycota- Ustilago, Spacelotheca, Tolyposporium and Exobasidium. Study of bacterial diseases –leaf blight, leaf streak, canker,scab,crown gall, wilt and soft rot. Symptoms and vectors of viral diseases mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis, ring spot, vein clearing, leaf crinkle, rosette and bunchy top.Transmission of plant viruses. Plant phanerogamic parasites. Field visit

## Lecture schedule

1. Plant Pathology - Introduction, definition, and history
2. Terms and concepts of plant pathology.
3. Classification of plant diseases and factors affecting disease development.
4. Plant Pathogenic organisms: Protozoa, Chromista, Fungi, Bacteria, and Phytoplasma, Spiroplasma, Fastidious vascular bacteria, Viruses, Viroids, Algae, and Phanerogamic parasites.
5. Host pathogen interaction, Mode of infection, pre-penetration, penetration and post penetration
6. Survival and dispersal of plant pathogens
7. Effect of Pathogen on physiological functions of the plants
8. Role of enzymes

9. Role of toxins
10. General characters of fungi
11. Different morphological structures of fungi
12. Mode of nutrition in fungi
13. Asexual Reproduction in fungi
14. Sexual Reproduction in fungi
15. Parasitism in fungi, Mode of nutrition
16. Classification of Plasmodiophoromycota- Plasmodiophora brassicae
17. Mid Semester Examination
18. Classification of Chromista- Oomycota; Pythium, Phytophthora, Sclerospora, Peronosclerospora and Albugo
19. Classification, general characters symptoms and life cycle of Chytridiomycota-Synchytrium
20. Classification, general characters symptoms and life cycle of Zygomycota - Mucor, Rhizopus
21. Classification, general characters symptoms and life cycle of Taphrina, Capnodium, Mycosphaerella, Helminthosporium, Macrophomina, Venturia,
22. Classification, general characters symptoms and life cycle of Ascomycota Lewia, Sclerotium, Eurotium, Talaromyces
23. Classification, general characters symptoms and life cycle of Ascomycota Erysiphe, Leveillula and Phyllactina
24. Classification, general characters symptoms and life cycle of Ascomycota Claviceps, Glomerella, Magnaporthe Gibberella, Verticillium, Ustilagoidea.
25. Classification, general characters symptoms and life cycle of Basidiomycota- Puccinia, Uromyces, Ustilago, Tilletia,
26. Classification, general characters symptoms and life cycle of Basidiomycota- Agaricus, Pleurotus and Calocybe.
27. Classification, general characters symptoms and life cycle of Basidiomycota -Rhizoctonia, Exobasidium, Ganoderma,
28. Classification of bacteria, General characters of bacteria and their symptoms.
29. Phytoplasma, spiroplasma, fastidious vascular bacteria and their symptoms.

30. General characters and Properties of virus
31. Symptoms of viruses.
32. General characters and symptoms of viroids
33. General characters and symptoms of Phanerogamic parasites.and algae.
34. Abiotic factors and their symptoms.

#### Practical schedule

1. Working principle and uses of various laboratory tools and equipment's.
2. Fungi- definition. Study of different morphological structures and fruiting bodies of fungi.
3. Study of symptoms of various plant diseases caused by fungi, bacteria, virus, viroids, algae, phytoplasma, etc.
4. Important characters of representative fungal genera of Oomycota- Sclerospora, Plasmopara and Albugo
5. Important characters of representative fungal genera of Plasmodiophoromycota and Oomycota- Pythium and Phytophthora
6. Important characters of representative fungal genera Zygomycota-Rhizopus, Mucor
7. Important characters of representative fungal genera of Ascomycota.-Taphrina, Capnodium, Cercospora, Botryodiplodia, Drechslera and Alternaria
8. Important characters of representative fungal genera of Ascomycota.-Eurotium, Penicillium,Fusarium,Claviceps and Verticillium
9. Important characters of representative fungal genera of Ascomycota.- Erysiphe, Leveillula, Phyllactina, Uninula, Podosphaera and Sphaerotheca
10. Important characters of representative fungal genera of Ascomycota.-Colletotrichum, Pestalotia, Pyricularia, Sarocladium and Macrosporium
11. Important characters of representative fungal genera of Basidiomycota- Puccinia, Uromyces and Hemileia
12. Important characters of representative fungal genera of Basidiomycota- Ustilago, Spacelotheca, Tolyposporium and Exobasidium.
13. . Study of bacterial diseases –leaf blight, leaf streak, canker,scab,crown gall, wilt and soft rot.

14. Symptoms and vectors of viral diseases mosaic, chlorosis, leaf curl, stem pitting, spotted wilt, necrosis, ring spot, vein clearing, leaf crinkle, rosette and bunchy top. Transmission of plant viruses.
15. Plant phanerogamic parasites.
16. Field visit
17. Final Practical Examination

Note: Students should submit fifty well preserved disease specimens

#### Text books

1. Agrios, G.N. 2005. Plant Pathology (5th Ed). New York: Academic Press. pp. 1-922.
2. Alice, D., & Jeyalakshmi, C. (2014). Plant Pathology. Coimbatore: A.E Publications. pp. 1-375.
3. Dube, H.C. 2013. An introduction to Fungi. India: Scientific publisher. pp. 1-603.
4. Singh, R.P. 2012. Plant pathology. India: Kalyani publishers. pp. 1-724.

#### Reference books

1. John Webster & Ronald Weber. 2007. Introduction to fungi. UK: Cambridge University Press. pp. 1-841.
2. Kirk, P.M. et al. 2008. Ainsworth and Bisby's Dictionary of the Fungi (10th ed.). Oxon, U.K: C.A.B International. pp.1-771.
3. Paul et al. 2009. Bergey's Manual of Systematic Bacteriology. New York: Springer-Verlag.
4. Richard N. Strange. 2003. Introduction of Plant Pathology. London: John Wiley & Sons Ltd. pp.1-480.

#### Web-references

1. <http://www.biologydiscussion.com>
2. [www.mycology.net](http://www.mycology.net)
3. [www.bspp.org.uk](http://www.bspp.org.uk)
4. <https://www.microscopemaster.com/fungi>
5. <https://talk.ictvonline.org/taxonomy/>
6. [www.apsnet.org/edcenter](http://www.apsnet.org/edcenter)

7. [www.Tolweb.org](http://www.Tolweb.org)
8. <http://www.hillagric.ac.in/edu/coa/ppath/lectures.htm>
9. <http://ecoursesonline.iasri.res.in/course/view.php?id=143>
10. [www.ucmp.berkeley.edu/fungi](http://www.ucmp.berkeley.edu/fungi)
11. [www.ictv.org](http://www.ictv.org)
12. [www.vivo.library.cornell.edu](http://www.vivo.library.cornell.edu)
13. <https://www.youtube.com/c/MTutorEdu/search?query=plant+pathology>
14. <https://www.youtube.com/channel/UCsqovy3Llp-dB8pMxU2VZ7A>

## 22STA 211 STATISTICAL METHODS (1+1)

### Course objective:

The purpose of learning this course is to understand the fundamental concepts and skills. To calculate mathematical models applicable to field trials and to apply sampling theory in all problems of agricultural sciences.

### Course outcome:

- Define the basics of probability and statistics
- Choose the model and analyze the system using random variables
- Apply the testing of hypothesis
- Apply the statistical models in the field
- Explain the techniques related in sampling
- Identify the fundamental difference between discrete and continuous distribution

## THEORY

### Unit I- Descriptive statistics

Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency

distribution tables. Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode – merits and demerits. Measures of dispersion: range, quartile deviation, mean deviation, standard deviation, and coefficient of variation – skewness and kurtosis – merits and demerits.

#### Unit II- Probability distributions and sampling theory

Probability – basic concepts – additive and multiplicative laws (without proof). Probability distributions – Discrete distributions: Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties. Sampling theory – population – sample – parameter and statistic – sampling distribution – sampling vs complete enumeration – Types of sampling – simple random sampling – selection of simple random sample using random number tables.

#### Unit III- Testing of hypotheses

Null and alternative hypothesis – types of errors – critical region and level of significance – degrees of freedom. Large sample test – single proportion and difference between two proportions – single mean and difference between two means. Small sample tests – F-test – t-test for testing the significance of single mean – independent t test and paired t test – chi square test for goodness of fit – chi square test for testing the association of attributes by  $m \times n$  contingency table –  $2 \times 2$  contingency table – Yates' correction for continuity.

#### Unit IV- Correlation and regression

Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

#### Unit V- Analysis of variance and experimental designs

Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) – lay out, analysis, merits and demerits of the above mentioned designs.

#### PRACTICAL

Formation of frequency distribution tables – Diagrammatic and graphical representation. Computation of different measures of central tendency and computation of various measures of dispersion for raw and grouped data – calculation of coefficient of variation (CV) – measures of skewness and kurtosis. Simple problems in Binomial distribution, Poisson and Normal distribution – Selection of simple random sampling. Large sample test for single proportion and difference between two proportions and Large sample test for single mean and difference between two means. t-test for single mean – t-test for testing the significance of two means for independent and paired samples – chi square test for goodness

of fit and test for independence of two attributes in a contingency table – Yates correction for continuity – calculation of the correlation coefficient – fitting of simple linear regression equation – One way and two way ANOVA – completely randomized design (CRD) – randomized block design (RBD) – Latin square design (LSD).

#### Lecture schedule

1. Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits
2. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis
3. Diagrammatic representation of data; One, Two and Three dimensional diagrams with applications. Graphical representation of data; Histogram, frequency polygon, frequency curve, ogives.
4. Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling selection using random numbers Stratified - Systematic sampling
5. Probability distributions – Discrete distributions: Bernoulli
6. Binomial and Poisson distribution,
7. Continuous distribution: Normal distribution
8. Null and alternative hypothesis – types of errors - critical region and tests of significance - Large sample test – single mean and difference between two means.
9. Mid-Semester Examination
10. Single proportion and difference between two proportions
11. Small sample tests – F-test - t-test for testing the significance of single mean
12. Independent and paired t test
13. Chi square test for testing the association of  $r \times c$  contingency table
14. Correlation – Scatter diagram - Karl Pearson's correlation coefficient – Spearman's rank Correlation - computation and properties
15. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

16. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs

17. Completely Randomized Design (CRD) – Randomized Block Design (RBD)

#### Practical schedule

1. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode
2. Computation of range, standard deviation, variance, coefficient of variance
3. Histogram, frequency polygon, frequency curve, ogives.
4. Selection of sample using simple random sampling method, Simple problems in Bernoulli distribution
5. Simple problems in Binomial distribution and Poisson distribution
6. Simple problems in Normal distribution
7. Large sample test – test for single proportion and difference between two proportions
8. Large sample test – test for single mean and difference between two means
9. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only)
10. Paired t-test
11. Chi square test
12. Computation of Karl Pearson's correlation coefficient
13. Fitting of simple linear regression equation  $y$  on  $x$  – correlation and regression
14. Analysis of Completely Randomised Design (CRD) – for equal replications only
15. Analysis of Randomised Block Design (RBD) and FRBD
16. Analysis of Split plot design and Latin Square Design (LSD)
17. Final Practical Examination

#### Text books

1. Chandel S. R. S. 2014. A Handbook of Agricultural Statistics. Kanpur: Achal Prakashan Mandir. pp. 1-87
2. Gupta, S.P. 2004. Statistical Method. New Delhi: Sultan chand and sons. pp. 1-1476.
3. Nageswara Rao, G. 2007. Statistics for Agricultural Sciences. Hyderabad: B.S. Publications. pp. 1-512
4. Panse, V.G. & Sukhatme, P. V. 1954. Statistical Methods for Agricultural Workers. India: Indian Council of Agricultural Research. pp. 1- 361
5. Vittal P. R. 2012. Mathematical Statistics. Chennai: Margham Publications. pp. 1 – 950

#### References books

1. Agrawal B.L. 2005. Basic Statistics. New Delhi: New age International Ltd. pp. 1- 656
2. Dhamu, K.P. & Ramamoorthy, K. 2009. Fundamentals of Agricultural Statistics. India: Scientific Publishers. pp. 1- 130
3. Gupta, S.P. 1978. Elementary Statistical Method. New Delhi: Sultan chand and sons. pp. 1-438
4. Kailasam, G. & Gangaiselvi, R.2010. Applied Statistics. New Delhi: Kalyani Publishers. pp. 1 -200
5. Vijay K. Rohatgi, Ehsanes Saleh A.K.M.D. 2008. An Introduction to Probability and Statistics, (2nd ed.). New Jersey: John Wiley and sons Inc. pp.1 - 631

#### Web references

1. [www.statisticshowto.com](http://www.statisticshowto.com)
2. [www.mathisfun.com](http://www.mathisfun.com)
3. [www.mathinsight.org](http://www.mathinsight.org)
4. <http://www.statistics.com/resources/glossary/>
5. [www.statsoft.com](http://www.statsoft.com)
6. [http://www.iasri.res.in/ebook/EB\\_SMAR/index.html](http://www.iasri.res.in/ebook/EB_SMAR/index.html)
7. [www.statsci.org/jourlist.html](http://www.statsci.org/jourlist.html)

Course objective:

- Explain the contributions of different types of livestock and Poultry
- Summarize Animal Population and rearing system in livestock and Poultry
- Outline the information on diversified Poultry
- Explain different livestock management systems
- Describe feed formulation and nutritional management in livestock and poultry
- Describe the management and bio security measures

Course outcome:

- Illustrate skills on different rearing system of livestock
- Explain the management of different age group animals
- Describe the poultry sector
- Demonstrate animal handling
- Discuss clean milk production and Milk processing methods
- Outline entrepreneurship skills

THEORY

Unit I- Introduction to livestock management

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry census – Different livestock development programs of Government of India and Tamil Nadu-Variou systems of livestock production extensive – semi intensive -intensive- mixed-Integrated and specialized farms.

