

# COLLEGE OF AGRICULTURE, BHILWARA

(MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY, UDAIPUR)

College of Agriculture, Bhilwara  
Hearty  
Welcome



**AGRICULTURE FACULTY**  
**Maharana Pratap University of Agriculture and Technology, Udaipur**  
**UG Curricula as per VI Deans Committee Recommendations for the session 2024-25**

**Department/section wise course breakup**

S. No	Course title	Credit Hours
<b>Agronomy 22 (11+11)</b>		
<b>1</b>	Fundamentals of Agronomy	3 (2+1)
<b>2</b>	Farming based livelihood systems	3 (2+1)
<b>3</b>	Crop Production Technology-I ( <i>Kharif</i> Crops)	3 (1+2)
<b>4</b>	Crop Production Technology-II ( <i>Rabi</i> Crops)	3 (1+2)
<b>5</b>	Water Management	2 (1+1)
<b>6</b>	Weed Management	2 (1+1)
<b>7</b>	Introductory Agro forestry	2 (1+1)
<b>8</b>	Dryland agriculture/ Rainfed agriculture and watershed management	2 (1+1)
<b>9</b>	Principles and Practices of Natural Farming	2 (1+1)
<b>Soil Science 8 (5+3)</b>		
<b>10</b>	Fundamentals of Soil Science	3 (2+1)
<b>11</b>	Soil Fertility Management	3 (2+1)
<b>12</b>	Problematic Soils and their management	2 (1+1)
<b>Horticulture 9 (5+4)</b>		
<b>13</b>	Fundamentals of Horticulture	3 (2+1)
<b>14</b>	Production Technology of Fruit and Plantation Crops	2 (1+1)
<b>15</b>	Production Technology of Vegetables and Spices	2 (1+1)
<b>16</b>	Ornamental Crops, MAPs, and Landscaping	2 (1+1)
<b>Genetics and Plant Breeding 12 (7+5)</b>		
<b>17</b>	Principles of Genetics	3 (2+1)
<b>18</b>	Basics of Plant Breeding	3 (2+1)
<b>19</b>	Crop Improvement ( <i>Kharif</i> crops)-I	2 (1+1)
<b>20</b>	Crop Improvement ( <i>Rabi</i> crops)- II	2 (1+1)
<b>21</b>	Fundamentals of Seed Science and Technology	2 (1+1)
<b>Entomology 6 (4+2)</b>		
<b>22</b>	Fundamentals of Entomology	3 (2+1)
<b>23</b>	Pest management in Crops and Stored Grains	3 (2+1)
<b>Plant Pathology 8 (5+3)</b>		
<b>24</b>	Fundamentals of Plant Pathology	3 (2+1)
<b>25</b>	Diseases of Field & Horticultural Crops & their Management	3 (2+1)

26	Agricultural Microbiology and Phyto-remediation	2 (1+1)
<b>Extension Education 8 (5+3)</b>		
27	Rural Sociology and Educational Psychology	2 (2+0)
28	Fundamentals of Extension Education	2 (1+1)
29	Communication skills	2 (1+1)
30	Personality development	2 (1+1)
<b>Agricultural Meteorology 5 (3+2)</b>		
31	Environmental Studies and Disaster mgt.	3 (2+1)
32	Introduction to Agro-meteorology	2 (1+1)
<b>Agricultural Economics 9 (6+3)</b>		
33	Principles of Agricultural Economics and Farm Management	2 (2+0)
34	Entrepreneurship Development and Business Communication	3 (2+1)
35	Agricultural Marketing and Trade	2 (1+1)
36	Agricultural Finance & Cooperation	2 (1+1)
<b>Agricultural Statistics 6 (4+2)</b>		
37	Agricultural Informatics and Artificial Intelligence	3 (2+1)
38	Basic and Applied Agril Statistics	3 (2+1)
39	Introductory Mathematics	1 (1+0) Non gradial
<b>Agricultural Engineering 4 (2+2)</b>		
40	Farm Machinery and Power	2 (1+1)
41	Renewable energy in Agriculture and Allied Sector	2 (1+1)
<b>Nematology 2 (1+1)</b>		
42	Fundamentals of Nematology	2 (1+1)
<b>Biochemistry 3 (2+1)</b>		
43	Essentials of Plant Biochemistry	3 (2+1)
<b>Crop Physiology 3 (2+1)</b>		
44	Fundamentals of Crop Physiology	3 (2+1)
<b>Animal Husbandry 2 (1+1)</b>		
45	Livestock and poultry Management	2 (1+1)
<b>Agricultural Bio-technology 3 (2+1)</b>		
46	Fundamentals of Agri Biotechnology	3 (2+1)
<b>Students' Welfare</b>		
	NCC/NSS	1 (0+1)
	Physical Education, First Aid and Yoga Practices	2 (0+2)
	Study Tour	2 (0+2) Non gradial

**\*Elective Courses (Indicative)****20\*(15+5)**

1 Agri-Business Management	4 (3+1)
2 Management of natural resources	4 (3+1)
3 Agrochemicals	4 (3+1)
4 Agricultural Journalism	4 (3+1)
5 Landscaping	4 (3+1)
6 Commercial Plant breeding	4 (3+1)
7 Food safety and standards	4 (3+1)
8 Bioformulation and Nano formulation	4 (3+1)
9 Biopesticides and Biofertilizers	4 (3+1)
10 System Simulation and Agro advisory	4 (3+1)
11 Hi-tech Horticulture	4 (3+1)
12 Protected cultivation	4 (3+1)
13 Climate Resilient Agriculture	4 (3+1)
14 Biotechnology of Crop Improvement	4 (3+1)
15 Geoinformatics and Remote Sensing, precision farming	4 (3+1)
16 Micro-propagation Technologies	4 (3+1)
17 Commercial Seed Production	4 (3+1)
18 Principles and Practices of Organic Farming/ Conservation Agriculture	4 (3+1)
19 Food Science and Nutrition	4 (3+1)
20 Post-Harvest Technology and Value Addition	4 (3+1)

**\*\*Skill enhancement courses (SECs)****12 (0+12)**

1. SEC-I	2 (0+2)
2. SEC-II	2 (0+2)
3. SEC-III	2 (0+2)
4. SEC-IV	2 (0+2)
5. SEC-V	2 (0+2)
6. SEC-VI	2 (0+2)

**Credit Hours allocation:**

The B. Sc. (Hons) Agriculture programme will consist of 177 credits, 167 of which will be offered by the parent university and 10 credits of online courses taken by the student as per his/ her choice in consultation with the university/HAEIs.

S. No.	Title	Approved Credits
A.	Credits offered by the University	
1.	Core Courses	
	Major Courses	: 80 credits
	Minor Courses	: 32 credits
2.	Skill Enhancement Courses	: 12 credits
3.	Common Courses	: 19 credits
4.	NCC/NSS/Scouts	: 02 credits
5.	Physical Education, First Aid and Yoga Practices	: 02 credits
6.	Student READY/Internship	: 20 credits
	Total A	: 167 credits
B.	Credits of online courses taken by the student as per his/ her choice in consultation	

	with the university		
7.	MOOC Courses (Compulsory non-gradual)	:	10 credits
	Total B	:	10 credits
	Grand Total (A+B)	:	177 credits

**The courses and code for the undergraduate programme have been proposed.**

S. No	Course Code	Course Title	Credit Hours	Total credit hours
<b>First Year</b>				
<b>I Semester</b>				
1	FCC 111	Induction cum Foundation course (Deekshaarambh)	2 weeks Non-gradual	21(11+10)
2	SEC 111	Nursery Management	2(0+2)	
3	SEC 112	Mushroom Cultivation	2(0+2)	
4	EXT 111	Communication Skills	3(2+1)	
5	AGRON 111	Fundamentals of Agronomy	3(2+1)	
6	SSAC 111	Fundamentals of Soil Science	3(2+1)	
7	HORT 111	Fundamentals of Horticulture	3(2+1)	
8	AGRON 112	Farming based livelihood systems	3(2+1)	
9	EXT 112	Rural Sociology and Educational Psychology	2 (2+0)	
10	NSS/NCC/NSO/SCOUT 111	National Service Scheme (NSS-I)/ National Cadet Corps (NCC-I)	1(0+1)	
		Introductory mathematics (need-based)	1(1+0) Non-gradual	

<b>II Semester</b>				
1	SEC 121	Seed Production and Testing Technology	2(0+2)	21(10+11)
2	SEC 122	Bio-fertilizer Production Technology	2(0+2)	
3	EXT 121	Personality Development	2(1+1)	
4	AGRON 121	Environmental Studies and Disaster Management	3(2+1)	
5	SSAC 121	Soil Fertility Management	3(2+1)	
6	ENTO 121	Fundamentals of Entomology	3(2+1)	
7	AP 121	Livestock and Poultry Management	2(1+1)	
8	PPATH 121	Fundamentals of Plant Pathology	3(2+1)	
9	NSS/NCC/NSO/SCOUT 121	NCC-II/NSS-II	1(0+1)	

**Post-II Semester Internship (Only for exit option for award of UG –Certificate in Agriculture**

S. No	Course Code	Course Title	Credits
1	INT 121	Internship (10 Weeks)	10(0+10)*

\*Compulsory Internship for students exercising exit option (UG Certificate) after I year

Second Year				
III Semester				
1	SEC 211	Poultry Production Management	2(0+2)	21(9+12)
2	AGECON 211	Entrepreneurship Development and Business Communication	3 (2+1)	
3	PE 211	Physical Education, First Aid and Yoga Practices	2(0+2)	
4	GPB 211	Principles of Genetics	3(2+1)	
5	AGRON 211	Crop Production Technology-I (Kharif crops)	3(1+2)	
6	HORT 211	Production Technology of Fruit and Plantation Crops	2 (1+1)	
7	EXT 211	Fundamentals of Extension Education	2(1+1)	
8	NEMAT 211	Fundamentals of Nematology	2(1+1)	
9	NF 211	Principles and Practices of Natural Farming	2(1+1)	

IV Semester				
1	SEC 221	Organic Production Technology	2(0+2)	21(11+10)
2	STAT 221	Agricultural Informatics and Artificial Intelligence	3(2+1)	
3	HORT 221	Production Technology of Vegetables and Spices	2(1+1)	
4	AGECON 221	Principles of Agricultural Economics and Farm Management	2(2+0)	
5	AGRON 221	Crop Production Technology-II (Rabi Crops)	3(1+2)	
6	AGENGG 221	Farm Machinery and Power	2 (1+1)	
7	AGRON 222	Water Management	2 (1+1)	
8	SSAC 221	Problematic Soils and their management	2(1+1)	
9	GPB 221	Basics of Plant Breeding	3(2+1)	

**Post-II Semester Internship (Only for exit option for award of UG –Diploma in Agriculture**

S. No	Course Code	Course Title	Credits
1	INT 221	Internship (10 Weeks)	10(0+10)*

\*Compulsory Internship for students exercising exit option (UG Diploma) after I year

Third Year				
V Semester				
1	AGECON 311	Agricultural Marketing and Trade	3 (2+1)	22(13+9)
2	AGRON 311	Introduction to Agro-meteorology	2(1+1)	
3	PPHY 311	Fundamentals of Crop Physiology	3(2+1)	
4	ENTO 311	Pest management in Crops and Stored Grains	3 (2+1)	
5	PPATH 311	Diseases of Field & Horticultural Crops & their Management	3(2+1)	

6	GPB 311	Crop Improvement (kharif crops)-I	2 (1+1)	
7	AGRON 312	Weed Management	2(1+1)	
8	HORT 311	Ornamental Crops, MAPs and Landscaping	2 (1+1)	
9	AGRON 313	Introductory Agro forestry	2 (1+1)	

<b>VI Semester</b>				
1	MBB 321	Fundamentals of Agri Biotechnology	3(2+1)	21(12+9)
2	STAT 321	Basic and Applied Agril. Statistics	3(2+1)	
3	GPB 321	Crop Improvement (Rabi crops) – II	2(1+1)	
4	AGENGG 321	Renewable Energy in Agriculture and Allied Sector	2(1+1)	
5	AGRON 321	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)	
6	MBB 322	Essentials of Plant Biochemistry	3 (2+1)	
7	PPATH 321	Agricultural Microbiology and Phyto -remediation	2(1+1)	
8	AGECON 321	Agricultural Finance & Cooperation	2(1+1)	
9	GPB 322	Fundamentals of Seed Science & Technology	2(1+1)	

<b>Fourth year</b>				
<b>VII Semester</b>				
<b>1</b>		5 Elective Courses (major or minor) each of 4(3+1) credits for B.Sc (Hons) Agriculture degree		20(15+5)
<b>VIII Semester</b>				
<b>1</b>	EL 421 RAWE 421 INT 421	For B.Sc (Hons)Agriculture Degree Student READY (RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship		20 Credits
			Total	167
<b>2</b>		*Online courses	10	10
			Grand Total	167+10*

