B.Sc. (HONS.) AGRICULTURE
PROGRAMME SYLLABUS
(EMBEDDED WITH COs)
SCHOOL OF AGRICULTURE,
ITM UNIVERSITY, GWALIOR, MADHYA PRADESH
474001

SCHEME OF THE PROGRAMME

Academic Programme Semester-wise distribution of courses Agriculture (Scheme)			
First year			
I Semester			
S. No	**Course Code**	**Course Title**	**Credit Hours**
1	AFC-111	Deeksharambh (Induction cum Foundation course)	1 week (NG) Non-gradial
2	SEC-I	Biofertilizer and biopesticide production*	2(0+2)
3	SEC-II	Mushroom production technology*	2(0+2)
4	EXT-112	Communication Skills	2(1+1)
5	AGRON-112	Farming-based livelihood systems	3(2+1)
6	EXT-111	Rural Sociology and Educational Psychology	2 (2+0)
7	AGRON-111	Fundamentals of Agronomy	3(2+1)
8	SS-111	Fundamentals of Soil Science	3(2+1)
9	HORTI-111	Fundamentals of Horticulture	3(2+1)
10a	NSS-1	National Service Scheme	1(0+1)
10b	NCC-1	National Cadet Corps	1(0+1)
11	STAT-111	Introductory mathematics (need-based)	1(1+0) Non gradial
II Semester			
1	SEC-III	Seed Production Technology*	2(0+2)
2	SEC-IV	Post-harvest processing technology*	2(0+2)
3	EXT-121	Personality Development	2(1+1)
4	AGM-121	Environmental Studies and Disaster Management	3(2+1)
5	SS-121	Soil Fertility Management	3(2+1)
6	ENT-121	Fundamentals of Entomology	3(2+1)
7	AH-121	Livestock and Poultry Management	2(1+1)
8	PP-121	Fundamentals of Plant Pathology	3(2+1)
9a	NSS-II	National Service Scheme	1(0+1)
9b	NCC-II	National Cadet Corps	1(0+1)
Second year			
III Semester			
1	SEC-V	Beneficial insect farming*	2(0+2)
2	AE-211	Entrepreneurship Development and Business Communication	3 (2+1)
3	PE-211	Physical Education, First Aid, Yoga Practices and Meditation	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	HORTI-211	Production Technology of Fruit and Plantation Crops	2 (1+1)
7	EXT-211	Fundamentals of Extension Education	2(1+1)
8	NEM-211	Fundamentals of Nematology	2(1+1)
9	AGRON-212	Principles and Practices of Natural Farming	2(1+1)

IV Semester			
1	SEC-VI	Horticulture nursery management*	2(0+2)
2	AS-221	Agricultural Informatics and Artificial Intelligence	3(2+1)
3	HORTI-221	Production Technology of Vegetables and Spices	2(1+1)
4	AE-221	Principles of Agricultural Economics and Farm Management	2(2+0)
5	AGRON-221	Crop Production Technology-II (Rabi Crops)	3(1+2)
6	AENG-221	Farm Machinery and Power	2 (1+1)
7	AGRON-222	Water Management	2 (1+1)
8	SS-221	Problematic Soils and their management	2(1+1)
9	GPB-221	Basics of Plant Breeding	3(2+1)
Third year			
V Semester			
1	AE-311	Agricultural Marketing and Trade	3 (2+1)
2	AGM-311	Introduction to Agro-meteorology	2(1+1)
3	CP-311	Fundamentals of Crop Physiology	3(2+1)
4	ENT-311	Pest Management in Crops and Stored Grains	3 (2+1)
5	PP-311	Diseases of Field & Horticultural Crops & their Management	3(2+1)
6	GPB-311	Crop Improvement (kharif crops) - I	2 (1+1)
7	AGRON-311	Weed Management	2(1+1)
8	HORTI-311	Ornamental Crops, MAPs and Landscaping	2 (1+1)
9	AGRON-312	Introductory Agroforestry	2 (1+1)
VI Semester			
1	ABT-321	Fundamentals of Agri Biotechnology	3(2+1)
2	AS-321	Basic and Applied Agril Statistics	3(2+1)
3	GPB-321	Crop Improvement (Rabi crops) - II	2(1+1)
4	AENG-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	PP-321	Agricultural Microbiology and Phyto-remediation	2(1+1)
7	AE-321	Agricultural Finance & Cooperation	2(1+1)
8	BIOCHEM-321	Essentials of Plant Biochemistry	3(2+1)
9	GPB-322	Fundamentals of Seed Science & Technology	2(1+1)
Fourth year			
VII Semester			
5 Elective Courses (major or minor) each of 4 (3+1) credits for B.Sc. (Hons) Agriculture degree			
1	AE-411	Agri-Business Management	4 (3+1)
2	AGRON-411	Management of natural resources	4 (3+1)
3	ENT-411	Agrochemicals	4 (3+1)
4	AEXT-411	Agricultural Journalism	4 (3+1)
5	HORT-411	Landscaping	4 (3+1)
6	GPB-411	Commercial Plant Breeding	4 (3+1)
7	FST-411	Food safety and standards	4 (3+1)

8	ENT-412	Bioformulation and Nano formulation	4 (3+1)
9	PP-411	Biopesticides and Biofertilizers	4 (3+1)
10	AGRON-412	System Simulation and Agro Advisory	4 (3+1)
11	HORT-412	Hi-tech Horticulture	4 (3+1)
12	HORT-413	Protected cultivation	4 (3+1)
13	AGM-411	Climate Resilient Agriculture	4 (3+1)
14	GPB-412	Biotechnology of Crop Improvement	4 (3+1)
15	AENG-411	Geoinformatics and Remote Sensing, precision farming	4 (3+1)
16	GPB-413	Micro-propagation Technologies	4 (3+1)
17	SST-411	Commercial Seed Production	4 (3+1)
18	AGRON-413	Principles and Practices of Organic Farming/ Conservation Agriculture	4 (3+1)
19	FSN-411	Food Science and Nutrition	4 (3+1)
20	PHT-411	Post-Harvest Technology and Value Addition	4 (3+1)
VIII Semester			
For B.Sc. (Hons)Agriculture Degree Student READY: RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship			**20**
Total			**167**
***Online courses**			**10**
Grand Total			**167+10=177**
*** From the bouquet of Skill Enhancement Course (SEC) modules**			

Department/section wise course breakup

S. No	Course title	Credit Hours	Total
Agronomy			
1	Fundamentals of Agronomy	3 (2+1)	22 (11+11)
2	Farming based livelihood systems	3 (2+1)	
3	Crop Production Technology-I (Kharif Crops)	3 (1+2)	
4	Crop Production Technology-II (Rabi Crops)	3(1+2)	
5	Water Management	2 (1+1)	
6	Weed Management	2 (1+1)	
7	Introductory Agro forestry	2 (1+1)	
8	Dryland agriculture/ Rainfed agriculture and watershed management	2 (1+1)	
9	Principles and Practices of Natural Farming	2 (1+1)	
Soil Science			
1	Fundamentals of Soil Science	3 (2+1)	8(5+3)
2	Soil Fertility Management	3 (2+1)	
3	Problematic Soils and their management	2 (1+1)	
Horticulture			
1	Fundamentals of Horticulture	3 (2+1)	9 (5+4)
2	Production Technology of Fruit and Plantation Crops	2 (1+1)	
3	Production Technology of Vegetables and Spices	2 (1+1)	
4	Ornamental Crops, MAPs, and Landscaping	2 (1+1)	
Genetics and Plant Breeding			
1	Principles of Genetics	3 (2+1)	12 (7+5)
2	Basics of Plant Breeding	3 (2+1)	
3	Crop Improvement (Kharif crops) - I	2 (1+1)	
4	Crop Improvement (Rabi crops)- II	2 (1+1)	
5	Fundamentals of Seed Science and Technology	2 (1+1)	
Entomology			
1	Fundamentals of Entomology	3 (2+1)	6 (4+2)
2	Pest management in Crops and Stored Grains	3 (2+1)	
Plant Pathology			
1	Fundamentals of Plant Pathology	3 (2+1)	8 (5+3)
2	Diseases of Field & Horticultural Crops & their Management	3 (2+1)	
3	Agricultural Microbiology and Phyto-remediation	2 (1+1)	
Extension Education			
1	Rural Sociology and Educational Psychology	2 (2+0)	8 (5+3)
2	Fundamentals of Extension Education	2 (1+1)	
3	Communication skills	2 (1+1)	
4	Personality development	2 (1+1)	