Unit II- Dairy cattle management

Important White and Black cattle breeds-classification-indigenous and exotic – Breed characteristics – Breeding - Cross breeding- Upgrading - Economic traits of cattle –Culling - Estrus Cycle – Artificial Insemination –Introduction to Embryo transfer–Housing –Space requirement calf and adult stock – System and types of housing - Feeding and Management of Calf, Heifer, Pregnant, Milch animal and working animals – Nutrition – Ration – Balanced Ration - Characteristics of ration and classification of feed and fodder–Total Mixed Ration – composition of concentrate mixture for different stage - Milking methods - Clean milk production – Factors affecting milk composition – Common diseases of cattle – classification – symptoms - preventing and control measures.

Unit III- Sheep and goat management

Breeds –Sheep and goat classification —Economic traits - system of rearing -Housing Management– Floor spacerequirement-CareandManagementofyoungandadultstock–Nutrition–FeedandfoddersofSmall ruminants – Flushing - Common diseases – prevention and control.

#### Unit IV- Management of swine

Classification of breeds –Economic traits -Housing -Nutrition – creep feeding -Care and Management of Adult and Young Stock - Common disease- prevention and control.

#### Unit V- Poultry management

Classification of breeds - Commercial Strains of broilers and layers – Housing – brooding – deep litter and cage system – care and Management of broilers and layers -Nutrition of Chick, grower, Layer and broiler– Incubation and Hatching of Eggs -Common Diseases -Control and prevention.

#### PRACTICAL

Study of external parts of Livestock - Identification of livestock and poultry-Tattooing-ear tags-wing and leg bands-Common restraining methods-Disbudding (or) Dehorning-Different methods of castration- Dentition Study of type design of animal and poultry houses-Selection of dairy cow and work bullock- Determination of specific gravity, fat percentage and total solids of milk- Demonstration of cream separation,-Identification of feeds and fodder- Economics Dairy, Goat and Swine farming - Study of external parts of Fowl - Preparation of Brooder House - Brooder management-Identification of layer and non layer- Debeaking, delousing and deworming of poultry-Vaccination schedule for broiler and layer- Dressing of broiler chicken - Economics of Broiler and Layer Farming – Visit to a modern Dairy and commercial layer and broiler farms - Demonstration of incubator and setter.

#### Lecture schedule:

1. Significance of livestock and poultry in Indian economy-livestock and poultry census. Different livestock development programmes of Government of India and Tamil Nadu.
2. Various systems of livestock production-extensive– semi intensive, intensive-mixed integrated and specialized farms.
3. Definition of breed-classification of indigenous white and black cattle-breed characteristics of Tamil Nadu cattle breeds and Indian breeds.
4. Breed-characteristicsofexoticcattle-JerseyandHolsteinFriesian–IndianBuffaloes-Murrah, Surti and Toda.
5. Breeding-cross breeding-upgrading-economic traits of cattle-culling importance and methods.
6. Estrous cycle – signs of estrous – artificial insemination-merits and demerits-Principles and outline of embryo transfer.

7. Housing management farm site selection and floors pace requirement for calves, heifer, milch animal and work bullocks.
8. Systems of housing-single row system-double row system- head to head and tail to tail-merits and demerits - Type design of house.
9. Care and management of new born calf and heifers.
10. Care and management of pregnant animal and lactating animals.
11. Care and management of dry cows and work bullock.
12. Nutrition- definition- ration- balanced ration-desirable characteristics of a ration. Classification of feed stuffs-concentrate and roughage-comparison, Total Mixed Ration.
13. Model composition of concentrate mixture of young and adult stock-age wise feed and fodder requirement-Importance of green fodder.
14. Milking methods-clean milk production-factors affecting milk yield and composition.
15. Diseases-classification-viral, bacterial and metabolic-general control and preventive measures.
16. Viral diseases-foot and mouth disease, bacterial diseases, anthrax, hemorrhagic septicemia-black quarter - metabolic-tymanites, acidosis, ketosis and milk fever.
17. Mid Semester Examination
18. Sheep and goat farming-classification of breeds of Indian and exotic origin – economic traits.
19. Systems of rearing housing management- type design-floor diagram-space requirement for adult and young stock.
20. Care and management of ram, ewe and lamb-nutrition- feeds and fodder for small ruminants.
21. Care and management of buck, doe and kid- nutrition- flushing.
22. Common ailments of sheep and goat-sheep pox-foot and mouth-blue tongue- PPR-enterotoxaemia Ecto and endo parasites.
23. Swine husbandry –Common breeds of exotic origin-Large White Yorkshire, Landrace and Duroc - economic traits- housing ofSwine.
24. Care and management of sow, boar and piglets-nutrition- creep feeding.
25. Disease prevention and control of swine diseases –hog cholera, foot and mouth, ecto and endo parasites.
26. Classification of breeds - commercial strains of layer and broiler.

27. Care and management of Chicks-brooder management.
28. Systems of housing-deep litter and cage system-floor space requirement-common litter material litter management-merits and demerits.
29. Care and management of Grower and Layers- vaccination schedule.
30. Care and management of broilers –vaccination schedule.
31. Incubation and hatching of eggs.
32. Nutrition-feed formulation-composition of chick, grower, layer broiler- starter and Finisher mash Feed Conversion Ratio /dozen egg or kg of meat production.
33. Classification of disease –viral– bacterial- protozoan- causative organisms, symptoms and prevention – viral diseases- Ranikhet – IBD-avian flu.
34. Bacterial disease-E.coli-coryza-salmonellosis-protozoan–coccidiosis-casulative organism, symptoms and preventive measures. Management of dead birds and manure.

#### Practical schedule

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

15. Visit to a modern dairy and commercial layer and broiler farms
16. Demonstration of incubator and setter
17. Final Practical examination

#### Text book

1. CAR. 2002. Handbook of Animal Husbandry (4th ed). New Delhi: ICAR. pp.1-1549.
2. G.C. Banerjee. 2013. A Text Book of Animal Husbandry (8th ed).New Delhi : Oxford and IBH Publishing Company Private Limited.pp.1-1079
3. Lesson,S and Summers, J.D. 2001. A text book of Scott Nutrition of the chicken (4th ed). Canada: University books.pp.1-586
4. Reddy,D.V. 2001. Principles of animal nutrition and feed technology (2nd ed). Oxford and New Delhi: IBH Publishing Company Private Limited.pp.1-425

#### Reference books

1. Sastry, N.S.R and Thomas, C.K. 2005. Livestock Production Management. (3rd ed). Ludhiana: Kalyani Publishers.pp.1-850
2. Gopalakrishnan, C.A., and Lal, D.M.M. 1992. Livestock and Poultry Enterprises for Rural Development. Ghaziabad, Uttar Pradesh: Vikas Publications Private Limited.pp.1-1096
3. Sreenivasaiah, P.V. 2006. Scientific Poultry Production (3rd ed).Lucknow :International Book Distributing Co. pp- 1-1487.

#### Web-references

1. <https://www.drvet.in/p/e-books.html>
2. <https://www.coursera.org/lecture/livestock-farming/1-3-farming-101-the-basics-of-livestock-production-wfhyl>
3. <http://www.tanuv.ac.in/e-learning/objectivities.html>
4. <https://ecourses.icar.gov.in/>

#### Study tour (0+1)

The students will undertake the short tour during third semester for seven days covering KVK's, Research stations and ICAR institutes in the southern part of Tamil Nadu. The study tour will provide an exposure to the students to know about the soil, climatic conditions and cropping patterns in the respective agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

**2022 batch Semester VI**

<b>S. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>	<b>Total Credits</b>
1.	22 AGR 303	Practical Crop Production II (Rabi Crops)	0+1	1
2.	22 AGR 304	Principles of Organic farming	1+1	2
3.	22 PBG 302	Crop Improvement	2+1	3
4.	22 AEC 302	Agricultural Finance and Co-operation	2+1	3
5.	22 PAT 302	Diseases of Field and Horticultural Crops and their Management II	2+1	3
6.	22 ABT 301	Plant Biotechnology	2+1	3
7.	22 RSG 301	Geo-informatics, Nanotechnology and Precision Farming	1+1	2
8.	22 ARM 302	Intellectual Property Rights	1+0	1
9.	22 ENS 301	Environmental Studies and Disaster Management	2+1	3
10.	22 ELC ***	Elective Course III	2+1	3
		<b>Total</b>	<b>15+9</b>	<b>24</b>

**2022 batch - Semester VI**  
**22AGR 303 PRACTICAL CROP PRODUCTION – II (*Rabi* crops) (0+1)**

**Course objective:**

- Planning and practicing cultivation of *rabi* crops
- Imparting knowledge on integrated nutrient pest and disease management
- Sharing knowledge on marketing of produce and calculating cost benefit ratio.

**Course outcome:**

- Plan and decide on growing a suitable *rabi* crop
- Decide on the best cropping system that can be followed for a *rabi* season
- Recommend package of practices for growing *rabi* crops
- Practice *rabi* crop production through integrated management
- Calculate cost benefit ratio based on cultivation and marketing expenses of a crop

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

Ecosystem - Climate and weather – Seasons, soil and varieties of Tamil Nadu and India - Selection of field - Main field preparation - seed treatment - Application of manures and fertilizers - Sowing - Weed management and practicing pre- emergence application of herbicides - Thinning and gap filling - Estimation of plant population - Top dressing - Weed management - Water management - Pest management - Observation on nutrient and weeds - Recording growth, yield attributes and yield - Harvesting, threshing and cleaning the produce - Cost of cultivation and economics

- Each student will be allotted a minimum land area of 100/200 m<sup>2</sup>. He / she will do all field operations in the allotted land from field preparation to harvest and processing.
- Field preparation, seed treatment, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce.
- Any irrigated dry *rabi* crop (sunflower / Peas / Chickpea)

**Practical schedule:**

1. Study of importance, origin, distribution and botany of Sunflower.
2. Study of cropping systems, seasons and varieties of sunflower in Tamil Nadu and India
3. Selection of field and main field preparation for sunflower
4. Acquiring skill in seed treatment and sowing practices of sunflower
5. Practicing of application of manures and fertilizers for sunflower
6. Study of water management practices for sunflower
7. Study of weeds and weed management in sunflower
8. Estimation of plant population and acquiring skill in gap filling and thinning
- 9. Mid-Semester Examination**
10. Observation on nutritional deficiency symptoms and corrective measures
11. Recording growth parameters and assessing dry matter production
12. Acquiring skill in artificial pollination in sunflower
13. Observation of insect pests and diseases and their management
14. Estimation of yield and yield parameters in sunflower
15. Harvesting, threshing and cleaning, seed storage, seed dormancy and utilization of sunflower
16. Working out cost of cultivation and economics

## 17. Final Practical Examination

### Text books

1. Rajendra Prasad. 2016. Textbook of Field Crops Production (Volume 1). Indian Council of Agricultural Research (ICAR), New Delhi.
2. Mukund Joshi., 2015. Text Book of Field Crops. PHI Learning Private limited. New Delhi.
3. Reddy, S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.
4. Singh. S.S. 2015. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.
5. Annadurai, K. and B. Chandrasekaran. 2009. A Text Book Of Rice Science. Scientific Publishers

### Reference books

1. Crop Production Guide. 2020. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
2. Srinivasan Jeyaraman. 2018. Field crops production and management (Volume I). Oxford and IBH Publishers. India.
3. Yellamanda Reddy, T. and G.H. Sankara Reddy. 2017. Principles of Agronomy, Kalyani publishers, Ludhiana.
4. Reddy. S.R. 2014. Principles of Crop Production. Kalyani Publishers, Ludhiana.
5. Ahlawat, I.P.S., O. Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama Publishing House, Meerut.

### Web references

1. [www.tnau.ac.in/agriportal](http://www.tnau.ac.in/agriportal)
2. [www.fao.org/ag/ca](http://www.fao.org/ag/ca)
3. <https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-field-crops.pdf>

## 22AGR 304 PRINCIPLES OF ORGANIC FARMING (1+1)

### Course objective:

- Imparting knowledge on the scope and concepts of organic farming in India.
- Discussing on indigenous weed, pest, disease and nutrient management for organic farming.
- Educating students on the certification and marketing of organic farm produces

### Course outcome:

- Analyse the scope of organic farming
- Recommended varieties suitable for organic farming
- Comprehend management practices suitable for organic farming
- Understand processing and marketing of organic products.
- Develop entrepreneur skills and ideas to practice organic farming

## THEORY

### UNIT - I COMPONENTS AND PRINCIPLES OF ORGANIC FARMING

Organic farming: Definition - Scope - principles and concepts - history of organic farming – global scenario - biodiversity: importance and measure to preserve biodiversity - pre requisites for Organic farming: - Soil organic carbon: status and improvement strategies.