Elective courses (indicative)

S. No	Course Code	Title	Credit Hours	Total
1	AGECON 411	Agri-Business Management	4(3+1)	20*(15+5) 5* Elective Courses
2	SSAC 411	Management of Natural Resources	4(3+1)	
3	SSAC 412	Agrochemicals	4(3+1)	
4	EXT 411	Agricultural Journalism	4(3+1)	
5	HORT 411	Landscaping	4(3+1)	

6	GPB 411	Commercial Plant breeding	4(3+1)
7	FSN 411	Food safety and standards	4(3+1)
8	MBBT 411	Bioformulation and Nanoformulation	4(3+1)
9	SSAC 413	Biopesticides and Biofertilizers	4(3+1)
10	AGRON 411	System Simulation and Agroadvisory	4(3+1)
11	HORT 412	Hi-tech Horticulture	4(3+1)
12	HORT 413	Protected cultivation	4(3+1)
13	SSAC 414	Climate Resilient Agriculture	4(3+1)
14	MBBT 412	Biotechnology of Crop Improvement	4(3+1)
15	SSAC 415	Geoinformatics and Remote Sensing, precision farming	4(3+1)
16	HORT 414	Micro-propagation Technologies	4(3+1)
17	GPB 412	Commercial Seed Production	4(3+1)
18	AGRON 412	Principles and Practices of Organic Farming/ Conservation Agriculture	4(3+1)
19	FSN 412	Food Science and Nutrition	4(3+1)
20	HORT 415	Post Harvest Technology and Value Addition	4(3+1)

**Skill Enhancement Courses (Indicative)**

<b>S. No</b>	<b>Title</b>	<b>Credit Hours</b>	<b>Total</b>
1	Biofertilizer and biopesticide production	2(0+2)	12(0+12)
2	Production Technology of Bioagents	2(0+2)	
3	Seed Production and Testing Technology	2(0+2)	
4	Mushroom Production Technology	2(0+2)	
5	Soil, Plant and Water Testing	2(0+2)	
6	Post harvest processing technology	2(0+2)	
7	Beneficial insect farming	2(0+2)	
8	Plantation Crop Production and Processing	2(0+2)	
9	Poultry Production Technology	2(0+2)	
10	Commercial Horticulture	2(0+2)	
11	Floriculture and Landscaping	2(0+2)	
12	Food Processing	2(0+2)	
13	Agriculture Waste Management	2(0+2)	
14	Organic Production Technology	2(0+2)	
15	Commercial Sericulture	2(0+2)	
16	Video Production	2(0+2)	
17	Goat Production Management	2(0+2)	



# Department of Agronomy

## A. Core Courses

S. No.	Course Code	Course Title	Credit Hours	Total
1.	AGRON 111	Fundamentals of Agronomy	3 (2+1)	<b>27 (16+11)</b>
2.	AGRON 112	Farming Based Livelihood Systems	3 (2+1)	
3.	AGRON 211	Crop Production Technology-I ( <i>Kharif</i> Crops)	3 (2+1)	
4.	AGRON 212	Crop Production Technology-II ( <i>Rabi</i> Crops)	3 (2+1)	
5.	AGRON 213	Water Management	2 (1+1)	
6.	AGRON 221	Weed Management	2 (1+1)	
7.	AGRON 222	Introductory Agro forestry	2 (1+1)	
8.	AGRON 311	Dry land Agriculture/ Rainfed Agriculture and Watershed Management	2 (1+1)	
9.	AGRON 312	Principles and Practices of Natural Farming	2 (1+1)	
10.	AGRON 313	Environmental Studies and Disaster Management	3 (2+1)	
11.	AGRON 321	Introduction to Agro-meteorology	2 (1+1)	

## B. Elective Courses

### C. Skill Enhancement Courses (SECs)

1.	AGRON 411	Management of Natural Resources	4 (3+1)	<b>20 (15+5)</b>
2.	AGRON 412	System Simulation and Agro-advisory	4 (3+1)	
3.	AGRON 413	Climate Resilient Agriculture	4 (3+1)	
4.	AGRON 414	Geo-informatics and Remote Sensing, Precision Farming	4 (3+1)	
5.	AGRON 415	Principles and Practices of Organic Farming/Conservation Agriculture	4 (3+1)	

1.	SEC AGRON 101	Agriculture Waste Management	2 (0+2)	<b>4 (0+04)</b>
2.	SEC AGRON 201	Organic Production Technology	2 (0+2)	

<b>Course Code</b>	<b>:</b>	<b>Agron 111</b>
<b>Course Title</b>	<b>:</b>	<b>Fundamentals of Agronomy</b>
<b>Credit Hours</b>	<b>:</b>	<b>3 (2+1)</b>

### **Objectives**

1. To impart the basic and fundamental knowledge of Agronomy.

### **Theory**

**Agronomy and its scope:** Definition, meaning and scope of Agronomy; art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, fields crops and classification, importance, ecology and ecosystem, seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc.

**Tillage and tillth:** Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth and yield.

**Crop nutrition:** Essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, combined /un-combined forms manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, methods of preparation and role of organic manures in crop production.

**Integrated Nutrient Management:** Meaning, different approaches and advantages of INM Green manure-role in crop production: Definition, objectives, types of green manuring, desirable characteristics, advantages and limitations of green manuring.

**Water management:** Water resources of the world, India and the state; soil moisture constraints –gravitational water, capillary water, hygroscopic water, concept of water availability to plants, soil- plant-water relationship, crop water requirement, water use efficiency, methods of irrigation: Scheduling of irrigation, different approaches of scheduling irrigation

**Weeds:** Definition, importance and basics of classification of weeds and their control

**Cropping systems:** Cropping systems, Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation pollution and pollutants, Allelopathy: Meaning and importance in crop production, growth and development of crops: Definition, meaning and factors affecting growth and development

### **Practical**

A visit to Instructional Crop farm and study on field crops, Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of preparatory tillage implements, Study of inter tillage implements, Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops, seed germination and viability test of seed, Practice on time and method of manures and fertilizers application, measurement of soil moisture by gravimetric and volumetric method and bulk density, Determination of field capacity, Determination of gross and net irrigation requirement, Determination of infiltration rate.

### **Suggested readings:**

1. William L Donn.1965.Meteorology.McGraw-HillBookCo.NewYork.
2. Yawalkar K S and Agarwal J P.1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.

3. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
4. Reddy Yellamanda T and Shankar Reddy G H.1995. Principles of Agronomy. Kalyani Publishers Ludhiana.
5. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludiana

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<b>Course Code</b>	:	<b>Agron 112</b>
<b>Course Title</b>	:	<b>Farming based Livelihood Systems</b>
<b>Credit Hours</b>	:	<b>3(2+1)</b>

### **Objective**

1. To make the students aware about farming based livelihood systems in agriculture
2. To disseminate the knowledge and skill how farming based systems can be a source of livelihood

### **Theory**

Agriculture- Definition and its principles, status of agriculture in India, income of farmers and rural people, Livelihood-Definition, concept and livelihood pattern in urban & rural areas. Farming systems- Definition and farming based livelihood systems, different indicators to study livelihood systems, Agricultural Livelihood Systems (ALS): Meaning, approaches and framework, prevalent farming systems and its contribution to livelihood, types of traditional & modern farming systems.

Components of farming system/ farming based livelihood systems, crops and cropping systems, livestock (Dairy, piggery, goatry, poultry, duckry, pisci-culture, apiculture etc.), horticultural crops, agro-forestry systems etc.,

Enterprises (small, medium and large) including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Farming system's feasibility under various agro-climatic zones and farming based livelihood models.

Factors affecting farming based livelihood systems, schemes & programmes for promotion of farming based livelihood opportunities, role of farming based livelihood enterprises in 21<sup>st</sup> Century in view of circular economy, green economy, climate change, digitalization & changing life style.

### **Practical**

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming based livelihood models / systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models, Field visit of innovative farming system models. Visit of agri- based enterprises & their functional aspects for integration of production, processing & distribution sectors and study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming based livelihood systems along with cost & profit analysis, case study of Start-Ups in agri-sectors.

### **Suggested Readings**

1. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA
2. Ashley, C.; Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, U K: Volume 7. [Google Scholar]
3. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
4. Panwar *et al.* 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
5. Singh, J.P., *et al.* 2015. Region Specific Integrated Farming System Models, ICAR- Indian Institute of Farming Systems Research, Modipuram.
6. Walia, S. S. and U. S. Walia. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

7. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey Ujjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan , S. K. Singh, K. K. Singh and K. M. Singh  
ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar

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<b>Course Code</b>	:	<b>Agron 121</b>
<b>Course Title</b>	:	<b>Environmental studies and disaster management</b>
<b>Credit Hours</b>	:	<b>3(2+1)</b>

### **Objective**

To expose and acquire knowledge on the environment and to gain the state-of-the-art- skill and expertise on management of disasters

### **Theory**

Introduction to Environment- Environmental studies Definition, scope and importance –Multi disciplinary nature of environmental studies-Segments of Environment-Spheres of Earth- Lithosphere - Hydrosphere- Atmosphere- Different layers of atmosphere. Natural Resources: Classification-Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems-Concept of an ecosystem-Structure and function of an ecosystem- Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air(Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Disaster management- Disaster definition -Types- Natural Disasters- Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

### **Practical**

Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain. Energy: Biogas production from organic wastes. Visit to wind mill / hydro power/ solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and unpolluted system. Visit to local polluted site -Urban/ Rural/ Industrial/ Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of *E. coli* in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond /river/ hills. Visit to areas affected by natural disaster

### **Suggested Readings**

1. De. A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN: 13-978 81 224 2617 5. pp - 384.
2. Dhar Chakra Barti. P.G.2011. Disaster management-India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. pp- 36.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
4. Parthiban, K.T. Vennila, S. Prasanthrajan, M. Umesh Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi
5. Prasanth Rajan M, P.P. Mahendran. 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agro tech Publishing Academy, Udaipur
6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerat, India
7. Tyler, Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA

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<b>Course Code</b>	:	<b>Agron 211</b>
<b>Course Title</b>	:	<b>Crop Production Technology-I (<i>Kharif</i> crops)</b>
<b>Credit Hours</b>	:	<b>3(2+1)</b>

### **Objectives**

1. To impart basic and fundamental knowledge on principles and practices of *kharif* crop production.
2. To impart knowledge and skill on scientific crop production and management.

### **Theory**

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

### **Practical**

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

### **Suggested readings:**

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Ka Publishers, New Delhi.
2. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. New Delhi.
3. Rajendra Prasad. Text book of Field Crops Production – Commercial Crops. Volume IICAR Publication.
4. S. R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5. S. S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
6. UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.
7. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.

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<b>Course Code</b>	:	<b>Agron 212</b>
<b>Course Title</b>	:	<b>Principles and Practices of Natural Farming</b>
<b>Credit Hours</b>	:	<b>2 (1+1)</b>

### **General Objectives**

1. To provide comprehensive understanding and knowledge to students about natural farming

### **Specific Objectives**

1. To teach students the concept, need and principles of native ecology-based production under natural farming
2. To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives

### **Theory**

Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in view of climate change, soil health, water use carbons sequestration, biodiversity conservation, food security and nutritional security and sustainable development goals (SDGs), Concept of natural farming; Definition of natural farming; Objectives of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/scopes of natural farming. Characteristics and design of a natural farm, Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems, Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, Integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches on a natural farm, Rearing practices for animals under natural farming, Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming; Mechanization in natural farming, Processing, labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming, produce and products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

### **Practical**

Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm; Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management; On-farm inputs preparation methods and protocols, Studies in green manuring *in-situ* and green leaf manuring, Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and pest and disease management; Weed management practices in natural Farming; Techniques of Indigenous seed production-storage and marketing, Partial and complete nutrient and financial budgeting in natural farming; farming; Evaluation of ecosystem services in natural farming (Crop, Field and System).

### **Suggested Readings:**

1. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. pp - 104.
2. Shamasastri, R. 1915. Kautilya's Arthashastra.
3. Ayachit, S.M. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.

4. Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin.
5. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. pp -94.
6. Ecological Farming- The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
7. HLPE. 2019. Agro-ecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. <https://fao.org/3/ea5602en/ea5602en.pdf>.
8. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system .<https://www.fao.org/3/i9037en/i9037en.pdf> Agro ecosystem Analysis for Research and Development Gordon R. Conway.1985
9. U. K. Behera. 2013. A text Book of Farming System. Agro tech Publishing House, Udaipur. (ISBN:978-81-8321-309-7)
10. Hill, S.B. and Ott. P. (eds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
11. Nalini, S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara(13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. pp- 64.
12. Boeringa, R. (ed.).1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, pp - 199.
13. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
14. Fukuoka, M.1978. The One – Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. pp – 181.
15. Fukuoka M. 1985.The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
16. Hill S.B. and Ott. P. (eds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany. pp - 366.
17. INFRC.1988. Guidelines for Nature Farming Techniques. Atami, Japan. pp -38.
18. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
19. Reyes, Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
20. The Ultimate Guide to Natural Farming and Sustainable Living: Perm aculture for Beginners (Ultimate Guides) by Nicole Faires (2016).
21. Plenty For All: Natural Farming A To Z PRAYOGPARIWAR METHODOLOGY by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021).
22. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021).
23. Natural Asset Farming: Creating Productive and Bio diverse Farms by David B. Lindenmayer,Suzannah M. Macbeth, *et al.* (2022)
24. Malhotra, R. and S.D. Babaji. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.
25. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 to 7. Indian Council of Agricultural Research, New Delhi

<b>Course Code</b>	<b>:</b>	<b>Agron 221</b>
<b>Course Title</b>	<b>:</b>	<b>Crop Production Technology-II (<i>Rabi</i> Crops)</b>
<b>Credit Hours</b>	<b>:</b>	<b>3(2+1)</b>

### **Objectives**

1. To impart basic and fundamental knowledge on principles and practices of *rabi* crop production.
2. To impart knowledge and skill on scientific crop production and management.

### **Theory**

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

### **Practical**

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

### **Suggested readings:**

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., Delhi.
3. Rajendra Prasad. Text book of Field Crops Production – Commercial Crops. Volume III CAR Publication. Rajendra Prasad. Textbook of Field Crops Production – Food grain Crops. Volume I ICAR Publication.
4. S. R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5. S. S. Singh.2005. Crop Management. Kalyani Publishers, New Delhi. UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.
6. Rajendra Prasad. 2002. Text Book of Field crops Production, ICAR, New Delhi. Reddy, S.R. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.
7. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.

<b>Course Code</b>	:	<b>Agron 222</b>
<b>Course Title</b>	:	<b>Water Management</b>
<b>Credit Hours</b>	:	<b>2(1+1)</b>

### Objectives

1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
2. To study different methods of irrigation and water management practices of both field and horticultural crop sand drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas

### Theory

Irrigation: definition and objectives, Importance, functions of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships; Available and unavailable soil moisture – distribution of soil moisture – water budgeting – rooting characteristics – moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapo-transpiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation; Methods of irrigation: surface and sub-surface, pressurized methods *viz.*, sprinkler and drip irrigation, their suitability, merits and demerits, fertigation, economic use of irrigation water; Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut and sugarcane); Agricultural drainage. Water management problems, quality of irrigation water, irrigation management practices for different soils and crops, Layout of drip, sprinkler and underground pipeline system.

### Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water by using water measuring devices *viz.*, 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; Visit to farmers field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; layout for different methods of irrigation, Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, bio-carbonates, Ca<sup>++</sup> and Mg<sup>++</sup> in irrigation water (quality parameters).

### Suggested readings:

1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Aca Udaipur.
2. Dilip Kumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt.
3. S.V. Patil & Raja kumar, G.R., Water Management in Agriculture and Horticultural Crops. Satish publishing House, Delhi.
4. Carr M. K. V. and Elias Fereres. Advances in Irrigation Agronomy. Cambridge University Press.
5. Michael, A.M. Irrigation Theory and practice. Vikas publishing house Pvt, Ltd.

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<b>Course Code</b>	<b>:</b>	<b>Agron 311</b>
<b>Course Title</b>	<b>:</b>	<b>Introduction to Agro-meteorology</b>
<b>Credit Hours</b>	<b>:</b>	<b>2(1+1)</b>

### **Objectives**

1. To introduce the students to the concept of weather and climate and the underlying physical processes occurring in relation to plant and atmosphere
2. To impart the theoretical and practical knowledge of instruments / equipments used for measurement of different weather variables in an agro-meteorological observatory
3. To study the meteorological aspects of climate change in agriculture and allied activities

### **Theory**

Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, shortwave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rain making. Monsoon-mechanism and importance in Indian agriculture; Weather hazards-drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold- wave; Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and Livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

### **Practical**

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording, Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law, Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS; Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, Measurement of soil temperature and computation of soil heat flux, Determination of vapor pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of wind rose, Measurement, tabulation and analysis of rain, Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET.

### **Suggested readings:**

1. Introduction to Agrometeorology & Climate Change by Alok Kumar Patra
2. Fundamentals of Agrometeorology and Climate Change by G.S. Mahi & P.K.Kingra
3. Text Book of Agricultural Meteorology by MCV Arshneya & P B Pillai
4. Introduction to Agrometeorology by H.S. Mavi
5. Agricultural Meteorology by G.S.L. H. V. Prasado Rao

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<b>Course Code</b>	<b>:</b>	<b>Agron 312</b>
<b>Course Title</b>	<b>:</b>	<b>Weed Management</b>
<b>Credit Hours</b>	<b>:</b>	<b>2 (1+1)</b>

### **Objectives**

1. To teach students about principles of weed science
2. To impart practical knowledge of weed management in field crops

### **Theory**

Introduction to weeds, characteristics of weeds; their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds, crop-weed competition, factors of competition, losses on growth and yield of crops; factors affecting growth and development. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management, Implements for weed control, robotic weed control, weed management in organic/ natural farming. Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use. Mode of action of herbicides and selectivity phenomenon. Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application, Herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management.

### **Practical**

Techniques of weed preservation, Weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, Study on shift in weed flora in long term trials, Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide spraying equipments, their parts, use and maintenance. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index.

### **Suggested readings:**

1. Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.
2. Naidu, V.S.G.R., Hand book of Weed Identification. Directorate of Weed Research, Jabalpur.
3. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G., 2015. Weed management of Horticultural Crops. Agr (India), Jodhpur.
4. Ramamoorthy, K. and Subbian, P., Pre dominant Weed flora in hill –ecosystems. Agrobios (India), Jodhpur. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.
5. Subramanian,S., Mohammed Ali, A. and Jayakumar, R. 1991. All About Weed Control. Kalyani Publi Ludhiana.
6. Tadulingam, C. and Venkat narayana, D. 1955. A Handbook of Some South Indian Weeds. Government Madras.
7. Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.

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<b>Course Code</b>	<b>:</b>	<b>Agron 313</b>
<b>Course Title</b>	<b>:</b>	<b>Introductory Agro forestry</b>
<b>Credit Hours</b>	<b>:</b>	<b>2 (1+1)</b>

### **Objectives**

1. To study Agro forestry as an alternate system of land use
2. To study different types of Agro forestry for soil and water conservation
3. To study the characteristics of Agro forestry in terms its potential for soil moisture conservation practices

### **Theory**

**Agro-forestry:** Definition and scope of Agro forestry system, Types of Agro forestry system, potential of Agro forestry in India, Prevailing agro forestry systems in N-E India, MPTS-definition, role of MPTS in agro forestry system, its selection for different agro forestry system, MPTS of N-E India, Ecological aspects of Agro forestry system, tree -crop interaction – competition, nutrient recycling, Traditional Agro forestry as a viable choice to conserve Agro biodiversity in North-East India. Management of Agro-forestry system, Role of agro forestry in soil and water conservation: wind breaks, shelterbelts–definition, objectives., Socio-economic aspects of Agro forestry system, Design and Diagnostic study of agro forestry system, **Silvi-culture:** Definition and scope of silvi-culture system, Propagation of tree species, Regeneration by seed, coppice, root suckers , Transplanting, stamp, branch cutting, rhizomes, Nursery bed preparation and management, Cultural practices for bare root and seedling, field handling of nursery stock, Management of tree species, Silvi-culture of important tree species, choice of species-site factors, root, crown and bole characteristics, phenology , nutritional and water requirement, ground operation, tendering and harvesting utility etc.

### **Practical**

Study of tree growth measurement, Study of environmental parameters affecting AF System. Plant propagation methods, Pre-sowing seed treatment, preparation of nursery bed exercise, practicing students experience in vegetation, afforestation method, practical training, pruning, coppicing, pollarding etc. natural and artificial regeneration. Design and diagnostic survey of agro-forestry system. Evaluation of agro-forestry system in different agro climatic zones. Exposure Visit to prevailing agro forestry systems of the state and related important institutions.

### **Suggested readings:**

Nair, P. K. R: 1993. An Introduction to Agro forestry, Kluar Academic Publisher

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<b>Course Code</b>	<b>:</b>	<b>Agron 321</b>
<b>Course Title</b>	<b>:</b>	<b>Dry land Agriculture / Rainfed Agriculture and Watershed Management</b>
<b>Credit Hours</b>	<b>:</b>	<b>2 (1+1)</b>

### **Objectives**

1. To learn about characteristics and conditions of dry land / rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management

### **Theory**

Dry land / Rainfed agriculture: Introduction, types and characteristics; History of dry land / rainfed agriculture in India; Problems and prospects of dry land/ rainfed agriculture in India ; Soil and climatic conditions prevailing dry land/ rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, efficient utilization of water through soil and crop management practices, Crops and cropping systems in dry land / rainfed areas; Management of crops in dry land/rainfed areas, Contingent crop planning of aberrant weather conditions, Concept, history, objective, principles and components of watershed management, factors affecting watershed management.

### **Practical**

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country, demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplement irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought in the country. Effective rainfall and its calculation. Studies on cultural practices for mitigating moisture including mechanical and agronomic measure. Soil moisture determination under different situations, Importance of seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

### **Suggested readings:**

1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, Delhi.
2. D. Lenka. 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
3. G.S.L.H.V. Prasad Rao. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
4. H. S. Mavi and Graeme J. Tupper, 2005. Agrometeorology – Principles and applications of climate stud agriculture. International Book Publishing Co., Lucknow.
5. H.S. Mavi. 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. H .V. Nanjappa and B. K. Ramachandra ppa,2007. Manualon Practical Agricultural Meteorology. Agr India. Jodhpur.
7. S. R. Reddy. 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
8. T. Yellam and a Red dy and G.H. Sankara Reddi, 2010. Principles of Agronomy. Kalyani Publishers, New
9. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030.
10. Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome,Italy



11. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'.  
In FAO, The State of Food and Agriculture, FAO, Rome, Italy
12. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for  
Environmentally, Sound and Participatory Rural Development, Center for Science and  
Environment, New Delhi, India

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## B. Elective Course 1

<b>Course Code</b>	<b>:</b>	<b>EC-Agron 401</b>
<b>Course Title</b>	<b>:</b>	<b>Management of natural resources</b>
<b>Credit Hours</b>	<b>:</b>	<b>4(3+1)</b>

### Objectives

1. To enlighten students about available natural resources and their relationship with crop production
2. To impart the knowledge of principles and practices of natural resource management

### Theory

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification. Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and groundwater, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Introduction to soil and water conservation and causes of soil erosion., Definition and agents of soil erosion, water erosion - Forms of water erosion, Gully classification and control measures. Soil loss estimation by universal soil loss equation-Soil loss measurement techniques. Principles of erosion control Introduction to contouring strip cropping. Contour bund - Graded bund and bench terracing. Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures, Water harvesting techniques - Lining of ponds, tanks and canal systems.

### Practical

Identifying natural resources and their utility Practicing survey - Principles and educating to use pacing technique for measurement. Area calculations through chain survey- GPS demo for tracking and area measurement. Estimation of soil loss and calculation of erosion index. Leveling concepts and practical utility in agriculture. Preparation of contour maps. Concept of vegetative water ways and design of grassed water ways. Wind erosion and estimation process. Different irrigation pumps and their constructional differences. Farm pond construction and its design aspects. Visit to nearby farm pond. Visit to an erosion site. Exposure to strip cropping/contour bunding.

### Suggested readings

1. Sustainable Natural Resource Management by Danill R. Lynch
2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and BS Rathor, Daya Publishing House
3. Managing Natural Resources: Focus On Land And Water: Ed. Harikesh N. Mishra PHI, 2014 Learning, 496p.
4. Management of Resources for Sustainable Development: Sushma Goel, The Orient Blackswan 2016, 284p.
5. Natural Resources: Their Conservation and Management: Arvind Rai Upadhyay, Aspiration Academy, 320p.
6. Natural Resource Management for Growth Development and Sustainability: Vasudeva Srishti Pal, 2023, Today & Tomorrows Printers and Publishers, 336p.

## Elective Course 2

<b>Course Code</b>	<b>:</b>	<b>EC-Agron 402</b>
<b>Course Title</b>	<b>:</b>	<b>System Simulation and Agro advisory</b>
<b>Credit Hours</b>	<b>:</b>	<b>4(3+1)</b>

### Objectives

1. To impart the knowledge of statistical and simulation modeling in crop yield estimation
2. To get acquainted with different weather forecasting techniques and their usability analysis
3. To study about the preparation and dissemination of agro-advisory bulletin

### Theory

System Approach for representing soil-plant-atmospheric continuum, system boundaries, Crop models, concepts & techniques, types of crop models, data requirements, relational diagrams. Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis. Potential and achievable crop production- concept and modeling, techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance. Weather forecasting, type's methods, tools & techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity; Crop- Weather Calendars; Preparation of agro- advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro-advisory and its effective dissemination.