Agricultural Meteorology			
1	Environmental Studies and Disaster mgt.	3 (2+1)	5 (3+2)
2	Introduction to Agro-meteorology	2 (1+1)	
Agricultural Economics			
1	Principles of Agricultural Economics and Farm Management	2 (2+0)	9 (6+3)
2	Entrepreneurship Development and Business Communication	3 (2+1)	
3	Agricultural Marketing and Trade	2 (1+1)	
4	Agricultural Finance & Cooperation	2 (1+1)	
Agricultural Statistics			
1	Agricultural Informatics and Artificial Intelligence	3 (2+1)	6 (4+2)
2	Basic and Applied Agril Statistics	3 (2+1)	
3	Introductory Mathematics	1 (1+0) Non gradial	
Agricultural Engineering			
1	Farm Machinery and Power	2 (1+1)	4 (2+2)
2	Renewable energy in Agriculture and Allied Sector	2 (1+1)	
Nematology			
1	Fundamentals of Nematology	2 (1+1)	2 (1+1)
Biochemistry			
1	Essentials of Plant Biochemistry	3 (2+1)	3 (2+1)
Crop Physiology			
1	Fundamentals of Crop Physiology	3 (2+1)	3 (2+1)
Animal Husbandry			
1	Livestock and poultry Management	2 (1+1)	2 (1+1)
Agricultural Bio-technology			
1	Fundamentals of Agri Biotechnology	3 (2+1)	3 (2+1)
Students' Welfare			
1	NCC/NSS	(0+1)	(0+1)
2	NCC/NSS	(0+1)	(0+1)
3	Physical Education, First Aid and Yoga Practices	2 (0+2)	2 (0+2)
4	Study Tour	2 (0+2)	2 (0+2) Non gradial
***Elective Courses (Indicative)**			
1	Agri-Business Management	4 (3+1)	20*(15+5) 5* Elective Courses
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)**			
1	SEC-I	2 (0+2)	12 (0+12)
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)	
*Host institution may add more courses into this list			
** SEC will be decided by host institution depending on strength			

Summary of Credit Distributions		
	Type of courses Credits	**Credits**
1	Core courses (Major & Minor/s)	**112**
2	Common courses (MDC+VAC+AEC)	**23**
3	Skill Enhancement Courses (SEC)	**12**
4	Internship/ Student READY	**20**
5	**MOOCS/SWAYAM	**10 non-gradial**
Total		**167+10****

COURSE SYLLABUS

WITH

EMBEDDED

COURSE OUTCOMES (COs)

Course Code: AFC-111		Course Name: Deeksharambh (Induction-cum-Foundation Course)		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**01**	**0**	**0**	**B.Sc. (Hons.) Agriculture**
Curriculum level	Integration and Orientation		**Student-specific course outcome**	Adaptation and Integration

Course Objectives:

1. Help for cultural integration of students from different backgrounds.
2. Know about the operational framework of academic process in the University/College/Institute.
3. Instilling life and social skills.
4. Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
5. Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.
6. Identify strength and weakness of the students in different core areas of the discipline. The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:
   i. Discussions on operational framework of academic process in the University, as well as interactions with academic and research managers of the University.
   ii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences.
   iii. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences.
   iv. Activities to enhance cultural Integration of students from different backgrounds.
   v. Field visits to related fields/ establishments.
   vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.

Course Code: SEC-I		Course Name: Biofertilizer and biopesticides production		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**00**	**02**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To understand the principles and methods of producing bio-agents and bio-fertilizers.
2. To learn techniques for mass production and formulation of beneficial microorganisms.
3. To explore the role of bio-agents and bio-fertilizers in sustainable agriculture and soil health management.
4. To develop skills to integrate bio-agents and bio-fertilizers into crop production systems for enhanced yield and reduced environmental impact.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Identify and classify various types of biofertilizers and biopesticides, along with their role in sustainable agriculture.
CO-2	Demonstrate skills in the mass production of biofertilizers and biopesticides using microbial cultures and carrier materials.
CO-3	Perform quality control procedures as per standard guidelines (FCO 1985, amended 2009) for biofertilizers and microbial pesticides.
CO-4	Assess the antagonistic properties and field efficacy of fungal and bacterial biocontrol agents using in vitro and *In vivo* methods.
CO-5	Develop and apply eco-friendly pest and disease management tools.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Skill demonstration (Lab Performance)
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Introduction to lab safety, sterilization and aseptic techniques 2. Preparation of media (Nutrient agar, PDA, YEMA, King's B, Jensen's etc.) 3. Serial dilution and pour plate techniques 4. Gram staining and endospore staining of bacteria 5. Observation of colony morphology on solid media 6. Isolation of Rhizobium from root nodules 7. Isolation of Trichoderma from rhizospheric soil (TSM medium) 8. Isolation of Pseudomonas fluorescens using King's B medium 9. Isolation of Azospirillum using Dobereiner's medium 10. Isolation of Azotobacter using Jensen's medium 11. Isolation of phosphate-solubilizing bacteria using Pikovskaya's medium 12. Isolation of Bacillus subtilis from soil 13. Isolation of Metarhizium anisopliae from soil 14. Isolation of Beauveria bassiana using selective DOC2 medium 15. Isolation of cyanobacteria from water/soil using BG11 medium 16. Mass production of Trichoderma viride and its formulation 17. Mass production of Pseudomonas fluorescens and its formulation 18. Mass production of Rhizobium using YEMA and carrier material 19. Mass multiplication of Azospirillum using broth and talc-based method 20. Mass production of Azotobacter using broth and talc formulation 21. Seed treatment with Trichoderma, Pseudomonas, and Rhizobium biofertilizers 22. Root dip method of Azospirillum and Rhizobium for seedlings 23. Soil application method of Trichoderma and Pseudomonas 24. Foliar spray method using Pseudomonas fluorescens 25. Mixing with FYM/compost for application in fields 26. Observation of AM (arbuscular mycorrhizal) fungi in roots (KOH +	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

cotton blue staining) 27. Isolation of AM fungi by wet sieving and sucrose gradient method 28. Field visit to observe biofertilizer labs and entomopathogenic biocontrol in field condition	
Assignment	1. Classification of Biofertilizers *(Nitrogen fixers, Phosphate solubilizers, Potassium solubilizers, etc.)* 2. Mass Production Techniques of Carrier-Based and Liquid Biofertilizers 3. List of Important Biocontrol Agents Used in Plant Disease and Pest Management
Suggested reading	• Atlas Bartha. Microbial Ecology - Fundamentals and Application. Pearson (Fourth edn). • Bhoopander Giri, Ram Prasad *et al.* Biofertilizers for Sustainable Agriculture and Environment (Soil Biology Book 55). • Bikas R. Pati and Santi M. Mandal. Recent Trends in Biofertilizers. • Eiri Board. Handbook of Biofertilizers and Vermiculture. 1 January 2009. • Himadri Panda. Complete Technology Book on Biofertilizer and Organic Farming. • J. Nicklin, K. Graeme-Cook, T. Paget and R. Killington. Instant Notes in Microbiology. Viva. • M K Rai. Handbook of Microbial Biofertilizers. • Mark S. Coyne. Soil Microbiology - An Exploratory Approach. Delmar Publishers-2004. • Michael Madigan, John Martinko, David Stahl and David Clark. Brock-Biology of Microorganisms. Pearson (Thirteen Edition). • Koul O, Dhaliwal GS and Khokhar S. Biopesticides in Sustainable Agriculture Progress and Potential. Hardcover – 1 January 2014. • Veeresh GK, Shivashankar K and Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bengaluru. • WHO. 1990. Public Health Impact of Pesticides Used in Agriculture.WHO. • Woolmer PL and Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF and Wiley.
Suggested resources (Websites/eBooks)	1. https://agrimoon.com/wp-content/uploads/Insect-Ecology-Integrated-Pest-Management.pdf 2. https://niphm.gov.in/Recruitments/ASO-Pathology.pdf

Course Code: SEC- II		Course Name: Mushroom Production Technology		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
2 (0+2)	**0**	**02**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To introduce students to the current status and future scope of mushroom cultivation in India.
2. To impart knowledge on the nutritional, medicinal, and economic significance of edible mushrooms.
3. To train students in laboratory and field techniques of mushroom tissue culture, spawn preparation, and substrate management.
4. To develop practical skills in cultivating important edible mushrooms (e.g., button, oyster, shiitake, milky, and paddy straw mushrooms).
5. To provide insights into marketing strategies, disease management, value addition, and commercial farm management practices.

Course outcomes: After completion of the course, the student will be able to:

CO-1	**Understand** the scope and potential of mushroom cultivation as an agribusiness opportunity in India.
CO-2	**Identify** the major edible mushroom species and their unique features, nutritional and medicinal values.
CO-3	**Demonstrate** laboratory skills in media preparation, tissue culture, spawn preparation, and culture maintenance.
CO-4	**Apply** practical knowledge in composting, casing, and crop management for successful mushroom cultivation.
CO-5	**Evaluate** the economics, disease management, marketing strategies, and value addition to develop a sustainable mushroom enterprise.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Skill demonstration (Lab Performance)
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1: Introduction and Scope** • Current status and scope of mushroom cultivation in India and Punjab • Important features of edible fungi • Nutritional and medicinal value of mushrooms	Assignments Practical exam
	Unit 2: Mushroom Culture Techniques • Preparation of media • Tissue culture preparation • Sub-culturing for culture maintenance and preservation • Spawn preparation techniques • Collection of wild mushroom flora of Punjab	Assignments Practical exam
	Unit 3: Cultivation Techniques for Button Mushroom • Raw material formulations for Agaricus bisporus (button mushroom) • Composting (long method and short method) • Casing preparation • Crop management practices • Mushroom farm design and infrastructure for commercial units.	Assignments Practical exam

	Unit 4: Cultivation Techniques of Other Mushrooms
	• Cultivation techniques of:
	  ○ *Pleurotus florida* (dhingri)
	  ○ *Lentinus edodes* (shiitake)
	  ○ *Calocybe indica* (milky)
	  ○ *Volvariella volvacea* (paddy straw)
	• Marketing of mushrooms
	• Mushroom diseases and their control
		Assignments
		Practical exam