### UNIT - II ORGANIC SOURCES OF NUTRIENTS

Organic sources of nutrients - manures and other inputs - on farm and off farm sources - organic waste recycling - methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers.

#### **UNIT - III NON - CHEMICAL WEED AND PEST DISEASE MANAGEMENT**

Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological measures - Bio-intensive pest and disease management.

#### **UNIT - IV INDIGENOUS TECHNICAL KNOWLEDGE (ITK)**

Indigenous Technical Knowledge (ITK) in organic agriculture - scientific rationale - soil, nutrient, weed, water, management - prospects and problems in organic farming.

#### **UNIT - V CERTIFICATION AND MARKETING**

Organic certification - NPOP guidelines - Certification agencies in India - crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities.

#### **PRACTICALS**

Resource inventory of organic farm. Raising and incorporation of green manure - seed treatment and rising of field crop. Practice on preparatory cultivation; soil and water conservation methods. Recycling techniques; bio-composting and vermicomposting. Quantification of nutrients and application of manures and bio- fertilizers. Organic crop production, weed, pest and diseases management. Grading, packaging and post-harvest management. Exposure visit to an organic farm to learn ITK based preparations, bio-control agent production units, organic market out lets and organic certification agencies / Directorate of Organic Certification, Tamil Nadu.

#### **Lecture schedule:**

1. Organic farming; definition - prospects - principles and concepts - History and genesis of organic farming in World and India: Present status in World, India and Tamil Nadu.
2. Introduction to bio - diversity; importance and measures to preserve bio - diversity.
3. Pre-requisites and basic steps for organic farming; conversation to organic farming - planning and processes in practices - IFS approach - Integration of animal components.
4. Organic carbon; status and improvement strategies - conservative tillage systems.
5. Sources of organic manures - plant, animal and microbial origin - on - farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry and vermicompost.
6. Off-farm resources; coir pith, press mud, oilcakes, flyash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations.
7. Organic waste recycling methods and techniques - composting, vermicomposting, *in situ* composting - system approach.
8. Soil and crop management in organic farming; Inter cropping and companion planting, crop rotation green manures and cover crops, mulching.
9. **Mid-Semester Examination**
10. Weeds - Ecology - habitat management of weeds - Non - chemical weed management methods; preventive, physical, cultural, use of tools and implements and biological measures - good crop husbandry practices.
11. Integrated pest and diseases management - bio control agents, bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations - sanitation.

12. Indigenous technical knowledge (ITK) in organic agriculture - rationale and principles - general, indigenous practices for soil, nutrient, weed, water pest and disease management in farming - ITK's in farmers practice.
13. Benefits and problems in organic farming.
14. Organic farming; Promotional activities; role of government and NGO's - action plan - policy considerations.
15. Economic evaluation of organic production systems - cost - benefit analysis and comparison with conventional systems.
16. Organic certification - procedures - certification agencies in India - labeling, marketing and export opportunities.
17. Crop production standards - NPOP guidelines - principles, recommendations and standards - Quality considerations - assessment methods - premium and export opportunities.

**Practical schedule:**

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

**Text books:**

1. Bansal, M. 2020. Basics of organic farming. CBS publishers and distributors pvt. Ltd., New Delhi.
2. Maliwal, P.L. 2020. Principles of organic farming. Scientific Publishers (India).
3. Reddy, S.R. 2017. Principles of organic farming. Kalyani publishers, India
4. Lampkin, N., M. Measures and S. Padel. 2014 Organic Farm Management Handbook. University of Wales, Aberystwyth.
5. Arun. K. Sharma. 2011. Handbook of Organic farming. Agrobios (India), Jodhpur.
6. Palaniappan S.P and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.

**Reference books:**

1. Dushyant Gehlot. 2010. Organic farming: Components and management. Agrobios (India), Jodhpur.
2. Barker, A.V. 2010. Science and Technology of Organic Farming. CRC Press.
3. Gehlot, D. 2010. Organic Farming- Components and Management. Agrobios (India), Jodhpur.
4. Panda, S.C. 2012. Principles and Practices of Organic Farming. Agrobios (India), Jodhpur.
5. Peter Fossel. 2014. Organic Farming: How to Raise, Certify, and Market Organic Crops and Livestock. Reprint edition, Voyageur Press, USA.
6. Masanobu Fukuoka, Larry Korn, Wendell Berry and Frances Moore Lappe. 2009. The One-Straw Revolution: An Introduction to Natural Farming. NYRB Classics, New York.

**Web references:**

1. [www.ifoam.org](http://www.ifoam.org)
2. [www.apeda.org](http://www.apeda.org)
3. [www.cowindia.org](http://www.cowindia.org)
4. [www.ncof.org](http://www.ncof.org)
5. [www.earthfooda.co.uk](http://www.earthfooda.co.uk)
6. [www.newfarm.org/training](http://www.newfarm.org/training)
7. <https://www.youtube.com/watch?v=JIWsx05nNgg>
8. <http://www.soilassociation.org>

**22PBG 302 CROP IMPROVEMENT (2+1)**

**Course Objectives:**

- Acquire knowledge on cereal breeding
- Gain knowledge on breeding of pulses
- Gain knowledge on breeding of oilseeds and fibres
- Learn about the breeding of vegetables and cash crops
- Gain the knowledge on breeding for biotic and abiotic stresses

**Course Outcome:**

- Describe the emasculation and artificial pollination in crops
- Explain the production of hybrids in different crops
- Clarify the difficulties on crop improvement and rectifications
- Explain the development of the varieties in crops
- Explain the genetics of qualitative and quantitative characters

**THEORY**

**UNIT I: Breeding Cereals**

Place of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

Cereals and Millets: Rice, Wheat, Maize, Sorghum, Pearl millet and Finger millet.

## **UNIT II: Breeding Pulses and Oilseeds**

Place of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

Pulses: Red gram, Bengal gram, Green gram, Black gram, Cowpea and Soybean. Oilseeds: Groundnut, Sunflower, Gingelly, Castor, Rape and Mustard.

## **UNIT III: Breeding Cash crops and Fodder crops**

Place of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future in the following crops.

Fibres: Cotton, Mesta and Jute; Sugars and starches: Sugarcane and Potato; Fumitories: Tobacco and Areca nut; Fodder: Guinea grass, Napier grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*.

## **UNIT IV: Breeding for Biotic and Abiotic stresses and Quality**

Breeding for insect resistance – mechanisms, basis, genetics of insect resistance - suitable breeding methods-merits and demerits of resistance breeding; Breeding for disease resistance – horizontal and vertical resistance. Gene for gene hypothesis – mechanisms, genetics of disease resistance; Suitable breeding methods for disease resistance-exploitation of vertical resistance in plant breeding-multilines, gene pyramiding, gene deployment. Breeding for Abiotic stress – drought – mechanisms, basis, genetics of drought resistance - suitable breeding methods-limitations of drought resistance breeding; Breeding for Abiotic stress –salinity and alkalinity; Breeding for quality traits- Important quality traits in different crops- nutritional quality of cereals and pulses-Genetics of nutritional traits-breeding methods- Breeding for low toxic substances- limitations of breeding for enhanced nutritional quality.

## **UNIT V: Maintenance breeding and IPR Issues**

All India Coordinated Crop Improvement Projects. Procedure for release of new varieties; stages in seed multiplication; steps in nucleus and breeder seed production. Varietal rundown and renovation. Participatory plant breeding. Intellectual Property rights issues. Protection of plant varieties under UPOV and PPV & FR Act of India. Plant breeder's rights, Registration of plant varieties under PPV & FR Act 2001. Breeders right, researcher rights and farmers rights.

## **PRACTICAL**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops- Rice, Maize and Sorghum, Pearl millet and Finger millet, Redgram, Bengal gram, Green gram, Black gram, Cowpea and Soybean, Groundnut and Sunflower, Sesame and Castor, Cotton, Sugarcane, Guinea grass, Cumbu – Napier hybrids, Lucerne and *Stylosanthes*, Bhendi, Brinjal, Tomato, Papaya and Banana, Study of quality

characters in rice, Study of donor parents for different characters, General seed production techniques in field crops, Visit to AICRP and seed production plots of different field crops

### Lecture Schedule

Centers of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds; Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideo type- concept and climate resilient crop varieties for future in the following crops:

1. Cereals: Rice.
2. Cereals: Wheat
3. Cereals : Maize
4. Cereals: Sorghum
5. Cereals: Pearl millet and Finger millet
6. Pulses: Red gram and Bengal gram
7. Pulses: Green gram and Black gram
8. Pulses: Soybean and Cowpea
9. Oilseeds: Groundnut and Gingelly
10. Oilseeds: Rapeseed and Mustard
11. Oilseeds: Castor and Sunflower
12. Fibres: Cotton and Jute
13. Sugars and starches: Sugarcane and Potato
14. Forrage Grasses: Guinea grass, Napier grass, Cumbu-Napier hybrids
15. Forage legumes: Lucerne and *Stylosanthes*
16. Fumitories and Narcotics: Tobacco and Areca nut
17. **Mid Semester Examination**
18. Breeding for insect resistance – mechanisms, basis, genetics of insect resistance-
19. Suitable breeding methods- merits and demerits of resistance breeding
20. Breeding for disease resistance –horizontal and vertical resistance
21. Gene for gene hypothesis – mechanisms, genetics of disease resistance
22. Suitable breeding methods for disease resistance- exploitation of vertical resistance in plant breeding- multi lines, gene pyramiding, gene deployment.
23. Breeding for Abiotic stress – drought – mechanisms, basis.
24. Genetics of drought resistance - suitable breeding methods-limitations of drought resistance breeding.
25. Breeding for Abiotic stress – salinity and alkalinity
26. Breeding for quality traits- Important quality traits in different crops- nutritional quality of cereals and pulses.
27. Genetics of nutritional traits-breeding methods- Breeding for low toxic substances- limitations of breeding for enhanced nutritional quality.
28. All India Coordinated Crop Improvement Projects.
29. Procedure for release of new variety.

30. Stages of seed production. Nucleus and Breeder seed production of field crops. Varietal rundown and renovation.
31. Intellectual property and IPR Issues.
32. Protection of plant varieties under UPOV and PPV & FR Act of India, Plant breeder's rights.
33. Registration of plant varieties under PPV & FR Act, 2001.
34. Breeders, researcher and farmers rights.

### **Practical schedule**

Observation on floral biology – anthesis and pollination – selfing – crossing techniques – observation on cultivated germplasm, wild species – Experimental design – handling segregating generations- Yield trials in following crops.

1. Rice.
2. Maize and Sorghum.
3. Pearl millet and Finger millet.
4. Red gram, Bengal gram and Soybean.
5. Green gram, Black gram and Cowpea.
6. Groundnut and Sunflower.
7. Sesame and Castor.
8. Cotton.
9. Sugarcane.
10. Guinea grass, Cumbu – Napier hybrids Lucerne and *Stylosanthes*.
11. Bhendi, Brinjal, Tomato.
12. Papaya and Banana.
13. Study of quality characters in rice.
14. Study of donor parents for different characters.
15. General seed production techniques in field crops.
16. Visit to AICRP and seed production plots of different field crops.

### **17. Final Practical Examination.**

### **Text books**

1. Sharma, J.R. 1994. Principles and practice of Plant Breeding. Tata McGraw – Hill Publishing Co. Ltd., New Delhi.
2. Singh, R.B., R.M. Singh and B.D. Singh, 1984. Advances in Cytogenetics and crop improvement. Kalyani Publishers, New Delhi.
3. Singh, B.D. 2007. Plant breeding - Principles and methods.
4. Phundan Singh. 2015. Essentials of Plant Breeding. Kalyani Publishers, New Delhi
5. D.N.Bharadwaj. 2012. Breeding Field Crops. Agrobios (India), Jodhpur - 342002

### **References**

1. George Acquaah.2012. Principles of Plant Genetics and Breeding. Blackwell Publishing Ltd., USA.
2. Kumar, N. 2006. Breeding of Horticultural Crops - Principles and Practices. New India Publishing Agency, New Delhi.
3. Ram, H. H and Govind H. S. 1994. Crop breeding and Genetics. Kalyani Publishers, New Delhi.
4. Sleper, D. A. and J. M. Poehlman. 2007. Breeding Field Crops. Blackwell Publishing Professional (USA).