### Practical

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential & achievable production; yield forecasting, insect & disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro advisory.

### Suggested readings

1. Introduction to Agrometeorology by H.S. Mavi
2. Agricultural Meteorology by G.S.L.H.V. Prasad Rao
3. Advances in Plant Atmospheric Interactions (Eds. Rao, V.U.M., Rao, A.V.M.S., Rao, G.G.S.N., Ramana Rao, B.V., Vijaya Kumar, P. and Venkateswarlu, B), Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad.
4. Text Book of Agricultural Meteorology. ICAR by MC Varshneya & PB Pillai
5. Principles of Agricultural Meteorology by OP Bishnoi

### Elective Course 3

Course Code	:	EC-Agron 403
Course Title	:	Climate Resilient Agriculture
Credit Hours	:	3(2+1)

#### Objectives

1. To impart the concept of climate resilient agriculture under the present context of climate change
2. To study the integrated role of different sectors in building resilience to climate change in agriculture

#### Theory

Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak *etc.* Basics of adaption and mitigation in the agricultural sectors; analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio-economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.

Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather & climatic information, agro-advisories, ICTs and simulation models; climate resilient agronomic practices–crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro- irrigation, deficit irrigation and drainage management, organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling; use of renewable sources of energy; climate resilient pest-disease management strategies. Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.

#### Practical

Acquaintance with meteorological instruments including AWS, Statistical techniques to study trend of climatic parameters, Analysis of extreme weather events using non-parametric tests, Building climate change scenarios under different futuristic emission of GHGs, Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars, climate resilient technologies and manipulation of cropping patterns, Acquaintance with ICTs for effective dissemination of local weather information and agro advisories, Analysing carbon sequestration potential of different agro-ecosystems; Designing climate smart village model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.

#### Suggested readings

1. Climate Resilient Animal Agriculture by GSLHV Prasada Rao (New India Publishing Agency)
2. Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish, New India Publishing Agency
3. Climate-Smart Agriculture Source book, FAO (2013).
4. Implications for Climate Smart Agriculture, Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari, Biotech Books, 357p.
5. Climate Resilient Agriculture, Adaptation and Mitigation Strategies, Manish Bhan, 2018, New India Publishing Agency, 294p.

6. Climate Change & Agriculture Over India by Prasad Rao, 2010, PHI Learning, 352p.
7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M.2022, Satish Serial Publishing House, 178p.

## Elective Course 4

<b>Course Code</b>	:	<b>EC-Agron 404</b>
<b>Course Title</b>	:	<b>Geo-informatics and Remote Sensing, precision farming</b>
<b>Credit Hours</b>	:	<b>4(3+1)</b>

### General Objectives

1. Enabling students acquire knowledge on basics of remote sensing technique for precision farming applications

### Specific Objectives

1. To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management

### Theory

Introduction and history of remote sensing; sources, Principles of remote sensing propagation of radiations in atmosphere; Interaction with matter, Application of remote sensing techniques land use soil surveys, crop stress and yield forecasting, Advantages and disadvantages of remote sensing Remote sensing institutes in India, Basic Concepts about geo-informatics.

What is artificial intelligence; History of artificial intelligence, Fundamentals of big data & machine learning (ML), Use of artificial intelligence in autonomous systems: agricultural robots and drone monitoring systems, driverless tractors, automated sprinklers and self-harvesting machines etc.; Use of AI in crop analysis: monitoring soil quality, promoting organic crops, monitoring weeds, precision agriculture, using drones for crop analysis; Role of AI for sustainability and climate change, yield and demand forecasting, foodtech/wider value chain including impact of blockchain, AI use for in the emerging markets; Technology deployment like sensors , AI and agricultural technologies and How to scale AI for agricultural technologies applications, Responsible AI in agriculture, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents.

### Practical

Familiarization with different remote sensing equipments and data products, Interpretation of aerial photographs and satellite data for mapping of land resources, Global positioning system (GPS), Basics of Geographic Information System (GIS), Geo referencing of topo sheets,

Live examples and cases study of AI use in Agriculture, Search and Control strategies: Blind search, Breadth - first search, Depth First search, Hill climbing method, Best First search, Branch and Bound search, Programming in Prolog Syntax and meaning of Prolog Programs. Using Data Structures. Controlling Back- tracking. Input and Output. Built-in Predicates, Using Prolog Grammar Rules. Higher level assignments/exercises for implementation using Prolog.

### Suggested readings

1. Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor(s):. Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan
2. Machine Learning Approaches to Bioinformatics By Zheng RongYang
3. Text Book of Remote Sensing and Geographical Information Systems By M. Anji Reddy
4. Precision Agriculture Technologies for Food Security and Sustainability by A El-Kader, M Sherine, M El-Basioni, M Basma.
5. Principles and Theory of Geoinformatics P.K. Garg Khanna Publishers, 2019, 296
6. Advances in Geo-informatics Remote Sensing and GIS by Bhunia, Gouri Sankar & Uday Chatterjee &Gopal Krishna Panda, BIO GREEN

7. Artificial Intelligence: Machine Learning, Deep Learning and Automation Processes, John Adamssen, 2020, Efalon Acies
8. Remote Sensing and Image Interpretation, 6ed(WSE) Paperback–1 January 2011, Willey Student Edition
9. Remote Sensing and Geographic Information: A.M. Chandra and S.K.Ghosh, Narosa

### Elective Course 5

<b>Course Code</b>	:	<b>EC-Agron 405</b>
<b>Course Title</b>	:	<b>Principles and Practices of Organic Farming and Conservation Agriculture</b>
<b>Credit Hours</b>	:	<b>2 (1+1)</b>

#### Objectives

1. To teach students the principles of crop production under organic and conservation agriculture situation
2. To impart practical knowledge of organic and conservation agriculture practices

#### Theory

Concept of organic farming, principles and its scope in India; Choice of crops and varieties inorganic farming; Nutrient management inorganic farming and their sources, Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture. Conservation agriculture: definition, origin, principles, advantages, challenges, primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture *vis a vis* Climate smart Agriculture,

#### Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost and their quality analysis; Method of application of bio-fertilizers; Indigenous technology knowledge (ITK)for nutrient, insect-pest and disease management; Studies in green manuring in- situ and green leaf manuring, Studies on different type of botanicals for insect-pest management; Weed management in organic farming; Cost of organic production system; Practices of conservation agriculture.

#### Suggested readings

1. A.C. Gaur. Handbook of Organic farming and biofertilizers
2. A.K. Dahama. Organic farming for sustainable agriculture. Agrobios (India), Jodhpur
3. Arun K. Sharma. Handbook of Organic farming. Agrobios (India), Jodhpur.
4. S.P. Palaniappan and K. Annadurai. Organic farming–Theory and Practice. Scientific Publishers, Jodhpur
5. U. Thapaand P. Tripathy. Organic farming in India-Problems and Prospects. Agrotech publishing, Udaipur.
6. G.K.Veeresh, Organic farming. Foundation Books. New Delhi.
7. Purshit, S.S. Trends in Organic Farming in India. Agros Bios (INDIA), Jodhpur.
8. Thampan, P.K. Organic Agriculture. Peckaytree Crops Development Foundation, Cochin, Kerala.
9. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
10. Abhinandan Singh Pankaj Kumar Ojha & Rahul Kumar, 2018. Conservation Agriculture Technologies, Biotech Books
11. Acharya Sankar Kr, Sreemoyee Bera, Cornea Saha, Prabhat Kumar, Monirul Haque, Riti Chatterjee and Anwasha Mandal, 2022 Conservation Agriculture Approach and Application, Scholars World, pp. 292



### C. Skill Enhancement Courses

<b>Course Code</b>	<b>:</b>	<b>SE-Agron 101</b>
<b>Course Title</b>	<b>:</b>	<b>Agricultural Waste Management</b>
<b>Credit Hours</b>	<b>:</b>	<b>2 (0+2)</b>

#### **Practical**

Selection and collection of degradable agricultural waste samples, utilization and recycling of agricultural waste, potential of recyclable crop residues and its management, *in-situ* management of agriculture waste, composting and vermicomposting for bio conservation of biodegradable waste, biogas technology, agricultural waste and water, air and animal resources. Determination of pH, EC, CEC, heavy metals, BOD, COD, TSS, TDS, NH<sub>4</sub>, Total P, and dissolved reactive P. Nutrient status (N, P, K, secondary and micronutrients) analysis of agricultural waste. Waste management equipment operation, Maintenance and safety hazards, computer software and models. Survey of different agri waste from live stock, dairy, poultry, food processing, fruit & vegetable and agri-chemicals, Preparation of compost, Vermicomposting, biogas and analysis of compost.

<b>Course Code</b>	<b>:</b>	<b>SE-Agron 102</b>
<b>Course Title</b>	<b>:</b>	<b>Organic Production Technology</b>
<b>Credit Hours</b>	<b>:</b>	<b>2 (0+2)</b>

### **Aim**

The module is developed to improve, knowledge, skill, ability and experience of students in the area of organic agriculture.

### **Objectives**

1. To promote professional skills and knowledge through meaningful hands on experience in organic production technology
  2. To build confidence of work in project mode in the area of organic farming
  3. To acquire enterprise management capabilities in the organic agriculture
1. Preparation of organic manure and compost for nutrient management
    1. Vermicompost
    2. NADEP compost
    3. Enriched compost
    4. Green manuring
    5. Compost granular and pellets making
    6. Oil cakes
    7. Fortified compost
  2. Preparation of liquid organic manures
    1. Vermiwash
    2. Panchagavya
    3. Jeevamrit
    4. Beejamrit
    5. Ghanjeevamrit
    6. Compost tea
    7. Matka khad
    8. Amrit pani
    9. Biodynamic manure
  3. Preparation of organic bio-pesticides for controlling of insect-pest
    1. Neem oil
    2. Neem leaf extract
    3. Neem seed kernel extract
    4. Dashparni
    5. Neemastra
    6. Barmastra
    7. Agnistra
    8. Fermented butter milk
    9. Pheromone trap
    10. Beneficial insect
    11. Light trap
  4. Disease management through organic means
    1. Tricoderma
    2. Beveria becciana
    3. Garlic paste
    4. NPV
  5. Weed management through bio-agent
  6. ITKS used in organic farming

## Department of Plant Pathology

S.No.	Title of Course	Credit Hours	Semester
1.	Skill Enhancement Courses: 1. Mushroom Cultivation	(0+2)	I
2.	Fundamentals of Plant Pathology	3(2+1)	II
3.	Diseases of Field & horticultural Crops & Their Management	3(2+1)	V
4.	Agricultural Microbiology and Phyto-remediation	2(1+1)	VI

### Skill Enhancement Courses (SEC)

#### Course Title: Mushroom Cultivation 2 (0+2)

#### Practical

History, current status and scope of mushroom cultivation in India, Important features of edible fungi, Nutritional and medicinal value of mushrooms, Preparation of media, Tissue culture preparation, Sub-culturing for culture maintenance and its preservation, Spawn preparation techniques, Raw material formulations for *Agaricus bisporus* (button mushroom), Composting (long, zero energy poly tunnel method (ZEPT) and short method), Casing preparation, Crop management practices, Mushroom farm design and infrastructure required for commercial unit, Cultivation techniques of *Pleurotus* spp. (Dhingri), *Lentulus edodes* (shiitake), *Calocybe indica* (milky) and *Agaricus bisporus* (button mushroom), mushrooms, Marketing of mushrooms, Mushroom diseases and insect pest and their control, Preparation of value-added products from mushrooms, Economics of mushrooms, Exposure visit to commercial farms.

#### Suggested readings:

1. Manjit Singh, Bhuvnesh Vijay, Shwet Kamal, G.C. Wakchaure.2011. Mushrooms Cultivation, Marketing and Consumption. ICAR-Directorate of Mushroom Research , Chambaghat, Solan (HP)
2. B.C. Suman and V.P. Sharma .2007. Mushroom Cultivation in India. Daya Publishing House, Delhi-110 035 (ISBN 817035479X, 9788170354796 ; 179 pages)
3. J.N. Kapoor .2016. Mushroom Cultivation. ICAR, New Delhi
4. Dr. Ravinder Singh Rana .2020. Mushroom Cultivation and its Diseases. Sankalp Publication (ISBN-13978-8194717607)
5. Rajni Gupta and Ajay Singh .2023. Textbook of Mushroom Cultivation. Daya Publishing House, Delhi-110 035

## **Course Title: Fundamentals of Plant Pathology 3 (2+1)**

### **Objectives:**

1. To study the importance of plant disease epidemics and its economic impact on crops
2. To study biotic (living), mesobiotic (viruses / viroids), and abiotic (non-living and environmental) causes of diseases/ disorders.
3. To study the different types symptoms, cause and pathogens characteristics & and its reproduction
4. To study the epidemiology and management of plant diseases.