	Unit 5: Value Addition, Economics, and Exposure • Preparation of value-added mushroom products • Economics of mushroom cultivation • Exposure visit to commercial farms.	Assignments Practical exam

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study of current status and scope of mushroom cultivation in India and Punjab 2. Important features of edible fungi 3. Nutritional and medicinal value of mushrooms 4. Preparation of media (PDA and MEA) 5. Tissue culture preparation of mushroom 6. Sub-culturing for culture maintenance 7. Spawn preparation – commercial spawn 8. Field collection of wild mushroom flora of Punjab 9. Identification of collected wild mushrooms 10. Raw material formulation for *Agaricus bisporus* (button mushroom) 11. Composting: long method – preparation of compost 12. Composting: long method – monitoring compost 13. Composting: short method – preparation of compost 14.Composting: short method – pasteurization phase 15. Casing soil preparation for button mushroom 16. Casing application and maintenance 17. Crop management practices for button mushroom	Activity-Based Learning Practical Exam Viva-Voce Examination Assignments

18. Mushroom farm design and layout planning 19. Infrastructure required for a commercial mushroom unit 20. Cultivation of *Pleurotus florida* (dhingri) – substrate preparation 21. Cultivation of *Pleurotus florida* – spawning and cropping 22. Cultivation of *Lentinus edodes* (shiitake) – sawdust log preparation 23. Cultivation of *Calocybe indica* (milky mushroom) 24. Cultivation of *Volvariella volvacea* (paddy straw mushroom) 25. Identification and management of mushroom diseases 26. Preparation of value-added mushroom products 27. Economic analysis of mushroom cultivation 28. Exposure visit to commercial mushroom farms	

Assignment	As part of their continuous evaluation system, students are required to submit one assignment **Assignment 1:** Prepare a detailed report on the current status, challenges, and future scope of mushroom cultivation in India and Punjab. **Assignment 2:** Describe the nutritional and medicinal values of mushrooms, and how they contribute to human health and diet. **Assignment 3:** Write a step-by-step procedure for spawn preparation, including mother spawn and commercial spawn, and highlight its importance in mushroom cultivation. **Assignment 4:** Develop a farm layout plan for a commercial mushroom cultivation unit, including infrastructure and equipment needed for optimal production. **Assignment 5:**

	Conduct a comparative study on the cultivation techniques of different mushrooms (button, oyster, shiitake, milky, paddy straw) and suggest which is most suitable for local conditions in Punjab
Suggested reading	1. **"Handbook of Mushroom Cultivation, Processing and Packaging"** Author: **S.C. Tripathi** Publisher: **NIPA** Focus: Practical techniques, value addition, and marketing. 2. **"Mushroom Cultivation"** Author: **B. Singh** Publisher: **Agrotech Publishing Academy** Focus: Detailed cultivation practices of different mushrooms. 3.**"The Biology and Cultivation of Edible Mushrooms"** Authors: **S.T. Chang & W.A. Hayes** Publisher: **Academic Press** Focus: In-depth biology and cultivation of edible mushrooms. 4. **"Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact"** Authors: **P.C. Chang, J.A. Buswell, & S.T. Chang** Publisher: **CRC Press** Focus: Nutritional and medicinal values, plus environmental impact. 5. **"Mushroom Cultivation Technology"** Author: **Dr. R.C. Upadhyay** Publisher: **Directorate of Mushroom Research** Focus: Indian context of mushroom cultivation with modern methods.
Suggested resources (Websites/eBooks)	**E-References** FAO Mushroom Cultivation Guide **FAO Document on Mushroom Cultivation** **National Horticulture Board (NHB)** NHB Resource on Mushroom Cultivation **Directorate of Mushroom Research (DMR), Solan** DMR Official Portal **Krishi Vigyan Kendra (KVK) Mushroom Cultivation Resources** Check your local KVK website for region-specific mushroom cultivation practices and e-resources. **KrishiShiksha Portal by ICAR** eKrishiShiksha - Mushroom Production

Course Code: EXT-111		Course Name: Rural Sociology and Educational Psychology		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**02**	**00**	**02**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives: Provide knowledge on concept and importance of sociology and rural sociology as well as the relationship with extension education.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Explain the fundamental concepts of Extension Education and Rural Sociology.
CO-2	Identify and differentiate various forms of social stratification.
CO-3	Demonstrate understanding of traditions, social values, and attitudes.
CO-4	Describe the nature, types, and functions of social organizations
CO-5	Apply psychological principles and educational psychology.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Case Studies 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report

AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Group discussion
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** 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 and 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification- characteristics and-differences between class and caste system. Cultural concepts: culture, customs, folkways, mores, taboos, rituals.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 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.	End-Term Exam Assignments

	Unit-4 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.	End-Term Exam Assignments
	Unit-5 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. Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension. Personality: Meaning, definition, types, factors influencing the personality and role of personality 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.	End-Term Exam Assignments
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Indian Rural Society: important characteristics, differences and relationship between rural and urban societies. b) Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension.	
Suggested reading	1. **Van den Ban, A.W. and Hawkins, H.S.** 1998. Agricultural Extension. CBS Publishers & Distributors, New Delhi. 2. **Gisbert, Pascal.** 2004. Fundamentals of Sociology. Orient Longman, New Delhi. 3. **Dahama, O.P. and Bhatnagar, O.P.** 2005. Education and Communication for Development. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 4. **Reddy, A.A.** 2019. Extension Education. Sree Lakshmi Press, Bapatla. 5. **Chauhan, S.S.** 2001. Advanced Educational Psychology. Vikas Publishing House Pvt. Ltd., New Delhi.	
Suggested resources (Websites/eBooks)	1. https://www.manage.gov.in 2. https://icar.org.in 3. https://ncert.nic.in/ebooks.html 4. https://ncert.nic.in/textbook.php	

Course Code: EXT-112		Course Name: Communication Skills		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives: To acquire competence in oral, written and non-verbal communication, to develop strong personal and professional communication and to demonstrate positive group communication.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Define communication, clearly briefing listening and speaking skills.
CO-2	Explain importance of oral and written communication in day-to-day working.
CO-3	Utilise the skills effectively to know targeted audience and conveying message accordingly.
CO-4	Analyses different types of communication and to emphasize on essential aspects of effective written and spoken communication necessary for professional success.
CO-5	Develop inter personal skills and problem-solving.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Case Studies 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz

AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Group discussion
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit-1** Communication Process, The Magic of Effective Communication, Self-Esteem and Overcoming Fears; Concept, Nature and Significance of Communication Process; Meaning, Types and Models of Communication. Meaning of communication & Types, Models of Communication.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Verbal and Non-verbal Communication, Linguistic and Non-linguistic Barriers to Communication, Lin and Reasons behind Communication Gap/ Miscommunication, Communication Skills: Listening, Speaking, Reading and Writing Skills.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Precise Writing/Abstracting/Summarizing, Style of Technical Communication Innovative Methods.	End-Term Exam Assignments
	Unit-4 Structural and Functional Grammar: Sentence Structure, Modifiers, Connecting Words and Verbal's.Phrases and Clauses, Case: Subjective Case, Possessive Case; Objective Case.	End-Term Exam Assignments
	Unit-5 Correct Usage of Nouns, Pronouns and Antecedents, Adjectives Adverbs and Articles, Agreement of Verb with the Subject:Tense Mood , Voice, Writing Effective Sentences; Basic Sentence Faults	End-Term Exam Assignments
List of Practical (Field/Lab Exercise)		**Assessment Tool**
1. Listening and Note Taking 2. Writing Skills: Precis Writing, Summarizing and Abstracting 3. Reading and Comprehension (Written and Oral) of General and Technical Articles		Activity-Based Learning Practical Exam Viva-Voce

4. Micro-presentations and Impromptu Presentations 5. Feedback on Presentations 6. Stage Manners: Grooming, Body Language, Voice Modulation, Speed 7. Group Discussions 8. Public Speaking Exercises 9. Vocabulary Building Exercises 10. Organization of Events	Examination Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment **1.** Prepare a flowchart illustrating the communication process with real-life examples. **2.** Write a 10-line paragraph using at least five different parts of speech and highlight each.
Suggested reading	1. Allport,G.W.1937.Personality:A Psychological Interpretation. Holt, New York. 2. Brown Michele and Gyles Brandreth. 1994. How to Interview and be Interviewed. Sheldon Press, London. 3. CarnegieDale.1997.TheQuickandEasyWaytoEffective 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 Pushpa Lata. 2011. Communication Skills. Oxford University
Suggested resources (Websites/eBooks)	1. https://www.manage.gov.in 2. https://icar.org.in 3. https://open.umn.edu/opentextbooks/textbooks/business-communication-for-success

Course Code: AGRON - 111		Course Name: Fundamental of Agronomy		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

1. To understand the definition, scope, and significance of Agronomy and its relation with other agricultural sciences.
2. To explain basic concepts related to crop production including sowing, tillage, and plant geometry.
3. To study the essential nutrients, nutrient absorption mechanisms, and principles of integrated nutrient management.
4. To examine the role of water and weed management in sustainable agriculture.
5. To analyze different cropping systems and sustainable practices in crop production.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Describe the definition, meaning, and scope of Agronomy, and its relationship with other disciplines.
CO-2	Explain the principles of sowing, tillage, and crop geometry affecting crop performance.
CO-3	Apply knowledge of nutrient requirements, sources, and integrated nutrient management in crops.
CO-4	Evaluate the role of water management and weed control techniques in crop production.
CO-5	Analyze cropping systems, ecological principles, and sustainable agricultural practices.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard/ Whiteboard 4. Power Point Presentations 1. Assignments 2. Flip Class/Seminars 3. Herbarium file