### **Web References:**

1. [https://agritech.tnau.ac.in/crop\\_improvement/crop\\_imprv\\_breed.html](https://agritech.tnau.ac.in/crop_improvement/crop_imprv_breed.html)
2. <https://www.bayer.com/en/agriculture/plant-breeding>
3. <https://www.cwrdiversity.org/project/pre-breeding/>
4. <https://learn.genetics.utah.edu/content/cotton/crop>
5. <https://www.crops.org/about-crops/breeding/>

## **22AEC 302 AGRICULTURAL FINANCE AND CO-OPERATION (2+1)**

### **Course objective:**

- Explain the importance of agricultural finance
- Identify and understand the Agriculture Finance institutions
- Discuss the Farm finance analysis
- Describe the types of banking institutions in India and overseas financial institutions
- Identify Agriculture co-operations and cooperation institutions in India
- Explain RBI, monetary policies and non-banking financial institutions and Insurance for crops

### **Course outcome:**

- Outline the financial activities in a farm
- Identify the institutional approach to avail projects and funding
- Describe on financial products in banks
- Recall the information on central bank and monetary policies
- Summarize the Activities of Agriculture cooperative banks and regional rural banks
- Identify Credit gaps and Agriculture insurances

## **THEORY**

### **Unit I – Agricultural Finance – Nature and Scope**

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Sources of credit - advantages and disadvantages - Rural indebtedness- History and Development of rural credit in India.

### **Unit II – Financial Institutions**

Sources of agricultural finance: institutional and non-institutional sources and their roles, commercial banks - social control and nationalization of commercial banks. Micro financing including KCC, Micro finance – SHG Models, Lead Bank Scheme, RRBs, Scale of finance and unit cost. Cost of credit. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Recent development in agricultural credit: Rural credit policies of Government – Subsidized farm credit - Differential Interest Rate (DIR) Scheme – Loan relief measures

### **Unit III – Farm Financial Analysis**

Credit analysis: 4 R's, 7 P's and 3C's of credit. Preparation of bankable projects / Farm credit proposals – Feasibility; Appraisal - Time value of money: Compounding and Discounting - Undiscounted and Discounted measures. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement. Basic guidelines for preparation of project reports - Bank norms – SWOT analysis.

### **Unit IV – Co-operation**

Agricultural Cooperation in India – Meaning, brief history of cooperative development in India - Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Co-

operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.

### **Unit V – Banking and Insurance**

Negotiable Instruments: Meaning, Importance and Types - Central bank: RBI – functions - Credit control – Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap. Non - Banking Financial Institutions (NBFI). NPA – Causes, consequences and mitigation. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation - Estimation of Crop Yields - Assessment of crop losses, Determination of compensation - Weather based crop insurance, features, determinants of compensation. Livestock Insurance Schemes Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

### **PRACTICAL**

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank / cooperative society to acquire first - hand knowledge of their management, schemes and procedures. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan–Fixation of Scale of Finance. Estimation of credit requirement of farm business – A case study. Preparation and analysis of Balance Sheet, and Cash Flow Statement – A case study. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals–A case study. Preparation and analysis of income statement–A case study. Preparation of Bankable projects / Farm Credit Proposals and appraisal- Undiscounted methods and Discounted methods. Techno-economic parameters for preparation of projects for various agricultural products and its value added products. Seminar on selected topics. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.

### **Lecture Schedule:**

1. Agricultural Finance - meaning, scope and significance, credit needs and its role in Indian agriculture.
2. Agricultural credit: meaning, definition, need and classification.
3. Sources of credit - advantages and disadvantages.
4. Rural indebtedness - History and Development of rural credit in India.
5. Sources of agricultural finance: institutional and non-institutional sources - their roles.
6. Commercial banks - social control and nationalization of commercial banks.
7. Micro financing including KCC, Micro finance – SHG Models, Lead bank scheme.
8. RRBs, Scale of finance and unit cost. Cost of credit.
9. An introduction to higher financing institutions–RBI, NABARD, ADB, IMF and World Bank.
10. Role of Insurance and Credit Guarantee Corporation of India.
11. Recent developments in agricultural credit.
12. Rural credit policies of Government: Subsidized farm credit- Differential Interest Rate (DIR) Scheme. – Loan relief measures

13. Credit analysis: 4 R's, 7 P's and 3C's of credit.
14. Preparation of bankable projects / Farm credit proposals – Feasibility.
15. Appraisal: Time value of money: Compounding and Discounting - Undiscounted and Discounted measures.
16. Preparation and analysis of financial statements – Balance Sheet, Income Statement and Cash Flow Statement.
17. **Mid Semester Examination**
18. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.
19. Agricultural Cooperation in India – Meaning, brief history of cooperative development in India.
20. Pre and Post - Independence periods and Co-operation in different plan periods, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.
21. Co-operating credit structure: short term and long term. Agricultural Cooperation - credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing;
22. Role of ICA, NCUI, NCDC and NAFED.
23. Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit.
24. Negotiable Instruments: Meaning, Importance and Types.
25. Central bank: RBI – functions, Credit control – Objectives and Methods: CRR, SLR and Repo rate.
26. Credit rationing - Dear money and cheap money. Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies.
27. Credit gap: Factors influencing credit gap.
28. Non - Banking Financial Institutions (NBFI).
29. NPA – Causes, consequences and mitigation.
30. Crop Insurance: Schemes, Coverage, Advantages and Limitations in Implementation.
31. Estimation of Crop Yields - Assessment of crop losses, Determination of compensation.
32. Weather based crop insurance, features, determinants of compensation.
33. Livestock Insurance Schemes
34. Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

### **Practical Schedule**

1. Determination of most profitable level of capital use.
2. Optimum allocation of limited amount of capital among different enterprise.
3. Analysis of progress and performance of cooperatives using published data.
4. Analysis of progress and performance of commercial banks and RRBs using published data.
5. Visit to a commercial bank, cooperative bank / cooperative society to acquire first - hand knowledge of their management, schemes and procedures.
6. Visit to District Central Co-operative Bank (DCCB) to study its role, functions and procedures for availing loan – Fixation of Scale of Finance.
7. Guest lecture on Role and functions of Commercial Bank and Lead Bank / NABARD and its Role and Functions.
8. Estimation of credit requirement of farm business – A case study.
9. Preparation and analysis of Balance Sheet and Cash Flow Statement – A case study.
10. Exercise on Financial Ratio Analysis. Appraisal of farm credit proposals – A case study.

11. Preparation and analysis of income statement – A case study.
12. Preparation of Bankable projects / Farm Credit Proposals and appraisal.
13. Undiscounted methods and Discounted methods.
14. Techno-economic parameters for preparation of projects for various agricultural products and its value added products.
15. Analysis of Different Crop Insurance Products / Visit to crop insurance implementing agency.
16. Seminar on selected topics.
- 17. Final Practical Examination.**

#### **Text Books**

1. Bhagat, D. 2014. Textbook of Agricultural Marketing and Co-operation. India: Neha Publishers & Distributors. pp. 2-66
2. Reddy, S, S., 2017. Agricultural Finance and Management. New Delhi: Oxford & IBH Publishing. pp 1-268

#### **Reference Books**

1. Charles Moss, B. 2013. Agricultural Finance.UK: Routledge Company. pp.1-295
2. Geman. H 2015. Agricultural Finance: From Crops to Land, Water and Infrastructure (The Wiley Finance Series), USA: Wiley Publishers. pp.1-288
3. Lee, W.F., Boehlje, M.D., Nelson, A.G., & Murray,W.G. 1998. Agricultural Finance, New Delhi: Kalyani Publishers. pp.1- 468

#### **Web-References**

1. [www.rbi.org.in](http://www.rbi.org.in)
2. [www.nsic.co.in](http://www.nsic.co.in)
3. [www.nabard.org](http://www.nabard.org)

## **22PAT 302 DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT -II (2+1)**

#### **Course objective:**

- To study the symptoms and cause of disease
- To understand host pathogen interaction
- Understand the role of environmental factors in disease development
- Gain knowledge on integrated disease management.

#### **Course outcome:** At the end of the course the student should be able to

- Diagnosis and distinguish various diseases of field and horticultural crops
- Distinguish the diseases caused by biotic factors and abiotic factors
- Detailed understanding of host parasite relationship, survival and spread
- Plan and recommendation of appropriate management practices

#### **THEORY**

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of diseases and nematode disease complex. Mushroom cultivation.

#### **Unit I- Diseases of Cereals, Pulses and Oil Seed Crops**

Cereals: Wheat - Rust, loose smut, bunt, powdery mildew, foot rot, leaf blight, yellow ear rot. Pulses: Chickpea - Wilt, blight, rust, powdery mildew, root rot, lentil – Rust and wilt. Oil seeds: Sunflower and mustard - leaf spot, rust, root rot, stem rot, powdery mildew, downy mildew, white rust, mosaic

#### **Unit II- Diseases of Cash Crops and Fruit Crops**

**Cash crops:** Cotton - wilt, root rot, anthracnose, grey mildew, rust, leaf spot, bacterial leaf blight, Sugarcane - Red rot, smut, wilt, sett rot, red stripe, rust, leaf spot, mosaic, ratoon stunting, grassy shoot, pokkah boeng. **Fruit crops:** Mango - mango malformation, powdery mildew, anthracnose, black tip of mango, algal leaf spot, gray blight, sooty mold, die back, gummosis, root rot, Citrus - citrus canker, citrus tristeza disease, citrus greening, citrus stubborn, citrus die back, citrus wilt, exocortis, root rot, citrus nematode, Grapevine - anthracnose, rust, powdery mildew, downy mildew, pierce disease, grape fan leaf virus, Apple - fire blight of apple, apple canker, anthracnose, apple scab, root rot, Peach - leaf curl, powdery mildew, Strawberry - leaf spot, rust, fruit blight, powdery mildew, Plum and pear – Leaf spot, powdery mildew, brown rot, black knot, crown gall.

### **Unit III- Diseases of Vegetable And Spice Crops**

Vegetable crops: Potato - late blight, early blight, ring rot, leaf roll, mosaic, leaf spot, black scurf, silvery scurf, powdery scab, black leg, bacterial soft rot, golden cyst nematode, Cucurbits - powdery mildew, leaf spot, downy mildew, root rot, wilt, bacteria leaf spot, mosaic disease, Peas – powdery mildew, fusarium wilt, rust, Cassava - leaf spot, mosaic disease, root rot, Colocasia and yam – Leaf spot, root rot, Chilli - damping off, leaf spot, anthracnose, powdery mildew, wilt, root rot, Turmeric - rhizome rot, leaf blotch, leaf spot, root rot, blast, bacterial wilt, Ginger – soft rot, bacterial wilt, leaf spot, storage rot, yellows, dry rot, Onion - blight, smut, smudge, rust, root rot, Garlic – basal rot, white rot, downy mildew, botrytis rot, penicillium rot, Coriander - stem gall, powdery mildew, Cardamom - Katte/marble mosaic disease, azhukal disease, rhizome rot, leaf spot.

### **Unit IV- Diseases of Plantation and Flower Crops**

Plantation crops: Black pepper - quick wilt, slow wilt, pollu disease, charcoal rot, root rot, Betelvine – foot rot, wilt, powdery mildew, anthracnose, leaf spot. Flower crops: Rose - black spot, powdery mildew, flower blight, rust, gray blight, die back, crown gall, Jasmine - leaf spot, collar rot, phyllody, root rot, Marigold - leaf spot, wilt, root rot, Crossandra – wilt, root rot, leaf blight, , Chrysanthemum - leaf spot, white rust, wilt, root rot, stunt viroid, Tube rose - stem rot, flower bud rot, botrytis spot and blight, sclerotial wilt, leaf spot, Carnation - wilt, root rot, wilt, rust, fairy ring spot, stem rot, Lillium - wilt, root rot, leaf spot, Orchids – Leaf spot.

### **Unit V- Post Harvest Diseases of Fruits and Vegetables, Mushroom Cultivation**

Post-harvest diseases of fruits and vegetable. Mushroom cultivation: Importance of mushroom - Cultivation of oyster mushroom, milky mushroom, paddy straw mushroom and button mushroom – Constraints in mushroom cultivation - Post harvest technology

### **PRACTICAL**

Identification of diseases based on symptoms, microscopic examination of causal organism and study of host parasite relationship and management of major diseases of wheat, chickpea, lentil, sunflower, mustard, cotton, sugarcane, mango, citrus, grapevine, apple, peach, plum, pear, strawberry, cucurbits, potato, peas, cassava, colocasia, yam, chilli, turmeric, ginger, onion, garlic, coriander, cardamom, black pepper, betelvine and flower crops. Cultivation of button and paddy straw mushroom

Cultivation of oyster, and milky mushroom

### **Lecture schedule:**

1. Diseases of wheat I
2. Diseases of wheat II
3. Diseases of chickpea and lentil
4. Diseases of sunflower and mustard

5. Diseases of cotton
6. Diseases of sugarcane
7. Diseases of mango
8. Diseases of citrus
9. Diseases of grapevine
10. Diseases of apple and peach
11. Diseases of plum and pear
12. Diseases of strawberry
13. Diseases of cucurbits
14. Diseases of potato I
15. Diseases of potato II
16. Diseases of peas
17. **Mid-semester examination**
18. Diseases of cassava, colocasia and yam
19. Diseases of chilli
20. Diseases of turmeric and ginger
21. Diseases of onion
22. Diseases of garlic
23. Diseases of coriander and cardamom
24. Diseases of black pepper and betel vine
25. Diseases of rose and jasmine
26. Diseases of marigold and crossandra
27. Diseases of chrysanthemum
28. Diseases of tuberose and carnation
29. Diseases of liliium and orchids
30. Post-harvest diseases of fruits and vegetables
31. Importance and scope of mushroom
32. Cultivation for button mushroom
33. Cultivation of paddy straw mushroom
34. Cultivation of oyster mushroom and milky mushroom

**Practical schedule:**

Symptomatology, host parasite relationship and management of (1 to 14)

1. Diseases of wheat
2. Diseases of chickpea, lentil, sunflower and mustard
3. Diseases of cotton and sugarcane
4. Diseases of mango
5. Diseases of citrus and grapevine
6. Diseases of apple, peach, plum, pear and strawberry
7. Diseases of cucurbits
8. Diseases of potato and peas
9. Diseases of cassava, colacasia and yam
10. Diseases of chilli, turmeric and ginger
11. Diseases of onion and garlic
12. Diseases of coriander, cardamom
13. Diseases of black pepper and betelvine
14. Diseases of flower crops

15. Cultivation of button and paddy straw mushroom
16. Cultivation of oyster, and milky mushroom
17. **Final Practical Examination.**

#### **Text Books**

1. Agrios, G.N. 2005. *Plant Pathology* (5<sup>th</sup> Ed.). New York: Academic Press. pp. 1-922.
2. Girish Chand and Santhosh Kumar. 2016. *Crop Diseases and Their Management*. Florida: CRC press. pp. 1-295.
3. Gupta, V. K. 2008. *Diseases of Fruit Crops*. Kalyani Publishers. pp. 1-344
4. Gupta, V.K. & Paul, Y S. 2005. *Diseases of Plantation Crops*. Kalyani Publishers. pp. 1-197.
5. Rangasawmi, G and Mahadevan, A. 2004. *Diseases of Crop Plants in India*. New Delhi: Prentice Hall of India Pvt. Ltd. pp. 1-548.
6. Roland N Perry & Maurice Moens. 2013. *Plant Nematology*. UK: CABI. pp. 1-568.
7. Sanjeev Kumar. 2015. *Diseases of Horticultural crops, Identification and Management*. India: New India Publishing Agency. Pai & Sons. pp. 1-296.