### **Theory :**

**Introduction, scope and objectives of plant pathology:** Definition, derivation and different disciplines of plant pathology; General terms (glossary) commonly used in plant pathology; Scope and objectives; Importance of plant pathology in agriculture.

**History and Development of Plant Pathology:** Important milestones, famous discoveries/ inventions and contributions of National and International Phytopathologists; Development of Plant pathology in India.

**Definition and Concept of Plant Diseases:** Plant disease; Conditions necessary for disease development; Disease triangle, disease tetrahedron/ pyramid concepts; classification of diseases based causal organism / agent, symptoms and mode of spread and severity.

**Causes of plant diseases and symptoms :** Plant diseases caused by abiotic and biotic agents; diseases caused by Fungi, bacteria, nematodes, viruses, Phytoplasmas and phanerogamic parasites.

**General characteristics of plant pathogens:** Classification of Prokaryotes, fungi, viruses, mollicutes and nematodes.

**Growth and reproduction of plant pathogens:** Types of growth, methods of measurement and kinetics of growth observed in pathogens; Reproduction types and reproductive structures in plant pathogens (Fungi, viruses, phytoplasmas, bacteria and nematodes)

**Liberation / dispersal and survival of plant pathogens:** Active and passive discharge of spores / inoculum; mechanism of liberation; Distribution-dissemination and direct and indirect methods of transmission; Survival of plant pathogens.

**Types of parasitism and variability in plant pathogens:** Biotrophs, Necrotrophs, pathotrophs, facultative saprophytes; Variability in plant pathogens. Mechanisms of variability in fungi: bacteria, viruses and nematodes. Mechanisms: Mutation, Recombination, Heterokaryosis, Heteroploidy, Parasexualism, Transmission, Transformation, Transduction and Conjugation.

**Pathogenesis:** Phenomenon of host infection by fungi, bacteria, viruses and nematodes penetration, colonization. Role of enzymes, toxins and growth regulators in disease development and their classification. Introduction to principles of plant disease management.

### **Practical:**

Study of Laboratory Equipment and Microscope, Study of Symptoms and Diagnosis of Plant Diseases caused by Virus, Virioids and Mollicutes. Collection and Preservation of Disease Specimen. Morphological Characters of Fungi, Bacteria, Virus, Virioids, Mollicutes and Nematodes. Macroscopic and Microscopic examination of Plant Pathogenic Fungi and Nematodes. Microscopic examination of Bacteria, Preparation of Culture Media and Sterilization, Isolation and Purification Techniques for Fungi and Bacteria, Virus Purification and Extraction of Nematodes, Methods of Inoculation and Proving Koch's Postulates, Study of Fungal Spore Liberation, Measurement of Size and Shape of Pathogens by Micrometry. Field Visit for the diagnosis of Plant diseases and collection of specimens.

**Suggested Readings:**

- 1) Agrios, G. N., 2006, Plant Pathology, Fourth Edition, Academic press, New York, 996pp.
- 2) Mehrotra, R.S and Ashok Agarwal, 2003, Plant Pathology, Tata McGraw- Hill publishing Company ltd., New Delhi,
- 3) Singh, R. S., 2002, Introduction to Principles of Plant Pathology, Fourth Edition, Oxford and IBH , Publishers Co. Pvt. Ltd., New Delhi,
- 4) Tripathi, D.P 2014 , Introductory Plant Pathology, Kalyani publishers, 380 pp .

## **Course Title : Diseases of Field & Horticultural Crops & their Management 3 (2+1)**

### **Objectives:**

1. To study the etiology, pathogens, pathogenesis, symptoms, disease cycle, epidemiology for disease development and management techniques of major diseases of field and horticultural crops:

### **Theory:**

Symptoms, etiology, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops:

**Field crops-** Rice (Blast, Brown Spot, Sheath Blight, False smut, Bacterial Leaf Blight, Bacterial Leaf Streak, Tungro, Khaira); Wheat (Rusts, Loose smut, Karnal Bunt); Maize (Banded Leaf and Sheath Blight, Curvularia leaf spot, Post-flowering Stalk Rot, Maydis Leaf Blight, Downy mildew); Sorghum (Smuts, Grain mold, Anthracnose); Bajra (Downy mildew, Ergot) and Finger millet (Blast, Leaf Spot); Groundnut (Early and Late leaf spots, Rust, Collar Rot); Soybean (Rhizoctonia blight, Bacterial Spot, Seedling rot, Mosaic); Grams (Ascochyta blight, Wilt, Grey mold); Pea (Downy Mildew, Powdery Mildew, Rust); Black gram and Green gram (Web blight, Cercospora Leaf Spot, Anthracnose, Yellow Mosaic); Sugarcane (Red rot, Smut, Grassy Shoot, Ratoon Stunting, Pokkah Boeng); Mustard (Alternaria blight, White Rust, Downy Mildew, Sclerotinia Stem Rot) and Sunflower (Sclerotinia Stem Rot, Alternaria blight); Cotton (Anthracnose, Vascular wilts, Black Arm). Horticultural crops: Citrus (Canker, Gummosis) and Guava (Wilt, Anthracnose); Banana (Sigatoka, Panama wilt, Bacterial wilt, Bunchy top); Papaya (Foot rot, Leaf Curl, Mosaic) and Pomegranate (Bacterial blight); Apple (Scab, Powdery Mildew, Fire Blight, Crown Gall) and Peach (Leaf Curl); Grapevine (Downy mildew, Powdery mildew, Anthracnose) and Strawberry (Leaf Spot); Coconut (Bud rot, Ganoderma Wilt), Tea (Blister blight) and Coffee (Rust); Mango (Anthracnose, Malformation, Bacterial blight, Powdery mildew); Potato (Early and Late blight, Black scurf, Leaf roll, Mosaic) and Tomato (Damping off, Wilt, Early and Late blight, Leaf curl, Mosaic); Brinjal (Phomopsis blight and fruit rot, Sclerotinia blight) and Chilli (Anthracnose and Fruit rot, Wilt, Leaf Curl); Cucurbits (Powdery and Downy mildew, Wilts) and Cruciferous vegetables (Alternaria leaf spot, Black rot, Cauliflower mosaic); Beans (Anthracnose, Bacterial blight) and Okra (Yellow vein mosaic); Ginger (Soft rot), Turmeric (Leaf Spot) and Coriander (Stem gall); Rose (Dieback, Powdery mildew, Black Leaf Spot) and Marigold (Botrytis blight, Leaf spots).

### **Practical:**

To study the symptoms of different diseases of field and horticultural crops: Blast and Brown spot of rice, Sheath blight and Bacterial leaf blight of rice, Downy mildew and Powdery of Cucurbits, Rhizoctonia and Cercospora leaf spot of Green gram / Black gram, Alternaria blight, White rust and Downy mildew of Mustard, Early blight of Late blight of Potato and Tomato, Phomopsis blight of Brinjal, Powdery mildew and rust of Pea, Stem Gall of Coriander, Anthracnose and Fruit rot of Chilli, Taphrina leaf spot of Turmeric, Red rot of Sugarcane. Acquaintance with fungicides, Antibiotics and Biopesticides and their use in management of diseases of horticultural crops. Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems, Collection and preservation of plant diseased specimens for herbarium. Students should submit 50 pressed and well mounted specimens

### **Suggested readings:**

1. Plant Diseases (By: R.S. Singh)
2. Plant Disease Management: Principles and Practices (By: Hriday Chaube)
3. Integrated Plant Disease Management (By: R.C. Sharma)
4. Plant Pathology (By: G.N. Agrios, 2010)

## **Course Title : Agricultural Microbiology and Bio -remediation 2(1+1)**

### **Objectives:**

1. To get an introduction to microbiology with specific focus on its significance in agriculture science
2. To get acquainted with the bacterial structure and the function of the different bacterial components
3. To get highlights on different fields of microbiology
4. To get highlights on the Bioremediation of polluted soils using microbial mediators and phytoremediation
5. To get a concept of biological control and the role of biopesticides in plant disease management

### **Theory:**

Introduction to Microbiology: Definition, applied areas of Microbiology and Importance of Microbiology. History of Microbiology: Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction Genetic Engineering: Plasmids, episomes, and genetically modified organisms Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning. Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test. Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management. Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome-residents and their roles. Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability. Bioremediation of polluted soils using microbial mediators. Phytoremediation of polluted soils

### **Practical:**

Study of the microscope, Acquaintance with laboratory material and equipments, Microscopic observation of different groups of microorganisms: moulds (Fungi), Direct staining of bacteria by crystal violet, Negative or indirect staining of bacteria by nigrosine, Gram staining of bacteria, Study of phyllosphere and rhizosphere microflora, Measurement of microorganisms, Preparation of culture media, Isolation and purification of rhizospheric microbes, Isolation and purification of N-fixers, Isolation and purification of Nutrient solubilizers, Isolation and purification of Endophytes.

### **Suggested readings:**

1. Pelczar, M.J., Chan, E.C.S. & Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Rangaswami, G. & Bagyaraj, D. J. (2005) Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mukherjee, N. & Ghosh, T. (2004). Agricultural Microbiology. Kalyani Publishers, Calcutta
4. Dubey, H.C. (2007). A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi – 10014
5. Salyers, A. A., & Whitt, D. D. (2001). Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.
6. Prescott, L. M. (2002). Microbiology 5th Edition. McGraw-Hill Inc., US

# Department of Agricultural Economics

Agricultural Economics 9 (6+3)	
Principles of Agricultural Economics and Farm Management	2 (2+0)
Entrepreneurship Development and Business Communication	3 (2+1)
Agricultural Marketing and Trade	2 (1+1)
Agricultural Finance & Cooperation	2 (1+1)

**Course Title: Entrepreneurship Development and Business Communication**  
3 (2+1).

## Objective:

- To provide student an insight into the concept and scope of entrepreneurship.
- To expose the student to various aspects of establishment and management of a small business unit.
- To enable the student to develop financially viable agribusiness proposal.

## Theory:

Development of entrepreneurship. motivational factors, social factors, environmental factors, characteristics of entrepreneurs. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs. Importance of entrepreneurial development and process of entrepreneurship development. Infrastructure and support systems good policies, schemes for entrepreneurship development, role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product/services, selection of form of ownership, registration selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project. Project report redepot Enterprise Management. Production management product, product mix, quality control, cost of production, production controls, Material management. Production management: raw material costing inventory control. Personal management: manpower planning, labour turn over, wages/salaries. Financial management/accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short term planning, book keeping, ledger, subsidiary books, annual financial statement, Marketing management : market, types market strategies. Crisis management – raw material, production, leadership, market, finance, natural etc. **Practical:**

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agric – entrepreneurs.

Visit to financial institutions and support agencies Preparation of project proposal for fun

## Suggested Readings:

- Charanmath P. M., 2009. Entrepreneurship Development and Small Business enterprises. Parnum Pabincatrons, New Delhi
- Desai V. 2015. Entrepreneurship Development and Management. Himalaya Publishing House



- Gupta CB. 2001 Management Theory and Practice. Sultan Chand & Son
- Indu Grover 2008 Handbook on Empowerment and Entrepreneurship Agrotech Public Academy
- Khanka 55: 1999. Entrepreneurial Development S. Chanal & Co.
- Mehra F. 2016 Business Communication for Managers. Pearson Inilit. New Delhi
- Pandey M. and Tewari D., 2010, The Agribusiness Book IBDC Publishers, Lucknow
- Singh D. 1995 Stfictive Managerial Leadership Deep & Deep Publ
- Singhal R.K. 2013. Entrepreneurship Developnunt & Management, Katson Books
- Tripathi PC & Redly PN. 1991 Principles of Management. Tata McGraw Hill
- Vasant Desat, 1997 Small Scale Industries and finer entrepreneurship. Himalaya Publ. House

**Course Title : Principles of Agricultural Economics and Farm Management  
2(2+0).**

**Objective:**

- To aware the students about broad areas covered under agricultural Economics and Farm Management
- To impart knowledge on judicious use of resources for optimum production

**Theory**

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macro economics, positive and normative analysis. Nature of economic theory;. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Demand: meaning, law of demand, demand schedule and demand curve determinants, utility theory; law of diminishing marginal utility, equi marginal utility principle. Consumer's equilibrium and demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process. creation of utility, factors of production, 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 v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Distribution theory: Concepts of rent, wage, interest and profit. 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. Money: meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies. Introduction to GST. Meaning and definition of farms, meaning and concept of farm management objective and relationship with other sciences, its type of characteristics of factor determining type and size of farms. Concept of production function and its type.

**Suggested readings:**

- S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd
- .Johl, S.S and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers
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## **Course Title : Agricultural Marketing and Trade 3 (2+1).**

### **Objectives:**

- To understand the fundamentals of agricultural marketing and trade.
- To analyze the factors influencing supply and demand in agricultural markets.
- To explore different marketing channels and strategies in agriculture.
- To examine the role of government policies and regulations in agricultural markets.