Assessment tools	
AT-1	Mid-term Exams , End-Term Exam and Practical Exam
AT-2	Activity-Based Learning
AT-3	Viva-Voce examination
AT-4	Field Visit Report
AT-5	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** 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.	Mid-term Exams and End-Term Exam / Quiz
	Unit-2 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 tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.	Mid-term Exams and End-Term Exam
	Unit-3 Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption: active and passive absorption, forms of plant nutrients absorbed by plants, combined/uncombined forms. Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; classification and characteristics, method of preparation, role of organic manures in crop production. Nutrient use efficiency.	End-Term Exam/ Quiz

	Unit-4 Integrated Nutrient Management (INM): Meaning, different approaches and advantages. Green manure: Definition, objectives, types, desirable characteristics, advantages and limitations.	End-Term Exam/ Assignments
	Unit-5 Water resources of the world, India and the state. Soil Moisture constants: gravitational, capillary, hygroscopic water. Weeds: Definition, Importance and basics of classification of weeds and their control. Agro-climatic zones of India and the state. Cropping systems: Factors affecting, major patterns and systems in the country. Sustainable crop production: Definition, importance, practices. Natural resource conservation, pollution and pollutants. Allelopathy: Meaning and importance. Growth and development of crops: Definition, meaning and factors affecting growth and development.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Visit to Instructional Crop Farm and Orientation to Field Crops 2. Identification of Major Field Crops Based on Morphological Characteristics 3. Identification of Seeds of Major Field Crops 4. Identification and Study of Common Fertilizers Used in Agriculture 5. Identification of Common Pesticides and Herbicides 6. Study of Crops and Cropping Systems in Different Agro-Climatic Zones of the State 7. Study of Preparatory Tillage Implements and Their Functions 8. Study of Inter-Tillage Implements and Their Applications 9. Practical Demonstration of Ploughing and Puddling Operations 10. Practice of Inter-Cultivation Operations in Standing Field Crops 11. Numerical Exercises on Calculation of Seed Rate and Plant Population 12. Calculation of Fertilizer Requirement Based on Nutrient Needs 13. Study of Yield-Contributing Characters in Major Crops 14. Estimation of Crop Yield Using Sample Plot or Quadrat Method 15. Identification of Common Weeds Found in Different Field Crops 16. Seed Germination and Viability Tests; Practice on Time and Method of Application of Manures and Fertilizers.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Prepare a chart identifying 10 field crops, 5 seeds, 5 fertilizers, and 5 pesticides with their key characteristics. 2. Describe cropping systems and major crops in different agro-climatic zones of your state with a seasonal crop calendar. 3. List and explain five preparatory and inter-tillage implements with diagrams and their functions. 4. Solve numerical problems on seed rate, plant population, and fertilizer requirement using appropriate formulas. 5. Describe the yield estimation method and identify five common weeds with their botanical names and control measures.
Suggested reading	1. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi. 2. Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana. 3. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana. 4. William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York. 5. Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.
Suggested resources (Websites/eBooks)	1. http://agriinfo.in/agronomy/42/

Course Code: AGRON-112		Course Name: Farming-based Livelihood Systems		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Know the status of Agriculture in India as a whole and also state-wise.
CO-2	Study the concepts, indicators, approaches, and framework of ALS (Agricultural Livelihood Systems).
CO-3	Students will study the farming systems approach and the concepts/ components of IFS contributing to the livelihood of farmers.
CO-4	Study the various small, medium, and large agricultural enterprises along with their integration and feasibility for livelihood under different farming systems for various agro-climatic zones.
CO-5	Have first-hand information on commercial farming-based livelihood models by NABARD/ICAR and other organizations, and various schemes/programmes involved in the promotion of farming-based livelihood opportunities.

Teaching Pedagogy	
T1	1. Flipped classes teaching model 2. Collaborative learning 3. Socratic method of teaching. 4. Power Point Presentations.
T2	5. IFS Model demonstration 6. Unannounced test 7. Group discussions or debate 8. Quiz

Assessment tools	
AT-1	Midterm Exams and end term exam
AT-2	Unannounced test
AT-3	Quiz
AT-4	Practical Exam
AT-5	Assignment
AT-6	Viva voce Examination

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit – I** Status of agriculture in India and different states, Income of farmers and rural people in India. Livelihood-Definition, concept, and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches, and framework.	Mid-term Exams and End-Term Exam Assignments
	Unit – II Definition of farming systems and farming-based livelihood systems. Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/farming-based livelihood systems: Crops and cropping systems. Livestock (Dairy, Piggery, Goatry, Poultry, Duckery etc.), Horticultural crops, Agro-forestry systems, Aquaculture Duck/Poultry cum fish, Dairy cum Fish, Piggery cum Fish etc.	Mid-term Exams and End-Term Exam Assignments
	Unit – III Small, medium, and large enterprises, including value chains and secondary enterprises as livelihood components for farmers. Factors affecting the integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones.	End-Term Exam Assignments
	Unit-IV Commercial farming-based livelihood models by NABARD, ICAR, and other organizations across the country. Case studies on different livelihood enterprises associated with farming. Risk and success factors in farming-based livelihood systems.	End-Term Exam Assignments

	Unit-V Schemes and programs by the Central and State Governments, Public and Private organizations involved in the promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in the 21st Century in view of circular economy, green economy, climate change, digitalization, and changing lifestyles.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Survey of farming systems and agriculture-based livelihood enterprises. 2. Study of components of important farming-based livelihood models/ systems in different agro-climatic zones. (N & W). 3. Study of components of important farming-based livelihood models/ systems in different agro-climatic zones. (S & E). 4. Study of the production and profitability of crop-based, livestock-based, processing-based, and integrated farming-based livelihood models. 5. Field visit to innovative farming system models. 6. Visit to Agri-based enterprises and their functional aspects for integration of production, processing, and distribution sectors. 7. Study of Agri-enterprises involved in industry and service sectors (Value Chain Models), 8. Learning about the concept of project formulation on farming-based livelihood systems, along with cost and profit analysis.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Components of farming system b) Components farming-based livelihood systems c) Schemes and programs by the Central and State Governments d) Commercial farming-based livelihood models by NABARD, e) Commercial farming-based livelihood models, by ICAR f) Commercial farming-based livelihood models, by other organizations across the country
Suggested reading	1. 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. 2. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK, Volume 7. 3. Carloni, A. 2001 Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy. 4. 4. Dixon, J., Gulliver, A. and Gibbon, D. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO and World Bank, Rome, Italy and Washington, DC, USA. 5. Evenson, R. E. 2000. Agricultural Productivity and Production in Developing Countries. In FAO, The State of Food and Agriculture, FAO, Rome, Italy. 6. Reddy, S. R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.

	7. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.
Suggested resources (Websites/eBooks)	1. https://www.agrostudy.in/2021/10/fundamentals-of-entomology.html#google_vignette 2. https://www.iaritoppers.com/2019/06/fundamentals-of-entomology-icar-ecourse-pdf-download.html

Course Code: SS-111		Course Name: Fundamentals of Soil Science		Semester: I[st]
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
03	**02**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives: To impart knowledge on soil genesis, basic soil properties with respect to plant growth.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand and explain the pedological and edaphological concepts of soil, including the origin, weathering of rocks and minerals, and pedogenic processes involved in soil formation..
CO-2	Demonstrate knowledge of soil organic matter and its role in soil formation, fertility, and sustainability.
CO-3	Describe the structure and properties of silicate clays, understand the source of charge, and evaluate cation and anion exchange capacity, base saturation, and buffering capacity
CO-4	Differentiate between organic and inorganic soil colloids, and explain their properties and roles in ion exchange mechanisms in soil systems.
CO-5	Assess and interpret soil physical properties such as soil texture, structure, bulk density, particle density, soil consistency, air, temperature, water, and reaction (pH)

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-TermExam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering. Soil formation, Soil organic matter, Pedogenic processes.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity)	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils.	End-Term Exam Assignments
	Unit-4 Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity	End-Term Exam Assignments
	Unit-5 Soil taxonomy, keys to soil orders. Soils of India	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study of general properties of minerals. 2. Study of minerals-silicate and non-silicate minerals. 3. Study of rocks-igneous, sedimentary and metamorphic rocks. 4. Study of a soil profile. 5. Collection and processing of soil for analysis. 6. Study of soil texture-feel method, mechanical analysis. 7. Determination particle density and soil porosity. 8. Determination of soil colour. 9. Study of soil structure and aggregate analysis. 10. Determination of soil moisture. 11. Determination of soil moisture constants. 12. Determination of field capacity & water holding capacity 13. Study of infiltration rate of soil. 14. Determination of pH and Electrical conductivity of soil.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Soil profile and fundamentals process of soil formation. b) Study about different Type of soil
Suggested reading	1. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers 2. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers 3. Soil Fertility and Fertilizers – By Samual 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.
Suggested resources (Websites/eBooks)	1. http://ecoursesonline.iasri.res.in/course/view.php?id=125 2. https://www.nrcs.usda.gov/ 3. ICAR e-Course PDF Link (Agrimoon) 4. https://www.fao.org/soils-portal/

Course Code: HORTI- 111		Course Name: Fundamentals of Horticulture		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Basic and applied		**Student-specific course outcome**	• Higher education

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Define and describe the branches, importance, scope and types of horticulture, and suitable soil and climate for crops.
CO-2	Explain propagation methods, structures, seed dormancy and germination and pros and cons of sexual and asexual propagation.
CO-3	Apply orchard layout principles and perform training and pruning in fruit crops.
CO-4	Analyze factors affecting flowering and fruit set, including pollination, fertilization and parthenocarpy.
CO-5	Assess the role of growth regulators, irrigation and fertilizers in crop productivity.