#### **Reference Books**

1. Alfred Steferud. 2005. *Diseases of Plantation Crops*. Delhi: Biotech Books. pp. 1-317.
2. Alfred Steferud. 2005. *Diseases of Vegetable Crops*. Delhi: Biotech Books. pp. 1-210.
3. Dasgupta, M.K. and Mandal, W.C. 1989. *Post-harvest pathology of perishables*. New Delhi: Oxford IBH publishing Co. pp. 1-638.
4. Madhu Meeta. 2005. *Diseases of Ornamental Plants in India: Reference Book Cum Bibliography*. South Asia Books. pp. 1-327.
5. Sonia Ahuja. 2005. *Plant Diseases*. New Delhi: Vishvabharti. pp. 1-268.
6. Trivedi, P.C. 2016. *Diseases of vegetables and their management*. Jaipur: Pointer publisher. pp. 1-270.

#### **Web-References**

1. <http://www.biologydiscussion.com>
2. <https://www.microscopemaster.com/fungi>
3. [www.apsnet.org/edcenter](http://www.apsnet.org/edcenter)
4. [Tolweb.org](http://Tolweb.org)
5. <http://www.hillagric.ac.in/edu/coa/ppath/lectures.htm>
6. <http://ecoursesonline.iasri.res.in/course/view.php?id=143>
7. [www.ucmp.berkeley.edu/fungi](http://www.ucmp.berkeley.edu/fungi)
8. [www.ictv.org](http://www.ictv.org)
9. [www.vivo.library.cornell.edu](http://www.vivo.library.cornell.edu)
10. <https://www.youtube.com/c/MTutorEdu/search?query=plant+pathology>
11. <https://www.youtube.com/channel/UCsgovy3Llp-dB8pMxU2VZ7A>
12. <https://www.youtube.com/user/uwipm/search?query=diseases>

### **22ABT 301 PLANT BIOTECHNOLOGY (2+1)**

#### **Course Objectives:**

- Explain the basic techniques in tissue culture.
- Understand the techniques in molecular biology.
- Gain knowledge about the rDNA technology.
- Inculcate the molecular markers for the identification of transgenes .

#### **Course Outcome:**

- Describe the concepts and scope of plant tissue culture.

- Interpret mapping populations, linkage and QTL analysis.
- Apply plant regeneration methods for crop improvement.
- Analyse GMOs regulations and biosafety.
- Evaluate the genetic transformants by using rDNA technology.

## **THEORY**

### **UNIT I: Basics of Plant Tissue culture**

Plant tissue culture: Concepts, history and scope, Media and Culture Conditions, Sterilization techniques, Regeneration methods - morphogenesis, organogenesis and embryogenesis. Cell culture types: callus culture and cell suspension culture, shoot tip and meristem tip culture, anther and pollen culture, ovule and embryo culture.

### **UNIT II: Applied Plant Tissue Culture**

Micropropagation - banana and ornamental plants; National certification and Quality management of TC plants. Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids). Protoplast isolation and fusion, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation. Secondary metabolite production and *in-vitro* germplasm conservation.

### **UNIT III: Basic Molecular Biology**

Genome organization- prokaryotes vs eukaryotes - Central dogma of life. Structure of nucleic acids. DNA replication, Transcription and translation. Genetic codes. Structure of a gene, regulation of gene expression, Operon concept. Polymerase chain reaction- DNA sequencing methods. Blotting techniques.

### **UNIT IV: Recombinant DNA Technology and Genetic Transformation**

DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases - Different types of vectors: plasmids, phagemids, cosmids, BAC - Construction of recombinant DNA molecules. Bacterial transformation - Direct and indirect gene transfer methods in plants, physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods. Tissue specific promoters, selectable and scorable markers, reporter genes. Molecular analysis of transgenic plants. Transgenic in crop improvement - Biotic stress resistance (Pest, Viral, Bacterial & Fungal), Abiotic stress tolerance (Herbicide, Salt, Drought), Crop improvement (Flavr Savr tomato, Golden rice, Amino acid enrichment). GMOs regulations and biosafety.

### **UNIT V: Molecular Marker Technology and Molecular Breeding**

DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs. DNA fingerprinting of crop varieties – Development of mapping populations- linkage and QTL analysis- principles, methods and applications of Marker Assisted Selection in crop improvement. Applications of Plant Genomics and genome databases.

## **PRACTICAL**

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening/ Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques-direct methods; Demonstration of Gene

transfer techniques-indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel electrophoresis techniques. Restriction enzymes for digestion of DNA.

**Lecture schedule:**

1. Plant tissue culture: Concepts, history and scope.
2. Media and Culture Conditions and Sterilization techniques.
3. Regeneration methods - morphogenesis, organogenesis and embryogenesis.
4. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture.
5. Anther and pollen culture; ovule and embryo culture.
6. Micropropagation - banana and ornamental plants.
7. National certification and Quality management of TC plants.
8. Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids).
9. Protoplast isolation and fusion.
10. Synthetic seeds and their significance; Embryo rescue and its significance.
11. Somatic hybridization and cybrids.
12. Somaclonal variation and its use in crop improvement and cryo-preservation.
13. Secondary metabolite production and *in-vitro* germplasm conservation.
14. Genome organization and Central dogma of life.
15. Structure of nucleic acids.
16. DNA replication, Transcription and translation. Genetic codes.

**17. Mid Semester Examination**

18. Structure of a gene and regulation of gene expression and Operon concept.
19. Operon concept and Polymerase chain reaction.
20. DNA Sequencing.
21. Blotting techniques.
22. DNA manipulation enzymes and Different types of vectors.
23. Construction of recombinant DNA molecules and bacterial transformation.
24. Direct and indirect gene transfer methods in plants. Promoter, marker and reporter genes.
25. Molecular analysis of transgenic plants.
26. Transgenic in crop improvement – Biotic stress resistance, Abiotic stress tolerance and Crop improvement.
27. GMOs regulations and biosafety.
28. DNA markers - hybridization based markers (RFLP).
29. PCR based markers- RAPD, and SSR.
30. PCR based markers- AFLP, and SNPs.
31. DNA fingerprinting of crop varieties.
32. Development of mapping populations, linkage and QTL analysis.
33. Principles, methods and applications of Marker Assisted Selection in crop improvement.
34. Applications of Plant Genomics and genome databases.

**Practical schedule**

1. Plant tissue culture media preparation, Culture Conditions and Sterilization techniques.
2. Regeneration methods - morphogenesis, organogenesis and embryogenesis.
3. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture.
4. Anther and pollen culture; ovule and embryo culture.

5. Micro-propagation of Banana and ornamental plants.
6. Meristem tip culture (virus free plants) and anther culture (doubled haploids).
7. Isolation of Bacterial Plasmid DNA.
8. Restriction Digestion and Ligation.
9. Competent Cell Preparation and Bacterial Transformation.
10. Confirmation of Transformation through Colony Screening.
11. Agrobacterium mediated gene transfer in plants.
12. Genomic DNA Extraction from Plants.
13. Quantification of DNA and Quality Check through Agarose Gel Electrophoresis.
14. DNA Fingerprinting using PCR.
15. A demonstration on hardening and field transfer of TC plants.
16. Visit to Tissue Culture Units /Biotech Lab in Seed Industry/Bt Cotton Field – Lateral Flow Strip Assay.
- 17. Final Practical Examination.**

#### **Text books**

6. Razdan M K, 2014. Introduction to plant Tissue Culture 2<sup>nd</sup> Edn. Science Publishers, inc. USA.
7. Thomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. Molecular markers and Plant biotechnology, New Publishers, New Delhi.
8. Purohit, S.S., 2004. A Laboratory Manual of Plant Biotechnology 2<sup>nd</sup> Edn. Agribios, India.
9. Singh, B.D. 2012. Plant biotechnology. Kalyani publishers, Ludhiana.
10. Chahal, G.S. and Gosal, S.S.2003. Principles and procedures of plant approaches breeding Biotechnological and conventional. Narosa Publishing House, New Delhi.

#### **References**

5. Singh, B D, 2004. Biotechnology Expanding Horizons 2<sup>nd</sup> Edn. Kalyani Publishers, New Delhi.
6. Gupta, P.K., 2015. Elements of Biotechnology 2<sup>nd</sup> Edn. Rastogi and Co., Meerut.
7. Gautam V K, 2005. Agricultural Biotechnology. Sublime Publications.
8. Bilgrami, K.S. and Pandey, A.K.1992. Introduction to biotechnology. CBS Pub. New Delhi.
9. Gupta, P.K. 1994. Elements of biotechnology. Rastogi Pub. Meerut.

#### **Web References**

1. <https://www.plantcelltechnology.com/blog/tissue-culture-vs-conventional-techniques-of-growing-plants/>
2. <https://www.sigmaaldrich.com/IN/en/applications/cell-culture-and-cell-culture-analysis/cell-culture-by-cell-type/plant-tissue-culture>
3. <https://www.intechopen.com/chapters/40180>
4. <https://www.isaaa.org/resources/publications/pocketk/14/default.asp>
5. <https://labassociates.com/6-plant-tissue-culture-media-for-beginners>

## **22RSG 301 GEO-INFORMATICS, NANO-TECHNOLOGY AND PRECISION FARMING (1+1)**

#### **Course objective:**

- To impart knowledge on application of ICT in agriculture using computerized models
- To understand the role of RS, GIS, GPS, and drones in agriculture

- To learn about precision agriculture using geospatial technology
- To learn, design and develop Decision Support Systems (DSS) and soil information for agricultural applications.
- To learn about the scope and importance of precision farming
- To familiarize with crop simulation models and their role in precision farming

**Course outcome:**

- Understand and use the information, communication, and technology (ICT) in agriculture.
- Demonstrate use of GIS and GPS systems in precision agriculture
- Apply and develop computerized models to understand plant growth process.
- Relate the use of GIS and GPS systems in drip installation and fertigation techniques
- Demonstrate use of Unmanned Aerial Vehicle (UMAV) to gather information.
- Develop precision farming technology for important crops.

**THEORY**

**Unit I – Concept of Geoinformatics**

Geo-informatics – Meaning, objectives, scope, and importance; Science and Technologies involved; Cartography, Geodesy- Geology- Remote Sensing- Geographical Information System-Photogrammetry - Information & Communication Technologies- Global Positioning System- Digital Image Processing – Hyperspectral Image Processing - Map as decision tool; Georeferencing, Geofencing and map design.

**Unit II – Application of Geoinformatics**

Application of Geoinformatics: Rural Development, Geosciences, Agriculture, Forestry, Soil Studies, Meteorology, Military, Transport, Environmental studies, Banking and Health Civil Engineering etc..

**Unit III – Nanotechnology**

History, definition, terminologies in nanoscience - Importance of Moore’s law - Scientific revolution - nano-scale effects, emergence and challenges of nanoscience and nanotechnology; Introduction to nanoparticles, 1D, 2D, 3D and Quantum Dots; bucky ball – CNT – Metals NPs, Metal oxide NPs, core-shell NPs, micelle; Use of nanotechnology in seed science, fertilizer, plant protection for scaling-up farm productivity

**Unit IV – Precision Farming Technology**

Precision farming – Definition, scope and importance, principles and concepts; Recent precision farming equipment’s / sensors / devices; Variable rate technology – principles and application; spatial and temporal variability, variable rate machinery; Soil mapping and fertilizer recommendation – Site Specific Nutrient Management; variable Spraying; Geospatial technology for generating valuable Agri-information; IOT - applications of IOT in agriculture / agro-hydrology, recent IoT systems; Smart sprayers for agro based application- Intelligent advance harvesting machines, Fruit picking machine; Grading and packing system

**Unit V – Crop Simulation models**

Crop simulation models and their uses for optimization of agricultural Inputs; DSSAT – Crop – info – CropSyst – Wofost; Agriculture Expert Systems; Decision Support Systems, concepts, components, and applications in Agriculture; Preparation of contingent crop-planning using IT tools.