### **Theory**

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets. nature and determinants of demand and supply of farm products, producer's surplus - meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities. market promotion advertising, personal selling, sales promotion and publicity - meaning, merits and demerits; marketing process and functions: market function meaning & classification, exchange functions- buying and selling: physical functions - Storage, transport and processing; facilitating functions- packaging, branding, grading, quality control and labelling (Agmark) Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing: meaning and definition of marketing channel; marketing channels for different farm products: market Integration, Meaning, definition and types of market integration; marketing efficiency: marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs. Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI — their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; Introduction of WTO; Agreement on Agriculture (AoA) and IPR. Role of APMC and its relevance in the present day context.

### **Practical**

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions —NAFED, SWC, e-NAM, cooperative marketing society, etc. to study their organization and functioning. Application of principles of comparative advantage of international trade.

### **Suggested Readings:**

- Acharya. S.S. and Agarwal, N.L., 2024, Agricultural Marketing in India, Oxford and IBH Publishing. Co. Pvt. Ltd., New Delhi.
- Chinna,S.S., 2005, Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
- Dominic Salvatore, Micro Economic Theory
- Kohls Richard. L. and UhlJoseph, N., 2002, Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
- Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall

- Lekhi, R. K. and Jogindr Singh, 2006, Agricultural Economics. Kalyani Publishers, Delhi.
  - Memoria. C.B., Joshi, R.L. and Mulla, N.I., 2003, Principles and Practice of Marketing in India. Kitab Mahal, New Delhi.
  - Pandey Mukesh and Tewari, Deepali, 2004, Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
- Sharma, R., 2005, Export Management, Laxmi Narain Agarwal, Agra.

## **Course Title : Agricultural Finance & Cooperation 2 (1+1)**

### **Objectives:**

- To impart knowledge on issues related to lending to priority sector credit management and financial risk management.

### **Theory:**

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 3 R's, 5 C's & 7P's of credit. Sources of agricultural finance: institutional and noninstitutional sources, Commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, . An introduction to higher financing institutions — RBI, NABARD, ADB, MF, world bank. Preparation and analysis of financial statements. Balance Sheet and Income Statement. Agricultural Cooperation - Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, LAMPS, farming cooperatives. cooperative warehousing; role of NAFED. Crop insurance: its scope, significance and limitations and the potential of the newly launched “Pradhan Mantri Fasal BimaYojana” (Prime Minister's Crop Insurance Scheme). Successful story of cooperative systems in India with example.

### **Practical**

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 and cooperative society to acquire firsthand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business — A case study. Preparation and analysis of balance sheet — A case study Preparation and analysis of income statement — A case study. Appraisal of a loan proposal — A case study. Preparation of Bankable projects for various agricultural products and its value added products. Different types of repayment

### **Suggested readings:**

- Gittinger JP 1982. Economic Analysis of Agricultural Projects. The Johns I lopkins Univ. Press.
- Reddy S. S and Ram P.R 1996. Agricultural Finance and Management. Oxford & IBM

**Course Title: Agri-Business Management 4 (3+1)**

**Objectives:**

- To impart knowledge on understanding the concepts processes, significance, and role of management and organizational behaviour.

**Theory**

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries. Institutional arrangement , procedures to set up agro based industries. Constraints in establishing agro-based industries, Agri-valuc chain: Understanding primary and support activities and their linkages. Business environment : PEST & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives. Strategies, polices procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behavior analysis, Product Life Cycle(PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

**Practical**

Study of agri —input markets: Seed, fertilizers pesticides. Study of output markets: grains, fruits. vegetables, flowers. Study of product market, retails trade commodity trading , and value added products. Study of financing institutions- Cooperative Commercial Bank, RRBs, Agribusiness Finance Limited, NABARD. Preparations of projects and Feasibility reports for agribusiness entrepreneur. Appraisal /evaluation techniques of identifying viable project- Non discounting techniques. Case study of agro- based industries, Trend and growth rate of price of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

**Suggested readings:**

- Broadway, A.C. and Broadway Arif 2002 A textbook of Agri-Business Management. Kalyani Publishers
- Bairwa, S-L 2016. Objective on fundamentals of Agri-business Management. KalyaniPublishers
- Anjan Nishra, Debasish Biswas and Anmangshu Giri, 20 1 9. Agribusiness Management Himalaya Publishing House, 220p.
- Shoji Lal Bairwa, Chandra Sen. L.K.Meena and Mcera Kumari, 2018. Agribusiness Management Theory And Practices:, Write And Print Publications
- Virender Kamalvanshi , Agribusiness Management:, Random.

## Extension Education 8 (5+3)

Rural Sociology and Educational Psychology	2 (2+0)
Fundamentals of Extension Education	2 (1+1)
Communication skills	2 (1+1)
Personality development	2 (1+1)

**Course Title : EXT-111 : Communication Skills 2 (1+1)**

### Objectives:

To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication

### Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/miscommunication. Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precise writing/Abstracting/Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions. Public speaking, note taking, field diary, references ,foot notes and indexing. Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals , phrases. Writing effective sentences; Basic sentence faults;

### Practical

Listening and note taking; Writing skills: precise writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

### Suggested readings

1. Allport, G W, 1937, Personality: A Psychological Interpretation. Holt,New York.
2. Brown Michele &GylesBrandreth, 1994, How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale, 1997, The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter S J, 2012, Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi
5. Kumar S and PushpaLata, 2011, Communication Skills. Oxford University Press.
6. Neuliep James W, 2003, Intercultural Communication A Contextual Approach. Houghton Mifflin Co Boston.
7. Pease, Allan, 1998, Body Language. Sudha Publications, Delhi.
8. Raman M and Singh P, 2000, Business Communication. Oxford University Press.
9. Seely J, 2013, Oxford Guide to Effective Writing and Speaking. Oxford University Press.
10. Thomson A J and Martinet A V, 1977, A Practical English Grammar. Oxford University

**Course Title : EXT-112: Rural Sociology and Educational Psychology 2(2+0)**

**Objective:**

Provide knowledge on concept and importance of sociology and rural sociology as well as the relationship with Extension Education

**Theory**

Extension Education and Agricultural Extension – Meaning, Definition, Scope, and Importance. Sociology and rural sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension, and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies. Social Groups- Meaning, Definition, Classification, Factors considered information and organization of groups, Motivation in group formation and Role of social groups in Agricultural Extension. Social Stratification- Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification- Characteristics and- Differences between Class & Caste System. Cultural concepts- Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in agricultural Extension. Social Institutions Meaning, Definition, Major institutions in Rural Society, Functions, and their Role in agricultural Extension. Social Organizations- Meaning, Definition, Types of organizations and role of social organizations in agricultural Extension. Social Control- Meaning, Definition, need of social control and Means of Social Control. Social change- Meaning, Definition, Nature of Social Change, Dimensions of social change and factors of social change. Leadership- Meaning, Definition, Classification, Roles of leader, Different methods of Selection of Professional and Lay leaders. Training of Leaders Meaning, Definition, Methods of training, Advantages and Limitations in use of local leaders in Agricultural Extension, Psychology and Educational Psychology Meaning, Definition, Scope, and Importance of Educational Psychology in Agricultural Extension. Teaching- Learning process- Meaning and Definition of Teaching, Learning, learning experience and Learning situation, Elements of learning situation and its characteristics. Principles of learning and their implication of teaching.

**Suggested readings**

1. J.B. Chitambar -Introductory Rural Sociology
2. Ray, G. L. -Extension Communication and Management
3. Dahama O. P. and Bhatnagar, O. P. - Education and Communication for Development
4. Sandhu A. S. -Textbook on Agricultural Communication
5. A. R. Desai -Rural Sociology in India
6. R Velusamy Textbook on Rural Sociology and Educational Psychology
7. M.B. Ghorpade- Essential of psychology
8. Web Materials
9. Prepared You Tube videos



**Course Title : EXT-121 : Personality Development      Credits Hours : 2 (1+1)**

**Objectives:**

To make students realize their potential strengths, cultivate their inter-personal skills and improve employability.

**Theory:**

Personality Definition, Nature of personality, theories of personality and its types, factors influencing the personality and role of personality in Agricultural Extension. . The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behaviour and factors influencing individual behaviour, Models of individual behaviour, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behaviour, Learning and training, learning feedback. Attitude and values, Intelligence- meaning, definition, types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behaviour, emotional intelligence and importance of intelligence in Agricultural Extension. Motivation- theories and principles, Teamwork and group dynamics.

**Practical**

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behavior.

**Suggested reading**

1. Andrews, Sudhir, 1988, How to Succeed at Interviews. 21st (rep.) New Delhi.Tata McGraw-Hill.
2. Heller, Robert, 2002, Effective Leadership. Essential Manager series. Dk Publishing.
3. Hindle, Tim, 2003, Reducing Stress. Essential Manager series. Dk Publishing.
4. Lucas, Stephen, 2001, Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
5. Mile, D.J, 2004, Power of Positive Thinking. Delhi. Rohan Book Company.
6. Pravesh Kumar, 2005, All about Self- Motivation. New Delhi. Goodwill Publishing House.
7. Smith, B, 2004, Body Language. Delhi: Rohan Book Company.
8. Shaffer, D. R.,2009, Social and Personality Development (6th Edition). Belmont, CA: Wadsworth

# Department of Horticulture

**Course Title: Horticulture Nursery Management 2(0+2) (under Skill Enhancement Course)**

**Theory: NIL**

**Practical:**

1. Identification of propagation material, media, equipment and tools for nursery.
2. Planning, layout and management of nurseries of progeny orchards.
3. Nursery techniques for fruits, vegetables and ornamental crops.
4. Raising of seedlings by advanced nursery technology.
5. Seed dormancy, seed treatment (Scarification, stratification, fungicide and PGRs).
6. Raising of rootstocks.
7. Procurement of bud wood and certification.
8. Propagation by cuttings in horticulture crops.
9. Propagation by budding in horticulture crops.
10. Propagation by grafting and inarching in horticulture crops.
11. Propagation by layering in horticulture crops.
12. Use of plant growth regulators in propagation.
13. Potting, repotting or lifting of saplings (packaging).
14. Use of propagation media, soil less media and pro tray method of seedling preparation.
15. Visit of commercial nurseries and marketing trends.
16. Project preparation and nursery regulation certification.
17. Procurement of inputs.
18. Care of nursery plants and management of insect, pest and diseases.
19. Visit to commercial orchard.
20. Introduction to micro propagation and exposure to tissue culture Lab.
21. Benefit cost calculation for commercial nurseries.

**Suggested Readings:**

1. Bose, T.K., Mitra, S.K. and Sandhu, M.K. (1986). Propagation of tropical & subtropical horticultural crops. Naya Prakash, Calcutta.
2. Hartman, HT and Kester, DE (1986). Plant propagation principles and practices. Prentice Hall of India, Pvt. Ltd. Bombay.
3. Gill, SS, Bal. JS and Sadhu, AS (1985). Raising Fruit Nursery, Kalyani Publications. New Delhi.
4. Bhardwaj, RL and DK Sarolia (2021) Modern Nursery Management. Agrobios (India). Jodhpur.

## **Course Title: FUNDAMENTALS OF HORTICULTURE 3(2+1)**

### **Objectives:**

- To provide knowledge on different branches of horticulture viz. pomology, olericulture, floriculture and landscaping, spices and medicinal plants
- To provide knowledge on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops
- To provide knowledge on different physiological aspects of horticultural crops

### **Theory:**

- Horticulture-its different branches, importance & scope, Horticulture & botanical classification, soil and climate for horticultural crops, plant propagation- methods and propagation structures, seed dormancy and seed germination, principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation, unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization and parthenocarpy, medicinal and aromatic plants, importance of bio-regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops

### **Practical:**

- Identification and nomenclature of fruits, vegetables and flowers. Layout of an orchard, pit making and system of planting, Nursery raising techniques of vegetables and flowers. Propagation through seeds and plant parts, Training and pruning methods on fruit crops, Preparation of fertilizer mixture and application, Preparation and application of PGR, Layout of different irrigation systems, Maturity studies, harvesting, grading, packaging and storage

### **Suggested readings:**

1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N. Kumar
3. Handbook of Horticulture by K.L. Chadda

## **Department: Animal Production**

<b>S.No.</b>	<b>Course Title</b>	<b>Semester</b>	<b>Cr. Hrs</b>	<b>Remarks</b>
1	Livestock and Poultry Management	II	2 (1+1)	Annexure I
2	Skill Enhancement Course I (Poultry Production Management)	III	2 (0+2)	Annexure II
3	Skill Enhancement Course II (Goat Production Management)	IV	2 (0+2)	Annexure III
4	Elective Course (Cattle and Goat Production Management)	VII	4 (3+1)	Annexure IV
	<b>Total Credit hours</b>		<b>10 (4+6)</b>	

### **Course Title: Livestock and Poultry Management 2(1+1)**

#### **Objectives:**

1. Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and Agriculture Integrated farming System

#### **Theory:**

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry. Digestion in livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

#### **Practical:**

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

#### **Suggested readings:**

1. A Textbook of Animal Husbandry by G. C Banerjee
2. A text Book of Livestock Production management in Tropic by D. N. Verma

## **Skill Enhancement Course I**

### **Course Title: Poultry Production Management 2( 0+2)**

#### **Objectives:**

1. Provide basic knowledge to the students about scientific poultry production and impart hands on training to enhance skill in Poultry Production Management

#### **Practical**

Introduction and scope of Poultry Production, Identification of poultry breeds. Incubation and hatching of eggs, Preparation of pens for brooding of chicks, Identification of feed and preparation of ration, Debeaking, Feeding and watering of birds, collection and storage of eggs, Judging and culling of poultry birds, biosecurity measures and vaccination of birds, Record keeping on farm, Economics of poultry farming, formulation of proposals for commercial poultry production.