Teaching Pedagogy	
T1	1. Activity based learning through field visits 2. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Flip Class/ Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term exams and end-term exams
AT-2	Presentation
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Viva voce examination
AT-7	Report writing
AT-8	Field trials
AT-9	Spot Identification

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1** Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops.	Presentation
	Unit 2 Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation, Stock-scion relationship.	Mid Term examination
	Unit 3 Principles of orchard establishment, principles, and methods of training and pruning of fruit crops.	Assignment
	Unit 4 Juvenility and flower bud differentiation, unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization, and parthenocarpy.	ABL Quiz
	Unit 5 Importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.	End term examination

List of Practical (Field/Lab Exercises)	Assessment tools
1. Identification and nomenclature of fruit crops **2.** Layout of an orchard and pit making **3.** Systems of planting in fruit crops **4.** Nursery raising techniques for fruit crops **5.** Study of plant propagation structures **6.** Propagation through seeds **7.** Propagation through vegetative plant parts **8.** Propagation techniques specific to horticultural crops **9.** Preparation of containers, potting mixtures, potting and repotting	Practical Activity Practical Record Viva voce

10. Training methods in fruit crops **11.** Pruning methods in fruit crops **12.** Preparation and application of fertilizer mixtures **13.** Preparation and application of plant growth regulators (PGRs) **14.** Layout of irrigation systems, and study of maturity, harvesting, grading, packaging, and storage.	
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a. Overview of Horticulture: Branches, Importance, and Its Role in Sustainable Agriculture b. Plant Propagation Techniques and Nursery Structures c. Steps in Orchard Establishment and Common Training & Pruning Systems in Fruit Crops d. Factors Affecting Flowering and Fruit Set in Horticultural Crops e. Role of Growth Regulators, Irrigation Methods, and Fertilizer Application in Horticulture
Suggested reading	• Chattopadhyay T K 2013. A Textbook on Pomology Vol I-IV. Kalyani Publications. New Delhi. • Misra Kausal Kumar and Kumar Rajesh 2014. Fundamentals of Horticulture. Biotech Books. • Peter K V 2009. Basics Horticulture. New India Publishing Agency. • Singh Jitendra 2011. Basic Horticulture. Kalyani Publications. New Delhi. • Singh Neeraj Pratap 2005. Basic concepts of Fruit Science 1st edn. IBDC Publishers.

Course Code: STAT-111		Course Name: Introductory Mathematics		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**01**	**00**	**01**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Placement • Higher education

Course Objectives:

1. Introduce foundational concepts of algebraic progressions and matrix operations for mathematical analysis.
2. Develop problem-solving skills using differential and integral calculus in economic and scientific applications.
3. Familiarize students with mathematical modeling techniques relevant to agricultural systems and data analysis.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Apply the concepts of arithmetic, geometric, and harmonic progressions, along with matrix operations and determinants, in solving algebraic problems.
CO-2	Demonstrate proficiency in differential calculus, including first principles, derivatives, and applications to economics such as cost and revenue analysis.
CO-3	Solve integrals using appropriate methods and interpret the area under standard curves using definite and indefinite integrals.
CO-4	Construct and analyze mathematical models for agricultural systems and fit linear, quadratic, and exponential models to real-world data.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Chalkboard 3. Power Point Presentations 4. Interactive Lecture 5. Problem Solving
T2	1. Assignments 2. Flip Class/Seminars 3. Quiz

Assessment tools

AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-5	Viva-Voce examination
AT-6	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit – 1** Algebra: Progressions- Arithmetic, Geometric and Harmonic Progressions.	Quiz
	Unit – 2 Matrices: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order by adjoint method, Properties of determinants up to 3rd order and their evaluation.	Mid Term examination
	Unit – 3 Differential Calculus: Definition - Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions. Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue. Partial differentiation: Homogeneous function, Euler's theorem, Maxima and Minima of the functions of the form y = f (x) and y = f (x1, x2).	Assignments, Quiz
	Unit – 4 Integral Calculus: Integration -Definite and Indefinite Integrals-Methods-Integration by substitution, Integration by parts. Area under simple well-known curves.	Assignments, Quiz
	Unit-5 Mathematical Models: Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data	End term examination Viva Voce
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Application of Calculus in Agricultural Economics b) Mathematical Modeling in Agriculture	
Suggested reading	**Textbooks:** 1. Singh, A. (2018). Introduction to Matrix Theory. Ane Books Pvt. Ltd. 2. Sreekumar, K. G. (2023). Integral Calculus: Differential Equations with GeoGebra. Viva Books. 3. B. Praba. (2021). Matrices and Calculus. Vijay Nicole Imprints Pvt. Ltd. 4. Das, B. C., & Mukherjee, B. N. (1938). Integral Calculus & Differential	

	Equations (57th ed.). U. N. Dhur & Sons Pvt. Ltd.
Suggested resources (Websites/eBooks)	1. https://swayam.gov.in 2. https://nptel.ac.in

Course Code: NCC-I		Course Name: National Cadet Corps		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**00**	**01**	**01**	**B.Sc. (Hons.) Agriculture**
Curriculum level	Designed to instill values like discipline, leadership, and national integration in cadets through a structured training program		**Student-specific course outcome**	Develop disciplined and well-rounded citizens by focusing on character building, leadership, and teamwork

Course Objectives:

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Practical/ Awareness activities
• Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.
• Drill- aim, general words of command, attention, stands at ease, stand easy and turning.
• Sizing, numbering, forming in three ranks, open and close order march, and dressing.
• Saluting at the halt, getting on parade, dismissing, and falling out.
• Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
• Marking time, forward march, and halt. Changing step, formation of squad and squad drill.
• Command and control, organization, badges of rank, honors, and awards.
• Nation Building- cultural heritage, religions, traditions, and customs of India. National integration. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens. Leadership traits, types of leadership. Character/ personality development. Civil defense organization, types of emergencies, firefighting, protection. Maintenance of essential services, disaster management, aid during development projects.
• Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.
• Structure and function of human body, diet and exercise, hygiene and sanitation. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.

Course Code: NSS-I		Course Name: National Cadet Corps		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**00**	**01**	**02**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Undergraduate and Postgraduate Students		**Student-specific course outcome**	• NSS aims to instil a sense of social and civic responsibility, leadership qualities, and a commitment to national integration among students.

Course Objectives:

1. Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skill in programme, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Practical/ Awareness activities
• Orientation: history, objectives, principles, symbol, badge; regular programs under NSS. • Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health. • NSS programme activities. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth programs/ schemes of GoI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change. • Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration. • Indian history and culture, role of youth in nation building, conflict resolution and peace-building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism.

- Citizenship, constitution, and human rights. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community-based organizations) and society.

Course Code: SEC-III		**Course Name:** Seed Production Technology		**Semester: II**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**00**	**02**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Skill-Based • Research-based		**Student-specific course outcome**	• Technical Skill Development • Entrepreneurship • Research and Higher Education • Regulatory and Policy Awareness

Course Objectives:

1. To impart operational and technical skills in seed production, sampling, testing, and certification.
2. To provide field-based experience on seed quality management, grow-out tests, and seed legislation compliance.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Demonstrate techniques of scientific seed production and field inspection.
CO-2	Perform various seed quality tests such as germination, viability, purity, and health.
CO-3	Understand and carry out seed sampling, drying, treatment, and packaging.
CO-4	Comprehend the seed certification process, quality regulation, and legislative frameworks.
CO-5	Apply advanced methods of seed enhancement, dormancy breaking, and biotechnology use in seed technology.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Laboratory Experiments 3. Field Based Experiments 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Field/Industry Visit 4. PBL activities

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-3	MOOC videos
AT-4	Poster Presentation
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Module-Wise Course Content	Assessment tools
Course Contents	**Module 1: Principles and Classes of Seed Production** • Basic principles of seed production • Classification of seeds: Nucleus, Breeder, Foundation, Certified • Rouging, Isolation distance, Field standards • Importance of maintaining genetic purity **Assessment:** AT-1, AT-3, AT-6 **Assignment:** Role of isolation and rouging in quality seed production **Video Link:** Seed Production Principles – NPTEL **PBL Module:** Create a model layout for a certified seed production field in a pulse crop.	Mid-term Exam and End-Term Exam Assignments
	Module 2: Seed Sampling, Drying, Processing, and Treatment • Seed sampling procedures and tools (ISTA guidelines) • Seed drying techniques: sun drying, mechanical drying • Seed processing: cleaning, grading • Seed treatment: fungicides, bio-inoculants, polymers **Assessment:** AT-1, AT-2, AT-6 **Assignment:** Comparison of chemical and biological seed treatment **Video Link:** Seed Processing Technology – eKrishiShiksha (ICAR-IASRI) **PBL Module:** Design a mini seed processing unit layout and workflow for an FPO	Mid-term Exams, Quiz and End-Term Exam Assignments