**PRACTICAL**

Map appreciation – map interpretation – thematic layers – map objects – data dictionary. Methods of data analysis: Measurement – Buffer – overlay – network analysis – surface interpolation – reclassification – TIN – DEM – Distance tools. Interpretation of Aerial

Photographs, Use of Google Earth, Bhuvan and MOSDAC portal. Application of spectroradiometer for development of vegetation index. Application of GPS in soil sampling. Use of precision farming equipment/sensors/devices. Reading and displaying satellite data from BIL, BSQ and BIP formats. Generating True, False and Pseudo Colour Composite (FCC). Geo referencing the base image, Image to Image, Map to Image – Geometric correction of satellite image. Land resource management: Change detection in various land use/ land cover types and cross tabulation - land capability assessment - soil erosion estimation - Village GIS- urban sprawl. Water resource management: Watershed delineation and identification of suitable site for constructing water harvesting structures – assessing the water holding capacity of a dam. Hydrological modelling - drought assessment – metrological, agricultural, hydrological and socio - economic drought - locating site for artificial recharge zone – water quality assessment. Use of spatial data in Arc-GIS / Open-source GIS / Web-GIS in Environmental analysis. Synthesis of Au, Ag and ZnO nanoparticles. UV-Visible spectroscopic measurement of Au, Ag and ZnO nanoparticles. Design variable rate fertilizer map for site specific nutrient management. DSSAT – Crop model for Banana and Paddy

### **Lecture Schedule**

1. Geoinformatics – Meaning, Objectives, scope, and importance.
2. Science and Technologies involved - Cartography, Geodesy, Geology, Remote sensing.
3. Science and Technologies involved – Geographical Information Systems – Photogrammetry - Information & Communication Technologies
4. Global Positioning System- Digital Image Processing – Hyperspectral Image Processing - Map as decision tool; Georeferencing, Geofencing and map design
5. Application of Geoinformatics – Rural Development, Geosciences, Agriculture, Forestry
6. Application of Geoinformatics – Soil Studies, Meteorology, Military, Transport
7. Application of Geoinformatics – Environmental studies, Banking and Health Civil Engineering
8. History, definition, terminologies in nanoscience - Importance of Moore’s law - Scientific revolution - nano-scale effects, emergence and challenges of nanoscience and nanotechnology
9. **Mid Semester Examination**
10. Introduction to nanoparticles, 1D, 2D, 3D and Quantum Dots; bucky ball – CNT – Metals NPs, Metal oxide NPs, core-shell NPs, micelle
11. Use of nanotechnology in seed science, fertilizer, plant protection for scaling-up farm productivity
12. Precision farming – Definition, scope and importance, principles and concepts; Recent precision farming equipment’s / sensors / devices.
13. Variable rate technology – principles and application; spatial and temporal variability variable rate machinery; Soil mapping and fertilizer recommendation –
14. Site Specific Nutrient Management; variable Spraying; Geospatial technology for generating valuable Agri-information.
15. IOT - applications of IOT in agriculture / agro-hydrology, recent IoT systems; Smart sprayers for agro based application- Intelligent advance harvesting machines, Fruit picking machine; Grading and packing system
16. Crop simulation models and their uses for optimization of agricultural Inputs. DSSAT – Crop – info – CropSyst – Wofost

17. Agriculture Expert Systems; Decision Support Systems, concepts, components and applications in Agriculture. Preparation of contingent crop-planning using IT tools

### **Practical Schedule**

1. Map appreciation – map interpretation – thematic layers – map objects – data dictionary
2. Methods of data analysis: Measurement – Buffer – overlay – network analysis – surface interpolation – reclassification – TIN – DEM – Distance tools.
3. Interpretation of Aerial Photographs, Use of Google Earth, Bhuvan and MOSDAC portal
4. Application of spectroradiometer for development of vegetation index
5. Application of GPS in soil sampling
6. Use of precision farming equipment/sensors/devices
7. Reading and displaying satellite data from BIL, BSQ and BIP formats
8. Generating True, False and Pseudo Colour Composite (FCC)
9. Geo referencing the base image, Image to Image, Map to Image – Geometric correction of satellite image
10. Land resource management: Change detection in various land use/ land cover types and cross tabulation - land capability assessment - soil erosion estimation - Village GIS- urban sprawl
11. Water resource management: Watershed delineation and identification of suitable site for constructing water harvesting structures – assessing the water holding capacity of a dam
12. Hydrological modelling - drought assessment – metrological, agricultural, hydrological and socio - economic drought - locating site for artificial recharge zone – water quality assessment
13. Use of spatial data in Arc-GIS / Open-source GIS / Web-GIS in Environmental analysis
14. Synthesis of Au, Ag and ZnO nanoparticles. UV-Visible spectroscopic measurement of Au, Ag and ZnO nanoparticles
15. Design variable rate fertilizer map for site specific nutrient management
16. DSSAT – Crop model for Banana and Paddy

### **17. Final Practical Examination**

#### **Textbooks**

1. Anji Reddy, M. 2008. *Textbook of Remote Sensing and Geographic Information Systems*. Third Edition. BS Publication, Hyderabad
2. Reddy, S. R. 2017. *Geoinformatics and Nanotechnology for Precision Farming*. First edition. Kalyani Publishers, India
3. T. Pradeep 2009 *Nano: The essentials understanding nanoscience and Nanotechnology* - 2009 - Mc Graw Hill.
4. John R Jenson, 1986 *Introducing Digital Image Processing*, Prantice Hall. New Jersey 1986.

#### **Reference Books**

1. Kang-tsungchang 2006. *Introduction to Geographic Information Systems*. Tata McGraw – Hill Publishing Company Limited, New Delhi.
2. George Joseph 2003 *Fundamentals of Remote Sensing*. Universities Press (India) Pvt Ltd, 3-5-819 Hyderguda, Hyderabad 500 029. 2003. 433 pp
3. Thomas & Kiefer R.W. 2007. *Remote Sensing and Image Interpretation*. John Wiley & Sons, New York

#### **Web-References**

1. [www.geospatialworld.net](http://www.geospatialworld.net)
2. <https://www.indiawaterportal.org/articles/remote-sensing-applications-book-nrsc-2010>

3. <https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309>
4. <https://www.ucdavis.edu/minors/precision-agriculture>

## 22AEC 303 INTELLECTUAL PROPERTY RIGHTS (1+0)

### Course objective:

- Expose the students on intellectual properties
- Gain knowledge on various property rights
- Understand the process of patent filing
- Learn about IPR Institutions
- Acquire knowledge about PPV & FR
- Expose the students on intellectual properties

### Course outcome:

- Explain about IPR and importance
- Appraise on IPR's
- Explain the Ideology on filing IPR's
- Persuade about the scope and importance for future generations
- Speculate about conservation of traditional food crops and Traditional Knowledge
- Elaborate on Bio-diversity conservation acts related to food crops

### THEORY

#### Unit I–Origin and Genesis Intellectual Property Rights

Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO

#### Unit II –Types of Intellectual Property and Legislations

Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc. Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.

#### Unit III – Procedures in Filing Patent

Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

#### Unit IV–International Union for the Protection of New Varieties of Plants

Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights.

#### Unit V – International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing. Traditional knowledge-meaning and rights of TK holders. Farmer's Rights, Tribal rights, Consumer rights, Indigenous people rights Food Security.

### Lecture Schedule

1. Historical perspectives and need for the introduction of Intellectual Property Right regime; GATT, WTO;
2. Brief introduction to GATT and WTO
3. TRIPs and WIPO TRIPS Agreement Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs;
4. Copyrights, geographical indications, designs and layout, Trade secrets and traditional

5. Knowledge and trademarks, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.
6. Indian Legislations for the protection of various types of Intellectual Properties;
7. Fundamentals of patents, patent, filing of patent
8. Patent specification, patent claims, compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

### **9. Mid Semester Examination**

10. Origin and history including a brief introduction to UPOV for protection of plant varieties  
Protection of plant varieties and farmers' rights.
11. Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001,
12. Protection of other biological materials, ownership and period of protection;
13. Biodiversity protection, Protectable subject matters, protection in biotechnology,
14. National Biodiversity protection initiatives; Convention on Biological Diversity;. International Treaty on Plant Genetic Resources for Food and Agriculture;
15. Licensing of technologies, Material transfer agreements,
16. Research collaboration Agreement, License Agreement. Patent system in India, Patent search and patent database.
17. Traditional knowledge-meaning and rights of TK holders. Farmer's Rights, Tribal rights, Consumer rights, Indigenous people rights Food Security.

### **Text Books**

1. Neeraj, P., & Khusdeep, D., 2014. Intellectual Property Rights. India: PHI learning Private Limited. pp1-268
2. Nithyananda, K, V., 2019. Intellectual Property Rights: Protection and Management. India: Cengage Learning India Private Limited. Pp. 1-396

### **Reference Books**

1. Ahuja, V, K., 2017. Law relating to Intellectual Property Rights. India: Lexis Nexis. Pp. 10-150

### **Web-References**

1. [www.wipo.int/portal/index.html.en](http://www.wipo.int/portal/index.html.en)
2. [www.wto.org/](http://www.wto.org/)
3. [www.uspto.gov](http://www.uspto.gov)
4. [www.patentoffice.nic.in/](http://www.patentoffice.nic.in/)
5. [www.ipindia.nic.in/Niipm/index.htm](http://www.ipindia.nic.in/Niipm/index.htm)
6. [www.nbaindia.org/](http://www.nbaindia.org/)

## **22ENS 301 Environmental Studies and Disaster Management (2+1)**

### **Course Objective**

- To study the nature of Environmental Science and Natural Resources
- To expose the students to Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems - Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources - Urban problems related to energy
- To impart knowledge on Environmental Science and disaster management

### **Course Outcome**

- Basics of Environmental Science , Ecosystems and Biodiversity, Environmental Pollution and Management, Social Issues, Human Health and the Environment , Disaster Management

## **THEORY**

### **Unit I – Introduction to Multidisciplinary nature of Environmental Science and Natural Resources**

Environmental Science: Definition, scope and importance - Multidisciplinary nature of environmental science, Concepts and Segments; Global environmental initiatives and perspectives; Ecological footprint - Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems - Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources - Urban problems related to energy, Case studies - Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people - Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies; Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.

### **Unit II – Ecosystems and Biodiversity**

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids - Species interactions and Biogeochemical cycles - Introduction, types, characteristic features, structure and function of Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Biodiversity - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India - Value of biodiversity - Biodiversity at global, National and local levels, India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity; Biosphere Reserve - National parks and Wildlife Sanctuaries; Botanical Garden; Biodiversity legislation.

### **Unit III – Environmental Pollution and Management**

Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution - Definition, cause, effects and control measures of Soil pollution – Bioremediation - Definition, cause, effects and control measures of Water pollution - Definition, cause, effects and control measures of marine pollution, Thermal pollution and Nuclear hazards - Causes, effects and control measures of urban and industrial wastes and Solid Waste Management.

### **Unit IV – Social Issues, Human Health and the Environment**

Social Issues and the Environment: From Unsustainable to Sustainable development, consumerism and waste products - Role of an individual in prevention of pollution - Environment Protection Act in India - Issues involved in enforcement of environmental legislation - Public awareness - Global treaties and Conventions for Environmental Protection - Water conservation, rain water harvesting, watershed management - Wasteland reclamation - Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme - Environment and human health: Human Rights, Value

Education, HIV/AIDS - Women and Child Welfare - Role of information technology in environment and human health.

### **UNIT V – Disaster Management**

Natural Disasters - Meaning and nature of natural disasters, their types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves - Man Made Disasters- Nuclear disasters and holocaust, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, pollution, road accidents, rail accidents, air accidents, sea accidents - Issues and possible solutions for climate change, global warming, sea level rise, acid rain, ozone layer depletion, deforestation - Concept of disaster management, national disaster management framework; financial arrangements - Disaster Management- Effect to migrate disaster at national and global levels - International strategy for disaster reduction - Role of NGOs, community –based organizations and media - Central, state, district and local administration on disaster management - Armed forces, police and other organizations in disaster response and disaster management - Contingency Planning for Disaster Risk Reduction - Existing schemes and government policies to tackle agricultural disasters.