## **Skill Enhancement Course II**

### **Course Title: Goat Production Management 2 (0+2)**

#### **Objectives:**

1. Provide basic knowledge to the students about scientific goat production and impart hands on training to enhance skill in Goat Production Management

#### **Practical**

Scope of goat production, identification of Indian goat breeds with special reference to Rajasthan. General principles of housing and housing management different categories of goat. Grazing and supplementary feeding, identification of feed and fodder, preparation of feed, feeds and feeding of goat, identification of animals, deworming and castration, milking of goats, common diseases and their prevention, record keeping on farm, economics of goat farming, formulation of project proposal for commercial goat farming.

## **Elective Course**

### **Title: Cattle and Goat Production Management 4 (3+1)**

#### **Objective**

1. To impart knowledge and skill in the cattle and goat production and management to the students for entrepreneurship development

#### **Theory**

Importance of cattle and goat production with particular reference to Rajasthan, Trends in Population and production dynamics of cattle and goat in India and contribution in national economy. Different production systems of cattle and goat in India. Important Indian and exotic breeds of cattle and goat, Breeding of dairy cattle and goat- concept and application, Reproductive management of cattle and goat. Feed resources of Rajasthan, nutrient requirements and Feeding management of cattle and goat, general principles of housing, Housing management of different categories of cattle and goat, Management of newly borne calf, young males, females, pregnant, lactating cattle and goat and breeding bulls and bucks. Important aspects of health care, measures of prevention and control of diseases in cattle and goat. Important diseases of cattle and goat and their control.

#### **Practical**

Identification of breeds of cattle and goat, detection of heat, Artificial Insemination and Pregnancy Diagnosis, methods of identification of cattle and goat, Identification of feed and fodder Feed formulation and preparation of feed Chaffing, grinding and preparation of feed, processing and conservation of fodder. Grazing and supplementary feeding. Deworming and castration. Methods of milking and clean milk production, feeding of cattle and goat at different ages, Important diseases and their prevention, Record keeping on farm, Economics of dairy and goat farm. Formulation of project proposal for commercial cattle and goat farming.

## Department: Entomology

S. No.	Code	Course Title	Credit load
<b>2<sup>nd</sup> Semester (1<sup>st</sup> year)</b>			
1.	ENTO-121	Fundamental of Entomology	3 (2+1)
<b>3<sup>rd</sup> semester (2<sup>nd</sup> year)</b>			
2.		Skill Enhancement course ; Production of bioagents	2 (0+2)
<b>V<sup>th</sup> semester (3<sup>rd</sup> Year)</b>			
3.	ENTO-311	Pest management in crop sand stored grains	3 (2+1)
<b>7<sup>th</sup> semester (4<sup>th</sup> year)</b>			
4.		Elective course Agro-chemicals	4 (3+1)

**Course Title : Fundamentals of Entomology**

**Credits Hours :3 (2+1)**

**Objectives:**

1. To know the history of entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class insecta and their importance for classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects
4. To study the characteristics of commonly observed insect orders and their economically important families

**Theory**

History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. 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. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs.

**Insect Ecology:** Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests. Concept of IPM, Practices, scope and limitations of IPM.

Classification of insecticides, toxicity of insecticides and formulations of insecticides.

**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, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, , Blattidae; Odonata; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; 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**

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

**Suggested readings:**

- 1) Imm's General Text book of Entomology— O.W. Rechar and R.G. Davies
- 2) Introduction to the study of Insects –D. J. Borror and DeLong's
- 3) Fundamentals of Ecology - Eugene.P. Odum & Gray W. Barrett
- 4) Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora



**Course Title : Pest management in crops and stored grains Credits Hours : 3(2+1)**

**Objectives:** Diagnosis and management of major insect and non- insect pests of crops in field and storage

**Theory**

General description on nature and type of damage by different arthropod pests; Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of various field crops, vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments. Structural entomology and important household pests, their nature of damage and management.

Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management. Storage structures and methods of grain storage and fundamental principles of stored grains management.

**Practical**

Field visit, identification of major insect pests and their damage symptoms. Collection and preservation of major insect pests; collection of damage samples, their identification and herbarium preparation. Methods of monitoring of pest incidence in situ. Management strategies of insect pests of different crops. Study on structural entomology and household pests. Storage structures and methods of grain storage. Spraying techniques for selected field and horticultural crops. Vertebrate pest management.

**Suggested Readings:**

- 1.. Pest Management: Methods, Applications and Challenges, Tarique Hassan Askary, Agriculture, Agriculture Issues and policies, Books, Nova, Pest Control, Science and Technology, 2022.
2. Essentials of Pest Management: Key Information on Pest Identification and its Management, 2022. Prakash Rambhat Thalya and Ravi Chandra
3. A Textbook of Insect Pest and Disease Management, 2021. Somnath Sen, and Mohd. Sameer, S. Kataria & Sons publish.
4. Agricultural Pests of India and South east Asia, A.S. Athwal, Kalyani Publish.
5. A Textbook of Applied Entomology, K.P. Srivastava and G.S. Dhaliwal, Kalyani Publish.

## **Elective course**

**Course Title : Agrochemicals**

**Credits Hours : 4(3+1)**

**Objectives:** To impart knowledge on different classes of agrochemicals

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

Herbicides -Major classes, properties and important herbicides. Fate of herbicides.

Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper, Mode of action- Bordeaux mixture and copper oxychloride.

Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

Introduction and classification and 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. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.

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

### **Suggested readings:**

1. Buchel KH (Ed.) 1992. Chemistry of pesticides. John Wiley & Sons
2. Panda H. 2022. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details  
2nd Revised Edition. NPCS
3. Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
4. Singh, A., 2022 Basics of Agrochemical Formulations:, Brillion Publishing, 176p.
5. Larramendy, M.L 2017 Toxicity and Hazard of Agrochemicals:, INTECH, 170p.

## **Skill enhancement course**

**Course Title : Production Technology of Bioagents Credits Hours : 2(0+2)**

### **Objectives:**

1. To enable students to acquire expertise and skills to produce biocontrol agents.
2. To know the importance of different biocontrol agents.
3. To make the students know about various techniques involved in bioagents production
4. To get knowledge on predators and parasitoids and their application in insect pest management.

### **Practical**

Introduction & acquaintance with bioagents; Preparation of host insects; a collection of different bioagents from the field; Identification and study of mass multiplication techniques of different bioagents; Production technology of egg parasitoids, *Trichogramma chilonis*; *T. pretiosum*; *Telenomus remus*; Production technology of Larval parasitoid; Predators, Green lacewing, Lady bird beetles; packaging of Bio-control agents; Cost-benefit ratio for different biocontrol agents production; constraints in mass production of biocontrol agents;

### **Suggested readings:**

Mass Production of Insect Predators By [BerinPathrose](#), [Mani Chellappan](#), [M.T. Ranjith](#)

## Department of Soil Science and Agricultural Chemistry

S. No	Course Title	Credit Hours	Total credit hours
1	SSAC 111. Fundamentals of Soil Science	3 (2+1)	<b>14 (8+6)</b>
2	Skill Enhancement course-III SEC 121. Bio-fertilizer Production Technology	2 (0+2)	
3	SSAC 121. Soil Fertility Management	3 (2+1)	
4	SSAC 221. Problematic Soils and their Management	2 (1+1)	
5	SSAC 311. Agrochemicals (Elective Course)	4(3+1)	

**Course No.: SSAC 111.**

**Course Title: Fundamentals to Soil Science**

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

**Objective:** To impart knowledge on soil genesis, basic soil properties with respect to plant growth

**Theory:** Soil- Pedological and edaphological concepts. Rocks and minerals, weathering, soil formation, soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India, Soil colloids, CEC, Base saturation.

**Practical:** Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks-igneous, sedimentary and metamorphic rocks; study of a soil profile, collection and processing of soil for analysis, study of soil texture-feel method, mechanical analysis, determination of bulk density, particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of soil moisture, determination of soil moisture constants, field capacity; water holding capacity, Study of infiltration rate of soil

**Suggested readings:**

1. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers, New Delhi.
2. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers, New Delhi.
3. Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils – By Harry O. Buckman and Nyle C.

**Course No.:** SEC 121. Skill Enhancement course-III

**Course Title:** Bio-fertilizer Production Technology

**Credit Hours:** 2(0+2)

**Objective:** To provide a comprehensive knowledge of Bio-fertilizer Production Technology for skill enhancement

**Practical:**

Biofertilizers- Definition, Benefits of biofertilizers, classification of biofertilizers, Precautions for use of biofertilizers.

Isolation of efficient N- fixing Rhizobium strains from nodules of leguminous plants: collection of effective nodules from legumes, surface sterilization techniques, crushing of nodules and their plating.

Preparation of media, Purification of the isolates.

Isolation of efficient phosphate solubilizing bacteria from rhizosphere soil: Preparation of media, collection of rhizosphere soils, serial dilution technique and their plating.

Purification of the isolates.

Mass production of Rhizobium, Azotobacter and PSB microbial inoculants: Media preparation, inoculation, Fermentation, mixing with carrier materials, packing and product development.

Quality control and ISI standards of different biofertilizers.

Evaluation of shelf life of the inoculants

Different biofertilizer application methods: seed, soil and seedling dip methods.

**Suggested readings:**

Soil Microbiology – By N.S. Subba Rao, OXFPRD & IBH Publishing Co. Pvt.Ltd., New Delhi

Production Technology for Bioagents and Biofertilizers: A Laboratory Manual – Compiled by Dr. A.N. Yadav

Biofertilizer Manual - By FNCA Biofertilizer Project Group Forum for Nuclear Cooperation in Asia (FNCA).

**Course No.: SSAC 121**

**Course Title: Soil Fertility Management**

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

**Objective:** To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management

**Theory:**

Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches. Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of macro and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/IPNS.

**Practical:**

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

**Suggested readings:**

1. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
2. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers
3. Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils – By Harry O. Buckman and Nyle C.

**Course No.: SSAC 221.**

**Course Title: Problematic Soils and their Management Credit Hours: 2 (1 + 1)**

**Objectives:**

1. To acquaint the students about various problem soils like degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils. Also to impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification.
2. To give hands on training about estimation of various soil and water quality parameters associated with problem soils

**Theory:**

Soil quality and health, Distribution of Waste land and problem soils in India with special reference to Rajasthan. Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Management of Riverine soils, Waterlogged soils, Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Irrigation water – quality and standards, utilization of saline water in agriculture. Use of Remote sensing and GIS in diagnosis and management of problem soils. Irrigation and water quality. Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

**Practical:**

Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO<sub>3</sub>, HCO<sub>3</sub>, Cl, SAR and RSC), Determination of nitrate (NO<sub>3</sub><sup>-</sup>) in irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

**Suggested readings:**

1. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices. AGROBIOS (India).
2. Osman, Khan Towhid, 2018, Management of Soil Problems. Springer publication
3. Indian Society of Soil Science, 2002. Fundamentals of Soil Science. IARI, New Delhi.
4. Brady Nyle C and Ray R Well, 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
5. Cirsan J. Paul, 1985, Principles of Remote Sensing. Longman, New York
6. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, New Delhi

**Course No.: SSAC 311.**

**Elective course 3**

**Course Title: Agrochemicals**

**Credit Hours: 4(3+1)**

**Objectives:** To impart knowledge on different classes of agrochemicals

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

Herbicides -Major classes, properties and important herbicides. Fate of herbicides.

Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper, Mode of action- Bordeaux mixture and copper oxychloride.

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

Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

Introduction and classification and insecticides: inorganic and organic insecticides organochlorine,

Ogranophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, fate of insecticides in soil & plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.

Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow-release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of 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 logistic 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  $P_2O_5$  and citrate soluble  $P_2O_5$  in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content

**Suggested readings:**

2. Buchel KH (Ed.) 1992. Chemistry of pesticides. John Wiley & Sons

3. Panda H. 2022. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details

2nd Revised Edition. NPCS



4. Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
2. Singh, A., 2022 Basics of Agrochemical Formulations, Brillion Publishing, 176p.
3. Larramendy, M.L 2017. Toxicity and Hazard of Agrochemicals, INTECH, 170p.

**Course No.: SSAC 111.**

**Course Title: Fundamentals to Soil Science**

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

**Objective:** To impart knowledge on soil genesis, basic soil properties with respect to plant growth

**Theory:** Soil- Pedological and edaphological concepts. Rocks and minerals, weathering, soil formation, soil profile, soil texture, soil structure, Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India, Soil colloids, CEC, Base saturation.

**Practical:** Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks-igneous, sedimentary and metamorphic rocks; study of a soil profile, collection and processing of soil for analysis, study of soil texture-feel method, mechanical analysis, determination of bulk density, particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of soil moisture, determination of soil moisture constants, field capacity; water holding capacity, Study of infiltration rate of soil

**Suggested readings:**

1. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
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3. Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils – By Harry O. Buckman and Nyle C.

**Course No.:** SEC 121. Skill Enhancement course-III

**Course Title:** Bio-fertilizer Production Technology

**Credit Hours:** 2(0+2)

**Objective:** To provide a comprehensive knowledge of Bio-fertilizer Production Technology for skill enhancement

**Practical:**

Biofertilizers- Definition, Benefits of biofertilizers, classification of biofertilizers, Precautions for use of biofertilizers.

Isolation of efficient N- fixing Rhizobium strains from nodules of leguminous plants: collection of effective nodules from legumes, surface sterilization techniques, crushing of nodules and their plating.

Preparation of media, Purification of the isolates.

Isolation of efficient phosphate solubilizing bacteria from rhizosphere soil: Preparation of media, collection of rhizosphere soils, serial dilution technique.

Purification of the isolates and their plating.

Mass production of Rhizobium, Azotobacter and PSB microbial inoculants: Media preparation, inoculation, Fermentation, mixing with carrier materials, packing and product development.

Quality control and ISI standards of different biofertilizers.

Evaluation of shelf life of the inoculants

Different biofertilizer application methods: seed, soil and seedling dip methods.

**Suggested readings:**

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Production Technology for Bioagents and Biofertilizers: A Laboratory Manual – Compiled by Dr. A.N. Yadav

Biofertilizer Manual - By FNCA Biofertilizer Project Group Forum for Nuclear Cooperation in Asia (FNCA).

**Course No.: SSAC 121**

**Course Title: Soil Fertility Management**

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

**Objective:** To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management

**Theory:**

Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches. Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of macro and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/IPNS.

**Practical:**

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

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4. The nature and Properties of Soils – By Harry O. Buckman and Nyle C.

**Course No.: SSAC 221.**

**Course Title: Problematic Soils and their Management Credit Hours: 2 (1 + 1)**

**Objectives:**

1. To acquaint the students about various problem soils like degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils. Also to impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification.
2. To give hands on training about estimation of various soil and water quality parameters associated with problem soils

**Theory:**

Soil quality and health, Distribution of Waste land and problem soils in India with special reference to Rajasthan. Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Management of Riverine soils, Waterlogged soils, Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Irrigation water – quality and standards, utilization of saline water in agriculture. Use of Remote sensing and GIS in diagnosis and management of problem soils, Irrigation and water quality. Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

**Practical:**

Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO<sub>3</sub>, HCO<sub>3</sub>, Cl, SAR and RSC), Determination of nitrate (NO<sub>3</sub><sup>-</sup>) in irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

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5. Cirsan J. Paul, 1985, Principles of Remote Sensing. Longman, New York
6. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, New Delhi

**Course No.: SSAC 311.**

**Elective course 3**

**Course Title: Agrochemicals**

**Credit Hours: 4(3+1)**

**Objectives:** To impart knowledge on different classes of agrochemicals

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

Herbicides -Major classes, properties and important herbicides. Fate of herbicides.

Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper, Mode of action- Bordeaux mixture and copper oxychloride.

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

Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

Introduction and classification and insecticides: inorganic and organic insecticides organochlorine,

Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, fate of insecticides in soil & plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.

Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow-release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of 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 logistic 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  $P_2O_5$  and citrate soluble  $P_2O_5$  in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content

**Suggested readings:**

2. Buchel KH (Ed.) 1992. Chemistry of pesticides. John Wiley & Sons
3. Panda H. 2022. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details  
2nd Revised Edition. NPCS
4. Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
2. Singh, A., 2022 Basics of Agrochemical Formulations, Brillion Publishing, 176p.
3. Larramendy, M.L 2017. Toxicity and Hazard of Agrochemicals, INTECH, 170p.

UG COURSES		GENETICS & PLANT BREEDING	2024-25
S.No.	Course No.	Title	Cr. Hr.
<b>First Year B.Sc.(Ag.) II Semester</b>			
1	GPB	Seed Production and Testing Technology (SEC Course)	2 (0+2)
<b>Second Year B.Sc. (Ag.) I Semester</b>			
1	GPB	Principles of Genetics	3(2+1)
<b>Second Year B.Sc. (Ag.) II Semester</b>			
1	GPB	Basics of Plant Breeding	3(2+1)
<b>Third Year B.Sc. (Ag.) I Semester</b>			
1	GPB	Crop Improvement – I	2 (1+1)
<b>Third Year B.Sc. (Ag.) II Semester</b>			
1	GPB	Crop Improvement – II	2(1+1)
2	GPB	Fundamentals of Seed Science & Technology	2(1+1)
<b>Fourth Year B.Sc. (Ag.) I Semester</b>			
1	GPB	Commercial Plant Breeding (Elective Course)	4 (3+1)

SEC: 121

- **GPB ----- Seed Production and testing Technology 2(0+2)**
- **Objectives:**
- To acquaint the students about seed production, seed certification and seed testing technologies in self and cross pollinated crops
- **Contents:**
- Classes of seed and their general principles of production. Techniques of seed production in major cereals (wheat, paddy, maize, sorghum and pearl millet), pulses (blackgram, greengram, chickpea, pigeonpea, lentil), oilseeds (soybean, rapeseed and mustard, groundnut), vegetables (okra, tomato), fibres (cotton) and forages (berseem, forage sorghum). Maintenance of A, B & R lines for hybrid seed production in self- and cross-pollinated crops. Organic seed production technology. Concept of rouging in seed production plot. Seed certification, phases of certification, procedure for seed certification, field inspection. Germplasm maintenance and evaluation. Determination of seed quality parameters; genetic purity (Grow Out Test, molecular and chemical testing), physical purity, moisture content, seed viability (Tetrazolium test), germination percentage. Seed grading, processing, treatment, packing, storage and marketing. Visit to seed growers/seed production fields of university farm, hi-tech nursery, etc. Visit to public/ private seed processing plants. Visit of seed testing laboratory.
- **Suggested Readings:**
- Agarwal, R.L. 2008. Seed Technology. Oxford and IBH Publishing Co., Pvt Ltd New Delhi.
- Agarwal, P.K. 1999. Seed Technology. ICAR, New Delhi.
- Bhojwani, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publ.
- Black, M., Bewley, D. and Halmer, P. 2006. The Encyclopedia of Seeds: Science, Technology and Uses. CABI.
- Chhabra, A.K. 2006. Practical Manual of Floral Biology of Crop Plants. Deptt. of Plant Breeding, CCS HAU, Hisar.
- Copeland, L.O. and McDonald, M.B. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
- Khare, D. and Bhale M.S. 2011. Seed Technology. Published by Scientific Publishers, New Delhi.
- Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers
-



**Course Title** : **Principles of Genetics**

**Credits Hours** : 3 (2+1)

**Objective:** To make the students acquainted with both principles and practices in the areas of classical genetics, modern genetics, quantitative genetics and cytogenetics.

**Theory**

Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis. Probability and Chi-square. Dominance relationships, Epistatic interactions with example.

Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanism, chromosome mapping, Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics, Mutation, classification, Methods of inducing mutations and CIB technique, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance, Genetic disorders, Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

**Practical**

Study of microscope, Study of cell structure, Mitosis and Meiosis cell division, Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and chi-square test, Determination of linkage and cross-over analysis (through two point test cross and three point test cross data), Study on sex linked inheritance in *Drosophila*. Study on models on DNA and RNA structures.

**Suggested readings:**

1. Fundamentals of Genetics: B. D. Singh
2. Principles of Genetics: Gardner, Simmons and Snustad.
3. Genetics: M. W. Strickberger.
4. Principles of Genetics: Sinnott, Dunn and Dobzhansky

**Course Title** : **Basics of Plant Breeding**  
**Credits Hours** : **3(2+1)**

**Objectives:** To acquaint with different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques for breeding new varieties which are higher yielding, resistant to biotic and abiotic stresses for ensuring food security.

**Theory:**

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

**Practical:**

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

**Suggested readings:**

1. Principles of Plant Breeding (1st & 2nd Edition) by RW Allard,
2. Plant Breeding: Principles & Practices by JR Sharma,
3. Plant Breeding- B.D. Singh
4. Principles and Procedures of Plant Breeding - Biotechnical and Conventional Approaches by GS Chahal and SS Gosal
5. Principles of Plant Genetics and Breeding by George Acquaah

**Course Title : Crop Improvement - I**

**Credits Hours : 2(1+1)**

- Specific Objectives:**
1. To provide knowledge about Self-pollinated and cross pollinated Kharif crops
  2. To learn about origin and distribution of Kharif crops
  3. To design breeding objectives of major kharif crops
  4. To impart information on different crop varieties for Kharif season

**Theory:**

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. 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); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl Millet and Pigeo pea etc. Ideotype concept, climate resilient crop varieties for future.

**Practical:**

Floral biology, emasculation and hybridization techniques in different crop species viz. Rice, Jute, Maize, Sorghum, Pearl millet, Ragi, Pigeo pea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Castor, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

**Course Title : Crop Improvement - II**

**Credits Hours : 2(1+1)**

- Objectives:** i) To provide knowledge about Self-pollinated and crosspollinated Rabi crops  
ii) To learn about origin and distribution of Rabi crops  
iii) To design breeding objectives of major rabi crops  
iv) To impart information on different crop varieties for Rabiseason

**Theory:**

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. 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); Hybrid seed production technology in Wheat, Oat, Chickpea, Rapeseed & Mustard etc. Ideotype concept, climate resilient crop varieties for future.

**Practical:**

Floral biology, emasculation and hybridization techniques in different crop species viz. Wheat, Oat, Rapeseed & Mustard, Pulses, Potato, Sugarcane, Tomato, Chilli, Onion etc. Study of field techniques for seed production and hybrid seed production in rabi crops; Estimation of heterosis, inbreeding depression and heritability;; Study of quality characters, donor parents for different characters in tomato; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

**Course Title** : **Fundamentals of Seed Science & Technology**  
**Credits Hours** : **2(1 + 1)**

- s: i) To impart basic and fundamental knowledge on principles and practices seed science and technology  
ii) To impart practical skills on scientific seed production and post harvest quality management .

**Theory:** Introduction to seed technology, definition and importance. Seed quality -definition, characters of good quality seed, Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed. Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures, post harvest seed quality management, seed processing procedures, seed drying Seed treatment, its importance, method of application and seed packing ;seed storage - general principles, stages and factors affecting seed longevity during storage, Seed health management during storage. Seed Certification and legislation, Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing

**Practical:** Seed Structure, Seed sampling, Physical purity, Moisture determination, Germination test, Seed and seedling vigour test, Seed Viability, Genetic purity test: Grow out test , Field inspection, seed health testing using blotter and agar plate method. Visit to seed production farms, seed testing laboratories and seed processing plant.

#### **Suggested Readings**

1. Agarwal, R.L (1995). Seed Technology (2<sup>nd</sup> edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India
2. Khare, D., Bhale, M.S. (2019). Seed Technology (2<sup>nd</sup> revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India
3. Vanangamudi, K. (2014). Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India
4. Bhojwani SS & Bhatnagar SP. 1999. The Embryology of Angiosperm. Vikas Publ
5. McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall.

## **Commercial Plant Breeding**

**3 (2+1)**

### **Objectives**

- i) To discuss about hybrid development and various crop improvement aspects of field crops viz., rice, wheat, maize, pearl millet, sorghum, pigeonpea, chickpea, green-gram, black gram, lentil, soybean, groundnut, rapeseed-mustard, cotton etc.
- ii) To provide understanding on tissue culture and biotechnological approaches as alternative strategies for development of line and cultivars.
- iii) To impart knowledge on seed production, release and notification of varieties and PPV&FR Act, 2001.

### **Theory**

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 test of commercial hybrids. Advances in 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. Alternative strategies for the development of the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools, IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FRA Act, Variety testing, release and notification systems in India, Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.

### **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 and private seed production and processing plants.