Module 3: Seed Quality Testing • Physical purity, Moisture content determination • Germination, Viability (Tetrazolium Test), Vigor Index • Seedling evaluation and standards • Seed health testing: Blotter, Agar, and incubation methods **Assessment:** AT-1, AT-2, AT-4 **Assignment:** Practical protocol preparation for seed viability testing **Video Link:** Seed Quality Testing – NPTEL (Seed Science & Technology) **PBL Module:** Comparative seed quality analysis report of two varieties of wheat using lab test data	Mid-term Exams, End-Term Exam Assignments and ABL
Module 4: Seed Certification and Seed Laws • Objectives and procedure of seed certification • Labeling and tagging in India • Seed Act, 1966; Seed Rules, 1968; Seed Bill, 2019 • Duties of seed inspector and analyst; penalties **Assessment:** AT-2, AT-5, AT-6 **Assignment:** Flowchart for certification of certified seed lot from field to market **Video Link:** Seed Certification – e-Krishi Shiksha (ICAR) **PBL Module:** Prepare a mock inspection report of a seed production plot by a certification officer	End-Term Exam Assignments and ABL
Module 5: Recent Advances in Seed Technology • Seed enhancement techniques (priming, coating, pelleting) • Breaking dormancy and improving storability • Use of biotechnology: DNA-based purity testing, seed genomics • Artificial seeds, Cryopreservation techniques (introductory level) **Assessment:** AT-3, AT-6, AT-7 **Assignment:** Seed priming methods and their impact on germination	End-Term Exam Assignments and ABL

speed
Video Link: Seed Enhancement Techniques – ICRISAT/NPTEL
PBL Module: Design a research-based protocol to test the efficacy of bio-priming in vegetable crops.

PBL Title: Innovative Approaches for Enhancing Seed Production Efficiency, Quality Testing, and Regulatory Compliance in Agricultural Crops.

Research Rationale:

With the growing importance of quality seeds in sustainable agriculture, there is a need to integrate practical skills and innovation among undergraduate students. This research-based project aims to consolidate multiple skill enhancement activities in seed science and technology under real-life situations. The project combines seed production design, processing system development, seed quality analysis, certification compliance, and application of recent advances such as seed enhancement.

Research Objectives:

1. To develop practical models and simulations for certified seed production and seed quality management.
2. To enhance hands-on competency in seed testing, sampling, and post-harvest handling.
3. To understand and apply seed legislation and certification processes through experiential learning.
4. To introduce advanced seed enhancement and biotechnology concepts through small-scale research and demonstrations.

Component	Description	Expected Outcome
1. Model Layout Design for Certified Seed Production	Students design a certified seed field layout for a pulse or cereal crop considering isolation, roguing, and seed class tagging.	Understand field-level seed production planning; apply seed class principles in real-world settings.
2. Development of Mini Seed	Design a low-cost, scalable seed	Encourage entrepreneurial

Processing Unit	processing workflow suitable for Farmer Producer Organizations (FPOs).	models and application of seed post-harvest techniques.
3. Comparative Seed Quality Analysis	Lab-based testing and comparison of two seed varieties for germination, purity, vigor, and viability.	Enhance analytical skills in seed quality testing and develop evidence-based decision-making.
4. Preparation of Mock Certification Report	Simulate a seed inspection visit and prepare a certification report based on field standards and compliance.	Familiarity with seed legislation, certification, and official documentation procedures.
5. Study on Bio-Priming Efficacy in Vegetable Crops	Conduct an experiment on seed priming using biological agents to evaluate its effect on germination and vigor.	Gain exposure to research on eco-friendly seed enhancement methods for improving seedling establishment.

Research Outcomes:

1. Developed technical competence in seed production design, seed sampling, and testing methods.
2. Gained experiential understanding of field and lab-based seed quality assurance techniques.
3. Applied regulatory knowledge for certification and legal compliance in seed systems.
4. Demonstrated problem-solving skills through design and execution of seed enhancement techniques.
5. Enhanced readiness for entrepreneurial ventures and higher studies in seed science and technology.

Contributions to SDGs:

SDG Goal	How Addressed
SDG 2 – Zero Hunger	Improved seed quality contributes to better crop productivity.
SDG 4 – Quality Education	Skill-based, field-integrated, and lab-based learning activities.
SDG 8 – Decent Work and Economic Growth	Encourages agri-entrepreneurship through seed processing unit models.
SDG 9 – Industry, Innovation and Infrastructure	Promotes infrastructure solutions for FPOs and smallholder seed enterprises.
SDG 12 – Responsible Consumption and Production	Efficient use of inputs through high-quality seed and post-harvest handling.
SDG 13 – Climate Action	Promotes sustainable seed practices (e.g., bio-priming) to reduce chemical usage.
SDG 15 – Life on Land	Encourages sustainable agriculture through seed health and soil-friendly practices.
SDG 16 – Peace, Justice and Strong Institutions	Builds awareness of legal and institutional frameworks in seed certification.

List of Practical (Field/Lab Exercises)	Assessment tools
List of Practical (Field/Lab Exercises) 1. Identification and classification of seed classes and tags 2. Field inspection simulation in seed production plot 3. Seed sampling procedures and equipment use 4. Determination of physical purity and moisture content 5. Germination testing and seedling evaluation 6. Viability testing using Tetrazolium 7. Seed vigor determination (Accelerated Aging, EC method) 8. Seed treatment (chemical & biological) demonstrations 9. Seed health testing using blotter and agar plate 10. Visit to certified seed production field 11. Visit to state seed certification agency 12. Visit to seed testing and processing laboratory	❖ Activity-Based Learning ❖ Project-Based Learning ❖ Practical Exam ❖ Viva-Voce Examination ❖ Field Visit Report ❖ Assignments

Suggested reading	1. Agarwal, R.L. (1995). *Seed Technology*. Oxford & IBH 2. Khare, D. and Bhale, M.S. (2019). *Seed Technology*. Scientific Publishers 3. Vanangamudi, K. (2014). *Seed Technology – An Illustrated Book*. NIPA 4. Copeland, L.O., McDonald M.B. (2001). *Principles of Seed Science and Technology*. Springer 5. Tunwar, N.S. & Singh, S.N. (1988). *Indian Minimum Seed Certification Standards*. MoA, GOI 6. Benech-Arnold, R. L., et al. (2000). *Seed Dormancy and Germination*. CAB International
Suggested MOOC/eLearning Resources	• https://ecourses.icar.gov.in/ (ICAR e-KrishiShiksha) • https://swayam.gov.in/ (SWAYAM-NPTEL) • https://onlinecourses.nptel.ac.in/noc23_ag01/preview • https://www.youtube.com/@ICRISAT/videos (ICRISAT YouTube Channel) • https://www.manage.gov.in – National Institute of Agricultural Extension Management

Course Code: SEC-IV		Course Name: Post harvest processing technology		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**0**	**02**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

- ✓ To provide hands-on training on various post-harvest handling techniques such as cleaning, grading, sorting, drying, milling, storage, and packaging.
- ✓ To promote entrepreneurial skills and small-scale business ideas related to post-harvest processing and value addition.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Identify and classify different post-harvest handling, grading, packaging, and storage technologies.
CO-2	Demonstrate practical skills in drying, milling, canning, packaging, and storage of grains, fruits, and vegetables.
CO-3	Analyze the causes of post-harvest losses and suggest appropriate technologies for minimizing these losses.
CO-4	Evaluate the quality parameters of processed products using standard laboratory methods (TSS, acidity, pH, etc.).
CO-5	Design and develop simple value-added products from agricultural produce and suggest innovative business ideas.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools

AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study of Post-Harvest Losses in Fruits and Vegetables 2. Grading and Sorting of Fresh Fruits and Vegetables 3. Measurement of Physical Properties of Grains (size, shape, density, etc.) 4. Moisture Content Determination of Grains, Pulses, and Oilseeds 5. Demonstration of Cleaning and Grading Equipment (screen cleaners, gravity separators, etc.) 6. Practice in Storage Techniques (Traditional vs. Modern Storage Structures) 7. Demonstration of Cold Storage and Controlled Atmosphere Storage Techniques 8. Preparation of Dehydrated Fruits and Vegetables (solar drying / mechanical drying) 9. Study of Milling Techniques for Cereals (rice, wheat, maize) 10. Demonstration of Oil Extraction Methods from Oilseeds (cold press, expeller) 11. Preparation of Value-Added Products (Jam, Jelly, Pickle, Squash) 12. Demonstration of Canning Techniques for Fruits and Vegetables	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

13. Practice of Blanching, Pasteurization 14. Practice of Sterilization Techniques 15. Preparation of Fruit Bar or Fruit Leather 16. Preparation of Fruit Bar Fruit Leather 17. Demonstration of Freezing Techniques for Preservation 18. Packaging Techniques for Grains, Fruits, and Vegetables (vacuum packaging, MAP, etc.) 19. Study of Packaging Materials and Their Properties 20. Demonstration of Vacuum Packing / MAP for Fresh Produce 21. Demonstration of Processing of Pulses (Dehusking, Splitting, Polishing) 22. Demonstration of Aflatoxin Testing in Stored Grains 23. Preparation of Fermented Products (Pickles, Sauerkraut, Curd) 24. Study of Waste Management in Post-Harvest Processing Units 25. Demonstration of Flour Milling (Atta Chakki / Roller Mill) 26. Determination of Quality Parameters: TSS, Acidity in Processed Foods 27. Determination of Quality Parameters pH, and Color in Processed Foods 28. Visit to Food Processing Industry / Cold Storage Facility / Grain Storage Godown	