### **PRACTICAL**

Waste water sample collection, processing and preservation. Biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units. Study of simple ecosystems-pond, river, hill slopes - Crop adaptation to different ecosystems. Biodiversity assessment in polluted and un polluted system. Visit to river/forest/grassland/hill/mountain to document environmental assets. Air sampling and determination of suspended particulate matter and important air pollutants. Estimation of acidity and alkalinity in water samples. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Solid waste management: composting and vermicomposting of farm wastes. Case studies on successful implementation of sustainable development model. Case studies on environmental issues and human health: Climate change. Quantitative risk assessment for natural hazards and preparation of environmental zonation map for cyclone. Visit to areas affected by natural disaster

### **Lecture Schedule**

1. Environmental Science: Definition, scope and importance - Multidisciplinary nature of environmental science, Concepts and Segments; Global environmental initiatives and perspectives; Ecological footprint.
2. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems - Energy resources: Growing energy needs, renewable and non-renewable energy sources, and use of alternate energy sources - Urban problems related to energy, Case studies
3. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people
4. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
5. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies

6. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies; Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles
7. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids - Species interactions and Biogeochemical cycles
8. Introduction, types, characteristic features, structure and function of Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
9. Biodiversity - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India - Value of biodiversity
10. Biodiversity at global, National and local levels, India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India
11. Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity; Biosphere Reserve - National parks and Wildlife Sanctuaries; Botanical Garden; Biodiversity legislation
12. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution
13. Definition, cause, effects and control measures of Soil pollution – Bioremediation
14. Definition, cause, effects and control measures of Water pollution
15. Definition, cause, effects and control measures of marine pollution, Thermal pollution and Nuclear hazards
16. Causes, effects and control measures of urban and industrial wastes and Solid Waste Management
17. **Mid semester examination**
18. Social Issues and the Environment: From Unsustainable to Sustainable development, consumerism and waste products
19. Environment Protection Act in India
20. Issues involved in enforcement of environmental legislation - Role of an individual in prevention of pollution
21. Global treaties and Conventions for Environmental Protection
22. Water conservation, rain water harvesting, watershed management - Wasteland reclamation
23. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme
24. Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and Child Welfare - Role of information technology in environment and human health
25. Natural Disasters - Meaning and nature of natural disasters, their types and effects - floods, drought, cyclone
26. Earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves
27. Man Made Disasters- Nuclear disasters and holocaust, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, pollution, road accidents, rail accidents, air accidents, sea accidents
28. Issues and possible solutions for climate change, global warming, sea level rise, acid rain, ozone layer depletion

29. Concept of disaster management, national disaster management framework; financial arrangements
30. Disaster Management- Effect to migrate disaster at national and global levels - International strategy for disaster reduction
31. Role of NGOs, community –based organizations and media - Central, state, district and local administration on disaster management
32. Armed forces, police and other organizations in disaster response and disaster management
33. Contingency Planning for Disaster Risk Reduction: agronomic, engineering other non-engineering interventions - Weather forecasting and early warning systems, flood forecasting, agricultural drought monitoring and forecasting
34. Existing schemes and government policies to tackle agricultural disasters - Insurance and loan schemes: criteria and constrains of crop/animal insurance and credit guarantee schemes

### **Practical Schedule**

1. Waste water sample collection, processing and preservation
2. Biogas production from organic wastes
3. Visit to wind mill / hydro power / solar power generation units
4. Study of simple ecosystems-pond, river, hill slopes - Crop adaptation to different ecosystems
5. Biodiversity assessment in polluted and un polluted system
6. Visit to river/forest/grassland/hill/mountain to document environmental assets
7. Air sampling and determination of suspended particulate matter and important air pollutants
8. Estimation of acidity and alkalinity in water samples
9. Estimation of water hardness
10. Estimation of DO and BOD in water samples
11. Estimation of COD in water samples
12. Solid waste management: composting and vermicomposting of farm wastes
13. Case studies on successful implementation of sustainable development model
14. Case studies on environmental issues and human health: Climate change
15. Quantitative risk assessment for natural hazards and preparation of environmental zonation map for cyclone
16. Visit to areas affected by natural disaster
17. **Final Practical examination**

### **Text Books**

1. Erach Bharucha. 2013. *Text book for Environmental studies*. New Delhi, India: University Grants Commission, pp.1-324.
2. Prasanthrajan, M & Mahendran, P.P. 2013. *A text book on Ecology and Environmental Science*. Udaipur, India: Agrotch Publishing Academy. pp.1- 285.

### **Reference Books**

1. Bhattacharya, T. 2012. *Disaster Science and management*. New Delhi, India: Tata McGraw Hill Education private limited, pp.1-198.
2. De, A.K. 2010. *Environmental Chemistry*. New Delhi, India: New Age International Publishers. pp.1-384.
3. Khanna, B.K & Nina Khanna. 2011. *Disaster–Strengthening community Mitigation and Preparedness*. New Delhi, India: New India Publication Agency. pp.1-308.
4. Mani, N. 2017. *Environment, Climate change and Disaster management*. New Delhi, India: New Century publication. pp.1-276.

5. Sharma P.D. 2010. *Ecology and Environment*. Meerut, India: Rastogi Publications. pp. 1-600.
6. Tyler Miller & Scot Spoolman. 2009. *Living in the Environment (Concepts, Connections, and Solutions)*. Belmont, USA: Brooks/cole, Cengage learning publication. pp.1-816.

**Web References:**

1. <http://ecoursesonline.iasri.res.in/course/view.php?id=486>

**22ELC 304 COMMERCIAL PLANT BREEDING (2+1)**

**Course Objectives:**

- Study the modes of reproduction and breeding lines.
- Learn about the genetic purity and seed production.
- Gain the knowledge on cultivars and IPR protection.
- Acquire knowledge on variety test and variety release.
- Study the principles in seed production techniques.

**Course Outcome:**

- Classify the types of seeds in crops
- Discuss the IPR issues in plant breeding
- Explain about seed quality and seed production
- Design the protocol for variety test
- Explain about variety release

**THEORY**

**UNIT I**

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production. Genetic purity test of commercial hybrids.

**UNIT II**

Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops. Advances in hybrid seed production techniques.

**UNIT III**

Hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment.

**UNIT IV**

Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. Speed breeding, Rapid generation advancement, Molecular markers and Genomic selection.

**UNIT V**

IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release, replacement rate and notification systems in India.

**PRACTICAL**

Floral biology in self and cross pollinated species, selfing and crossing techniques. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system. Learning techniques in hybrid seed production using male-sterility in field crops. Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed

production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing viz., grading and packaging. Visit to public private seed production and processing plants.

### **Lecture Schedule**

1. Types of crops and modes of plant reproduction.
2. Line development and maintenance breeding in self pollinated crops (A/B/R and two line system).
3. Principles and techniques of seed production in self pollinated crops.
4. Development of hybrids and seed production in self pollinated crops.
5. Line development and maintenance breeding in cross pollinated crops.
6. Principles and techniques of seed production in cross pollinated crops.
7. Development of hybrids and seed production in cross pollinated crops.
8. Genetic purity test of commercial hybrids.
9. Types of seeds, quality testing in self and cross pollinated crops.
10. Advances in hybrid seed production techniques.
11. Hybrid seed production in rice.
12. Hybrid seed production in maize.
13. Hybrid seed production in sorghum.
14. Hybrid seed production in pearl millet.
15. Hybrid seed production in castor.
16. Hybrid seed production in sunflower.
17. **Mid Semester Examination**
18. Hybrid seed production in cotton.
19. Hybrid seed production in pigeon pea.
20. Hybrid seed production in brassica.
21. Quality seed production of vegetable crops under open and protected environment.
22. Hybrid seed production in tomato.
23. Hybrid seed production in brinjal and bhendi.
24. Hybrid seed production in capsicum and chilli.
25. Hybrid seed production in cucurbits, cabbage and cauliflower.
26. Alternative strategies for the development of the line and cultivars.
27. Haploid inducer and tissue culture techniques.
28. Alternative strategies for the development of the line.
29. Cultivars: genetic engineering tools.
30. Speed breeding and rapid generation advancement.
31. Molecular markers and Genomic selection.
32. IPR issues in commercial plant breeding.
33. DUS testing and registration of varieties under PPV & FR Act.
34. Variety testing, release, replacement rate and notification systems in India.

### **Practical schedule**

1. Floral biology in self and cross pollinated species, selfing and crossing techniques.
2. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system.
3. Learning techniques in hybrid seed production using male-sterility in field crops.

4. Understanding the difficulties in hybrid seed production.
5. Tools and techniques for optimizing hybrid seed production.
6. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production.
7. Role of pollinators in hybrid seed production.
8. Hybrid seed production techniques in rice and sorghum.
9. Hybrid seed production techniques in maize and pearl millet.
10. Hybrid seed production techniques in pigeon pea and cotton.
11. Hybrid seed production techniques in rapeseed-mustard, sunflower and castor.
12. Hybrid seed production techniques in vegetable crops (brinjal, bhendi, and capsicum).
13. Sampling and analytical procedures for purity testing and detection of spurious seed.
14. Seed drying and storage structure in quality seed management.
15. Screening techniques during seed processing viz., grading and packaging.
16. Visit to public private seed production fields and seed processing plants.
17. **Final Practical Examination.**

#### **Text books**

1. L.O. Copeland, 1999. Principles of Seed Science and Technology. Springer Publications.
2. Agrawal R. L. 1999. Seed Technology. Oxford and IBH Publicity Company, New Delhi.
3. N.P. Nema, 1988. Principles of seed certification and Testing. Allied Publications.
4. G.N. Kulkarni, 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.
5. Arya, Prem Singh. 2003. Vegetable seed Production Principles. Kalyani Publishers. Ludhiana.

#### **References**

1. P. Hazra and M.G. Som, 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
2. Agarwal, P. K. 2010. Techniques in Seed Science and Technology. South Asian Publishers. New Delhi.
3. Fageria, M. S. 2011. Vegetable Crops- Breeding and seed production. Kalyani publishers Ludhiana.
4. D. N. Bharadwaj. 2012. Breeding Field Crops. Agrobios (India), Jodhpur.

#### **Web References**

1. <https://www.crops.org/about-crops/breeding/>
2. <https://plantbreeding2010.blogspot.com/p/commercial-plant-breeding.html>
3. <https://iipr.icar.gov.in/pdf/molecularbuletins2may13.pdf>
4. <https://lawexplores.com/intellectual-property-in-plant-breeding/>
5. [https://agritech.tnau.ac.in/crop\\_improvement/crop\\_imprv\\_breeding\\_methods.html](https://agritech.tnau.ac.in/crop_improvement/crop_imprv_breeding_methods.html)

### **22ELC 305 AGROCHEMICALS (2+1)**

**Course Objective:** At the end of the course, the students will be able to:

- Have an acquaintance with the methods involved in manufacture and properties of various inorganic fertilizers
- Have knowledge about different agro-chemicals, their properties and uses
- Understand the importance of fertilizers and pesticides, their uses and residual effects in soil

## Course Outcome

- At the end of this course, the students will be able to Remember the properties of fertilizers and agro-chemicals, their properties and uses
- Understand the concept of **Fertilizers and their importance.**

## THEORY

### Unit I - Introduction to agrochemicals

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

### Unit II - Herbicides

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

### Unit III - Fungicides

Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

### Unit IV - Insecticides

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

### Unit V - Fertilizers and their importance

Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility – preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

## PRACTICAL

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available in market. Estimation of nitrogen in Urea. Estimation of water soluble P<sub>2</sub>O<sub>5</sub> and citrate soluble P<sub>2</sub>O<sub>5</sub> in single super phosphate. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

## Lecture Schedule

1. Introduction to agrochemicals – classification, type and role of agrochemicals in agriculture - Introduction to insecticides and classification of insecticides based on chemical nature with examples

2. Botanical insecticides – examples, advantages – disadvantages. Neem – chemicals in neem and insecticidal action of neem
3. Natural pyrethrum – sources, extraction, chemistry and insecticidal action
4. Nicotene and Rotenone – sources, chemistry and mode of action
5. Organochlorine insecticides – structure, properties and insecticidal activity of BHC, DDT, endosulfan
6. Organophosphorous insecticides – mode of action – classification with structures of Acids
7. Examples of organophosphorous insecticides derivatives –
8. Structure-activity relationships of thiophosphoric acid derivative insecticides - structure and properties of DDVP, phosphamidon, chlorpyrifos,
9. Malathion, phorate, profenofos, methyl parathion, acephate, monocrotophos
10. Carbamate insecticides – chemistry – mode of action – structure and properties of carbaryl, carbofuran
11. Synthetic pyrethroids – examples, uses, advantages and disadvantages
12. Neonicotinoids – chemistry and insecticidal action – properties and uses of neonicotinoid insecticides imidacloprid, acetamaprid.
13. Herbicides – classification with examples – selectivity of herbicides – Mode of action of herbicides with examples
14. Structure and properties of important herbicides – Atrazine, butachlor, 2, 4-D, glyphosate - Fate of herbicides
15. Fungicides – classification with examples. Inorganic fungicides – characteristics, preparation, mode of action and use of sulphur fungicides
16. Characteristics, preparation, mode of action and use of copper fungicides – Bordeaux mixture and copper oxy chloride
17. Mid semester Examination
18. Organic fungicides – Dithiocarbamates - mode of action – structure, preparation, properties and use of zineb, maneb.
19. Organic fungicides – Dithiocarbamates - mode of action – structure, preparation, properties and use of thiram and ziram
20. Systemic fungicides – structure, characteristics and use of benomyl, carboxin, oxycarboxin, metalaxyl, carbendazim
21. Insecticide Act and rules - Pesticides banned, withdrawn and restricted use
22. Plant growth regulators – examples and uses - Biorationals, biopesticides, reduced risk insecticides.
23. Bio-insect repellents - Animal origin insecticides
24. Fertilizers – classification with examples – their importance in agriculture Nitrogenous fertilizers – Haber-Bosch process – feed stocks for ammonia synthesis
25. Feed stocks and manufacturing process of ammonium sulphate, ammonium nitrate.
26. Feed stocks and manufacturing process of calcium ammonium nitrate, ammonium chloride.
27. Feed stocks and manufacturing process of urea, slow release N-fertilizers
28. Phosphatic fertilizers – Feed stocks and manufacturing process of SSP – Preparation of bone meal and basic slag
29. Potassic fertilizers – natural sources – manufacturing of potassium chloride, potassium sulphate