Course Code: EXT-121		Course Name: Personality Development		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

1. To understand the concept and nature of personality, including its definition, types, and various theories.
2. To study the determinants and development of personality, focusing on factors influencing personality formation and growth.
3. To explore key psychological concepts, such as perception, learning, attitude, intelligence, and emotional intelligence, and their impact on individual behavior.
4. To examine motivational theories and principles, understanding their role in enhancing personal effectiveness and organizational behavior.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the fundamental concepts of personality, including its nature, types, and theories, with emphasis on humanistic approaches like Maslow's self-actualization theory.
CO-2	Analyze the determinants of personality and their impact on organizational behavior,
CO-3	Examine how perception, learning, and motivation influence personal and organizational behavior.
CO-4	Assess the role of emotional intelligence, attitudes, and values in effective interpersonal relationships.
CO-5	Build skills in communication, teamwork, conflict resolution, and leadership through practical exercises and case studies.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit-I** Definition and nature of personality, Theories of personality and types, 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 behaviors, Personality and organizational behavior	Mid-term Exams and End-Term Exam Assignments
	Unit-II Foundations of individual behaviour, Factors influencing individual behaviour, Models of individual behaviour, Perception and attributes, Factors affecting perception, Attribution theory, Case studies on perception and attribution	Mid-term Exams and End-Term Exam Assignments
	Unit-III Meaning and definition of learning, Theories and principles of learning, Learning and organizational behaviour, Learning and training, Learning feedback, Attitude and values	End-Term Exam Assignments
	Unit-IV Types of intelligence, Theories of intelligence, Measurement of intelligence, Factors influencing intelligence, Intelligence and organizational behaviour, Emotional intelligence	End-Term Exam Assignments

	Unit-V Theories and principles of motivation, Teamwork, Group dynamics	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. MBTI personality analysis 2. Learning Styles and Strategies 3. Motivational needs 4. Firo-B 5. Interpersonal Communication 6. Teamwork and team building 7. Group Dynamics 8. Win-win game 9. Conflict Management 10. Leadership styles 11. Case studies on Personality and Organizational Behavior	Activity-Based Learning Practical Exam Viva-Voce Examination Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment. a. Describe your personality type using the Myers-Briggs Type Indicator. b. Write a short note on Maslow's Hierarchy of Needs with one real-life example. c. Explain the difference between Type A and Type B personalities in one paragraph. d. Identify and describe any two types of intelligence with examples. e. Mention any one motivation theory and explain its importance in teamwork
Suggested reading	• Andrews, Sudhir. 1988. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw Hill. • Heller, Robert. 2002. Effective Leadership. Essential Manager series. Dk Publishing. • Hindle, Tim. 2003. Reducing Stress. Essential Manager series. Dk Publishing. • Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. • Mile, D.J. 2004. Power of Positive Thinking. Delhi. Rohan Book Company. • Pravesh Kumar. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House. Smith, B. 2004. Body Language. Delhi: Rohan Book Company. • S Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadswor.

Suggested resources (Websites/eBooks)	1. https://students.aiu.edu/submissions/profiles/resources/onlineBook/S7H9K6_The_Art_and_Science_of_Personality_Development.pdf 2. https://files.eric.ed.gov/fulltext/ED501451.pdf

Course Code: AGM-121		Course Name: Environmental Studies and Disaster Management		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the structure and components of the environment, natural resources, and ecosystems, and recognize the importance of sustainable resource utilization.
CO-2	Explain biodiversity, its types, value, and conservation strategies, along with the impact of various types of pollution and legal frameworks for environmental protection.
CO-3	Analyze current environmental issues such as climate change, global warming, ozone depletion, and disaster risks, and evaluate mitigation and management strategies.
CO-4	Develop skills to conduct environmental sampling, analyze water quality parameters (pH, EC, TDS, DO, BOD, COD), and assess pollution impacts on biodiversity.
CO-5	Gain hands-on experience through field visits and practical exercises related to biodiversity assessment, pollution monitoring, renewable energy systems, and disaster-affected areas, enabling effective environmental documentation and awareness.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. Assignments 2. Flip Class/Seminars 3. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Activity-Based Learning
AT-5	Practical Exam
AT-6	Viva-Voce examination
AT-7	Field Visit Report
AT-8	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
	Unit I: Fundamentals of Environmental Studies Introduction to Environment. Environmental studies: Definition, scope and importance. Multidisciplinary nature of environmental studies. Segments of environment. Spheres of Earth – Lithosphere, Hydrosphere, Atmosphere. Different layers of atmosphere.	Mid-term Exams and End-Term Exam Assignments
	Unit II: Natural Resources and Ecosystems Natural Resources: Classification of natural resources. 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 ecosystems.	Mid-term Exams and End-Term Exam Assignments

Course Contents	**Unit III: Biodiversity and Environmental Pollution** Biodiversity and its conservation: Introduction and definition of biodiversity. Types of biodiversity. Biogeographical classification of India. Importance and value of biodiversity. Biodiversity hot spots. Threats to biodiversity and its conservation. Environmental Pollution: Definition, causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and light pollution.	End-Term Exam Assignments
	Unit IV: Waste Management and Environmental Issues 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, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environmental Legislations: Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act.	End-Term Exam Assignments
	Unit V: Population and Disaster Management 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: Definition of disaster. Types of disasters – 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 strategies for disaster reduction. Concept of disaster management. National disaster management framework. Financial arrangements. Role of NGOs, community-based organizations and media in disaster management. Role of central, state, district and local administration in disaster control. Role of armed forces, police and other organizations in disaster response.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Visit to a local area to document environmental assets such as river, forest, grassland, hill, or mountain. 2. Study of biogas production from organic wastes. 3. Visit to renewable energy generation units – wind mill, hydro power, or solar power plant. 4. Biodiversity assessment in a farming system. 5. Comparative assessment of floral and faunal diversity in polluted and unpolluted environments. 6. Visit to a local polluted site (urban, rural, industrial, or agricultural) to study common plants, insects, and birds. 7. Environmental sampling and preservation techniques. 8. Analysis of water quality parameters – pH, Electrical Conductivity (EC), and Total Dissolved Solids (TDS). 9. Estimation of water acidity and alkalinity. 10. Estimation of water hardness. 11. Estimation of Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) in water samples. 12. Estimation of Chemical Oxygen Demand (COD) in water samples. 13. Enumeration of E. coli in water samples. 14. Assessment of Suspended Particulate Matter (SPM) and study of a simple ecosystem through a visit to a pond, river, or hill area.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Natural Resources of My Region: Classification and Conservation Challenges 2. Case Study of a Major Environmental Disaster 3. Biodiversity Profile of a Local Ecosystem 4. Survey of Environmental Pollution in My Locality 5. Overview of Major Environmental Laws in India
Suggested reading	1. Bharucha, E. 2005. Text book of Environmental Studies for undergraduate courses. University Grants Commission, New Delhi. 2. Anjaneyalu, Y. 2004. Introduction to Environmental Science, BS Publications, Hyderabad, A.P.,India.

Suggested resources (Websites/e Books)	https://ncert.nic.in https://moef.gov.in https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000031EN/P001475/M021810/ET/1503566323EnvironmentalStudiesErachBharucha.pdf https://books.google.co.in/books?id=K2RuDwAAQBAJ

Course Code: SS - 121		Course Name: Soil Fertility Management		Semester: II[nd]
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
03	**02**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives: To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the historical development of soil fertility and the criteria of nutrient essentiality, and explain the roles, deficiency and toxicity symptoms of essential plant nutrients.
CO-2	Analyze the chemical forms, availability, and evaluation methods of macro and micronutrients in soil and plants, and interpret soil testing and plant analysis data for fertility management.
CO-3	Demonstrate knowledge of different types of fertilizers and soil amendments, including their composition, properties, and use, and understand their role in integrated nutrient management (INM)
CO-4	Apply scientific principles in the selection, storage, and recommendation of fertilizers, and evaluate methods of application and factors affecting nutrient use efficiency (NUE) under varying field conditions.
CO-5	Develop understanding of advanced nutrient management strategies such as STCR, RTNM, IPNS, and explain the preparation and properties of organic manures and concepts of carbon sequestration and trading in sustainable agriculture.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Chemistry of macro and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, and rapid plant tissue tests. Indicator plants. Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches Integrated nutrient management.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customized fertilizers, water soluble fertilizers nano fertilizers Soil amendments.	End-Term Exam Assignments
	Unit-4 Fertilizer Storage, Fertilizer Control Order. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions	End-Term Exam Assignments

	Unit-5 STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes). .	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**
1. Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. 2. Estimation of alkaline hydrolysable N in soil. 3. Estimation of soil extractable P in soil. 4. Estimation of exchangeable K in soil. 5. Estimation of exchangeable Ca and Mg in soil. 6. Estimation of soil extractable S in soil. 7. Estimation of DTPA extractable Zn in soil. 8. Estimation of N in plant. 9. Estimation of P in plant. 10. Estimation of K in plant. 11. Estimation of S in plant.		Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Role, deficiency and toxicity symptoms of essential plant nutrients. b) Explain chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients
Suggested reading	1. Introductory Soil Science by Dilip Kumar Das, Kalyani Publishers 2. Soil Fertility and Nutrient Management by S. S. Singh, Kalyani Publishers. 3. Soil Fertility and Fertilizers by Samual 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
Suggested resources (Websites/eBooks)	1. http://ecoursesonline.iasri.res.in/course/view.php?id=125 2. http://cattheni.edu.in/wp-content/uploads/2018/09/SAC-301.pdf 3. https://www.nrcs.usda.gov/ 4. ICAR e-Course PDF Link (Agrimoon) 5. https://www.fao.org/soils-portal/

Course Code: ENT-121		Course Name: Fundamentals of Entomology		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course 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 the insect classes and their importance for the Classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development, and the communication of insects
4. To study the characteristics of commonly observed insect orders and their economically important families.