30. Complex fertilizers – manufacturing of ammonium phosphates, nitrophosphates, potassium nitrate and NPK complexes
31. Mixed fertilizers – sources and compatibility – preparation of major, secondary and micronutrient mixtures
32. Fertilizer control order- fertilizer logistics - fertilizer subsidy - fertilizer marketing
33. Persistence of agrochemicals – fate and effect of their use on the environment, soil, human health and animal health
34. Merits and demerits of use of chemicals in agriculture – management of agrochemicals for sustainable agriculture

### **Practical Schedule**

1. Sampling of fertilizers and pesticides for analysis
2. Pesticide application technology – pesticide application appliances
3. Pesticide formulations - formulations of pesticides available in market
4. Quick tests for identification of fertilizers – identification of cations
5. Quick tests for identification of fertilizers – identification of anions
6. Estimation of nitrogen content of urea
7. Estimation of phosphorous content in SSP by colourimetry
8. Estimation of potassium content of potassic fertilizers using flame photometer
9. Determination of calcium content of fertilizers
10. Standardization of sodium thiosulphate by iodimetry
11. Determination of iodine content of test solution by iodometry
12. Determination of purity of copper oxy chloride
13. Determination of purity of sulphur fungicide
14. Determination of purity of malathion
15. Calculations of fertilizer application and preparation of fertilizer mixtures
16. Calculation of doses of pesticides to be used

### **17. Final Practical Examination**

#### **Reference Books**

1. Manures and Fertilizers Yawalkar K S Agarwal J P and Bokde, S. 1992. Agri. Horticultural Publishing House, Nagpur
2. Fertilizers Guide Tandon, HLS 1994. Fertilisers Development Consultation Organization, New Delhi
3. Hand Book on Fertilizers Usage Seetharaman S Biswas B C, Yadav D S and Maheswaru S 1996. Oxford and IBH Publishing Company, New Delhi
4. Chemistry of insecticides and Fungicides Sreeramulu US 1991. Oxford and IBH Publishing Company, New Delhi
5. Fungicides in Plant Disease Control Nene Y L and Thapliyal P N 1991. Oxford and IBH Publishing Company, New Delhi
6. Principles of Weed Science Rao V S 1992. Oxford and IBH Publishing Company, New Delhi
7. The Pesticide Manual – A World Compendium 1995 British Crop Production Council, U.K.

## 22ELC 306 LANDSCAPING (2+1)

### Course Objective

- Demonstrating the scope of landscaping.
- Imparting knowledge on propagation and maintenance of plants involved in landscaping
- Demonstrating designing and maintenance of landscapes

### Course Outcome

- Understand the basic principles and importance of landscaping
- Select and propagate plants suitable for landscaping
- Propagate and manage pot plants
- Contribute to improve bio-aesthetic landscaping architecture in urban and rural areas
- Manage bonsai and lawns
- Develop and design sustainable landscapes

### THEORY

#### UNIT I Scope and Importance

Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. gardens for special purposes.

#### UNIT II Propagation

Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting,

#### UNIT III Garden Plants for Landscaping

Annuals: selection, propagation, planting scheme, Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management.

#### UNIT IV Landscape Designing and planning

Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions.

#### UNIT V Bonsai and Landscape software

Bonsai: principles and management, lawn: establishment and maintenance. CAD applications.

### PRACTICAL

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals, care and maintenance of plants, potting and repotting, identification of tools and implements used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lath house. Use of computer software, visit to important gardens/parks/institutes.

### Lecture Schedule

1. Importance and scope of landscaping- Goals of landscaping – Categories of landscaping (Residential, public, commercial, specialty landscaping).
2. Principles of landscaping-Initial approach – Axis – Focal Point – Mass effect – Unity – Space – Divisional Lines – Proportion and Scale – Texture – Time and Light – Tone and Colour – Mobility- Rhythm – Balance – Contrast – Harmony – Vista – Style.
3. Garden types- Formal - Informal – Wild Garden - Styles of garden in the world- Mughal Garden- Site and design – Walls and gates – Terrace- Running water- Baradari- Trees and flowers.
4. Features of English – Italian – French – Persian Gardens – Japanese Garden – Types of Japanese

- Garden – Hill – Flat – Tea – Passage – Sand Gardens.
5. Features of Japanese Garden – Ponds – Streams – Waterfalls – Fountains – Islands – Bridges – Water Basins – Stone Lanterns – Stones – Pagodas – Fences and Gates – Vegetation (Ever green, Deciduous and Flowering plants).
  6. Famous Gardens of India –Lal bagh (Bangalore) – Brindavan Garden (Mysore) – Government Botanic Gardens (Ootacamud) Mughal garden (Pinjore) – Chandigarh Rose garden.
  7. Terrace gardening – Features –Plants suitable – Planning – Maintenance.
  8. Vertical gardening – Components.
  9. Garden components or features-Garden walls – Retaining wall – Fences and Gates – Hedges and Edges – Flower bed – Borders – Carpet Bedding - Steps – Garden Drives (Gravel and Asphalt) and Paths (Gravel, Brick, Grass, Stone, Crazy pavings).
  10. Arches and Pergolas – Screens – Bridges – Outdoor garden rooms (Gazebos, garden pavilions, band stand, bower and thatched huts) walk-Paths, bridges, other constructed features etc.
  11. Garden adornments– Garden Seats – Ornamental tubs, urns and vases – Bird baths – Sun dials – Floral Clocks – Japanese Lanterns – Ornamental Stones – Fountains – Statues – Towers – Wells – Plants Containers – Plant Strands.
  12. Lawn making– Selection of Grass – Bermuda grass – Korean grass – Poa grass – Fescue grass – Kentucky blue grass - Grasses for shady areas – Site Selection – Soil – Preparation of soil – Drainage – Digging – Manuring and grading – Methods of planting – Sowing of Seeds – Dibbling.
  13. Turfing – Turf plastering – Bricking – Planting on Polythene – Maintenance of lawn –Mowing – Rolling – Sweeping – Scraping – Raking – Weeding – Irrigation – Top dressing with compost and fertilizers - Diseases and other problems – Fairy ring – Pale Yellow Lawns.
  14. Rockery- Rock Garden – Types of rock garden – Selection of site – Construction of the Rockery – Planting – Management of the Rockery – Plants for rock garden – Examples of cacti and succulents, ferns, shrubs, herbaceous plants, bulbs, flowering annuals.
  15. Water garden – Informal pool – Formal Pool – Construction – Planting methods – Filling the pool (water course and falls) – Care of the water garden – Plants for water garden – Surface flowering aquatics – Oxygenators – Floaters – Marginals.
  16. Gardens for special purposes- Specialized gardens – Herb garden – Bog Garden – Sunken garden - Topiary Garden – Kitchen garden – Paved garden – Moon Garden – Gardening in hanging baskets – Window garden – Miniature garden – Mini Zoo – Importance of Green house. Conservatory – Lath house – Fernery in ornamental horticulture.
- 17. Mid semester examination**
18. Trees: Selection, propagation, planting schemes, canopy management- Ornamental and shady Trees – Definition – Classification based on purpose with suitable examples – Specimen trees – Shady trees – Flowering trees
  19. Avenue or road side trees – Screening trees – Fragrant flowering trees – Pollution controlling trees.
  20. Shrubs - Definition – Utility (aesthetic values) – Classification with suitable examples – Based on purpose of growing – Flowering – Foliage – Flowering and foliage – Fragrant shrubs – Based on sunlight requirement - Growing of shrubs – Soil – Climate – Cultivation practices.
  21. Herbaceous perennials – Definition – Introduction – Classification with suitable examples – Herbaceous perennials for plains and for hills – Planting – Manuring Propagation.
  22. Climber and creepers: Utility (aesthetic values) – Classification with suitable examples – Sunny situation – Partial shade – Shade loving climbers – Showy flowering climbers – Climbers with scented flowers – Climbers with attractive foliage – Climbers for pots – Annual climbers – Climbers for hedge making – Classification based on vegetative growth – Heavy climbers – Light climbers – Soil – Digging of pits – Planting of climbers – After care – Manuring - Maintenance. Annuals: classification- Summer annuals- Winter annuals- Flowering annuals- Foliage annuals- Propagation - Colour scheme- Grouping – After care – Maintenance
  23. Palms- – Definition – Introduction – Utility (aesthetic values) – Classification with examples- Feather leaved Palm – Fan leaved Palm – Propagation – Pot culture – Potting – Re-potting - Potting

- media – Manuring – After care.
24. Ferns- – Introduction – Utility (aesthetic values) – Propagation – Spore – Division of Clumps – Suckers – Bulbils – Site of growing – Soil media – Pot culture – Repotting– Irrigation - Indoor culture – Important Examples. Selaginellas – Introduction – Propagation – Cultural hints – Important Examples.
  25. Ornamental grasses- Bamboos and reeds – Introduction – Propagation – Soil and climatic requirements – Site of growing – Planting – Important Examples.
  26. Cacti and Succulents – Introduction – Characteristics of Cactaceae – Site of growing – Natural habitat –Domestication (Housing of cacti) – Propagation – Seeds – Offsets – Grafting – Soil – Climate – Containers – Time and method of planting – Potting – Re-potting – Irrigation – Staking.
  27. Pot plants: introduction – Pots – Potting – Potting- Compost – Re-potting - Arrangement, management.
  28. Bio-aesthetic Planning – Definition – Aim and Concept – Need for Bio-aesthetic planning – Air pollution – Human welfare.
  29. Landscaping of urban and rural areas, Peri-urban landscaping- Road side –Planting trees in colonies– Landscaping City parks – Large –Medium –Small parks – Pleasure grounds – Examples of ornamental shade and flowering trees for town roads.
  30. Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions. Importance – Need – Planting materials for different areas of institutions.
  31. Bonsai: Definition – Criteria for selecting plants – Examples – Classification of Bonsai – Upright (formal and informal) – Production management - Production, plant layout and material handling - Winding – Oblique – Gnarled– Semi-cascade cascade – Clasped to stone.
  32. Containers (pots) and Media – Potting and Re-potting – Training – Pruning and Pinching (Shoot, leaf and root) – Watering– manuring – Defoliation – Mame Bonsai.
  33. Computer Aided Designs (CAD) – Applications in landscaping.
  34. Computer Aided Designs (CAD) – Applications in landscaping

## **Practical Schedule**

1. Identification of avenue trees.
2. Identification of shrubs.
3. Identification of annuals.
4. Identification of pot plants.
5. Propagation of ornamental trees.
6. Propagation of shrubs.
7. Propagation of annuals, care and maintenance of plants.
8. Potting and repotting of ornamentals.
9. Identification of tools and implements used in landscape design.
10. Training and pruning of plants for special effects.
11. Lawn establishment and maintenance.
12. Study of planning, designing and layout of formal gardens and informal gardens.
13. Layout of special type of gardens (sunken garden, terrace garden, rock garden).
14. Designing of conservatory and lath house.
15. Use of computer software.
16. Visit to important gardens/ parks/ institutes.

## **17. Final practical examination**

### **Reference books:**

1. Bhattacharjee, S. K. 2004. *Landscape Gardening and Design with plants*. Aavishkar Publishers and Distributors, Jaipur.

2. Bose, T.K. 1999. *Floriculture and Landscaping*. Naya Prakash, Kolkatta.
3. Chadha K.L and Choudhary, B. *Ornamental Horticulture in India*. ICAR, New Delhi.
4. Randhawa, G.S. and Mukhopadhyaya, A. 1998. *Floriculture in India*. AlliedPublishers Pvt. Ltd., New Delhi
5. Chattopadhyay, S.K. 2007. *Commercial Floriculture*. Gene-Tech Books, New Delhi
6. Bose T.K., B. Chowdhury and S.P. Sharma 2001. *Tropical garden plants in colour*. Horticulture and Allied Publishers, Kolkata.
7. Veena Amarnath, 2012. *Nursery and Landscaping*. AGROBIOS, Jhodpur.

**Web References**

1. [www.bestgarden.net](http://www.bestgarden.net)
2. [www.indiaagronet.com](http://www.indiaagronet.com)
3. [www.intuxford.tripod.com](http://www.intuxford.tripod.com)
4. [www.webct.uark.edu](http://www.webct.uark.edu)
5. [www.personal.psu.edu](http://www.personal.psu.edu)

\*\*\*\*\*