Course outcomes: Through this course, students will know:

CO-1	Ability to recognize and classify agriculturally important insect pests based on their morphology and behaviour
CO-2	Application of concepts from evolutionary biology, genetics, and insect ecology to analyze insect populations.
CO-3	Development of effective pest control methods by examining insect biology at different levels.
CO-4	Understanding the role of various insect families and orders in agriculture, including beneficial and harmful species.
CO-5	Learners will gain practical knowledge on insect physiology, behaviour, and their interactions with crops, aiding in sustainable agricultural practices.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insects with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and moulting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Categories of pests. Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present-day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata.	End-Term Exam Assignments
	Unit-4 Isoptera: Termitidae; Thysanoptera: T hripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae.	End-Term Exam Assignments
	Unit-5 Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Collection and Preservation of Insects 2. External features of Grasshopper 3. External features of the Blister beetle 4. Types of Insect Antennae 5. Types of Insect Legs 6. Types of Insect Mouthparts and Their Functions 7. Wing Venation, Types of Wings, and Wing Coupling Apparatus 8. Types of Insect Larvae 9. Types of Insect Pupae 10. Dissection of the Digestive System in the Grasshopper 11. Study of Orders and Families of Agricultural Importance 12. Insecticides and Their Formulations 13. Pesticide Appliances and Their Maintenance 14. Sampling Techniques for Estimating Insect Population and Damage.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Insect thorax: segmentation of thorax. Leg structure and its modifications b) Insect wing: structure and its modifications c) Insect abdomen: structure and its modifications d) Taxonomy, principles and procedures. Nomenclature and identification e) Classification of insects and different groups f) Study of insect orders: Protura, Collembola, Diplura, Microcoryphia,
Suggested reading	1. Fundamentals of Ecology - Eugene. P. Odum and Gray W. Barrett 2. Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies 3. Introduction to the study of Insects –D. J. Borror and DeLong's.
Suggested resources (Websites/eBooks)	1. https://www.agrostudy.in/2021/10/fundamentals-of-entomology.html#google_vignette 2. https://www.iaritoppers.com/2019/06/fundamentals-of-entomology-icar-ecourse-pdf-download.html

Course Code: AH-121		Course Name: Livestock and Poultry Management		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course 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.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Identify and describe the role of livestock and poultry in the national economy and recognize important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine, and poultry.
CO-2	Explain the principles of housing, reproduction, feeding, and disease prevention in livestock and poultry to promote scientific animal husbandry practices.
CO-3	Demonstrate handling, restraining, and identification techniques for livestock and poultry and carry out farm operations such as milking, debeaking, dusting, brooding, and judging.
CO-4	Compute and formulate appropriate rations and concentrate mixtures based on nutrient requirements and feed classification for different categories of livestock and poultry.
CO-5	Evaluate the economics and management strategies for sustainable and integrated livestock-poultry-agriculture farming systems and propose entrepreneurial opportunities in animal husbandry.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. PBL activities 3. Assignments 4. Flip Class/Seminars

	5. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1:** Role of livestock in the national economy. Different breeds of Cattle, buffalo, sheep, goat swine and poultry. Reproduction in farm animals and poultry. Principles of animal breeding. Improvement of farm animals and poultry.	Mid-term Exams and End-Term Exam Assignments
	Unit-2: Housing principles, space requirements for different species of livestock. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine.	Mid-term Exams and End-Term Exam Assignments
	Unit-3: Housing principles, space requirements for different species of poultry. Incubation, hatching and brooding. Management of growers and layers.	End-Term Exam Assignments
	Unit-4: 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.	End-Term Exam Assignments
	Unit-5: Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools

1. External body parts of cattle, buffalo, sheep, goat, and swine 2. External body parts of poultry. 3. Handling and restraining of livestock 4. Identification methods of farm animals and poultry. 5. Visit to IDF to study breeds of livestock and daily routine farm operations and farm records. 6. Visit to IPF to study breeds of poultry and daily routine farm operations and farm records. 7. Judging of cattle, and buffalo 8. Judging of poultry 9. Culling of livestock and poultry 10. Planning and layout of housing for different types of livestock 11. Computation of rations for livestock 12. Clean milk production and milking methods 13. Hatchery operations, incubation and hatching equipment 14. Management of grower and layer chicks.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Debeaking b) Management of growers and layers c) Economics of dairy production d) Economics of poultry production
Suggested reading	1. A Textbook of Animal Husbandry by G. C Banerjee 2. A text Book of Livestock Production management in Tropic by D. N. Verma
Suggested resources (Websites/eBooks)	agrimoon.com/wp-content/uploads/Livestock-Production-and-Management.pdf www.pork.org www.ilri.org www.fao.org www.defra.org.uk www.aciar.gov.au www.asap.asn.au www.thepigsite.com www.epa.com http://animalscience.ucdavis.edu www.tanu.edu www.sciencedirect.com http://trop.edmgr.com www.nianp.res.in/ http://www.aphca.org http://www.ars.usda.gov

Course Code: PP-121		Course Name: Fundamentals of Plant Pathology		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To get acquainted with the role of different microorganisms in the development of plant disease.
2. To get general concepts and classification of plant diseases.
3. To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases.
4. To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases
5. To get acquainted with various plant disease management principles and practices

Course outcomes: After completion of the course, the student will be able to:

CO-1	Highlighting the scope and objective of plant diseases and its development.
CO-2	Interpret about various pathogens including bacteria, fungi, viruses and nematodes and their life cycles.
CO-3	Understanding the concept of diseases and causal agents of plant diseases.
CO-4	Knowing the importance of microorganisms and their host-pathogen interactions.
CO-5	To analyse and identify the causal organisms of diseases.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis; Development of disease in plants: Disease Triangle, Disease cycle.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Fungi and their morphology, reproduction and classification of fungi. Bacteria: Morphology, reproduction classification of phytopathogenic bacteria.	End-Term Exam Assignments
	Unit-4 Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Greenalgae and parasitic higher plants; Viruses and viroids, virus transmission.	End-Term Exam Assignments
	Unit-5 Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study of the compound microscope and its handling techniques. 2. Familiarization with laboratory materials, glassware, tools, and equipment used in Plant Pathology. 3. Observation and identification of different types of plant disease symptoms (e.g., spots, rots, blights, wilts, galls, etc.). 4. Microscopic examination of general structure and reproductive structures of fungi using prepared slides. 5. Microscopic examination of fungal diseased specimens collected from the field. 6. Simple staining of bacteria – direct and indirect staining techniques. 7. Gram staining of phytopathogenic bacteria and observation under microscope. 8. Microscopic examination of bacterial diseased specimens. 9. Preparation of different culture media used in the isolation of plant pathogens. 10. Isolation techniques of fungal plant pathogens from diseased specimens. 11. Isolation techniques of bacterial plant pathogens from infected tissues. 12. Purification techniques of isolated plant pathogens – sub-culturing and single spore isolation methods. 13. Study on plant disease diagnosis including demonstration of Koch's Postulates. 14. Formulation of fungicides, methods of application, and calculations related to fungicide concentration and dosage.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Wet Preservation of Diseased Plant Samples 2. Preparation of Dry Herbarium of Diseased Plant Samples 3. Drawing of Disease Triangle and Disease Cycle (with Examples) 4. Observation and Identification of Fungal and Bacterial Structures Using PDA and NA (Nutrient Agar)
Suggested reading	1. Agrios, G.N. 2010. *Plant Pathology*. Academic Press. 2. Singh, R.S. 2008. *Plant Diseases*. 8th Ed. Oxford & IBH Publishing Co. 3. Singh, R.S. 2013. *Introduction to Principles of Plant Pathology*. Oxford & IBH Publishing Co. 4. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 1996. *Introductory Mycology*. 4th Ed. John Wiley & Sons. 5. Goto, M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York.

	6. Hull, R. 2002. *Matthews' Plant Virology*. 4th Ed. Academic Press, New York. 7. Nene, Y.L. and Thapliyal, P.N. 1993. *Fungicides in Plant Disease Control*. 3rd Ed. Oxford & IBH Publishing Co., New Delhi. 8. Verma, J.P. 1998. *The Bacteria*. Malhotra Publishing House, New Delhi. 9. Vyas, S.C. 1993. *Handbook of Systemic Fungicides*. Vols. I–III. Tata McGraw Hill, New Delhi.
Suggested resources (Websites/eBooks)	**ANGRU Notes- https://agribooks.co/angrau-notes-pdf-download/** **NPTEL**:https://www.researchgate.net/publication/370756410_Principles_of_Plant_Pathology **Animated Lab Videos:** https://www.youtube.com/watch?v=05ITJlgPcR0 **MOOC Supplemented:** https://www.apsnet.org/edcenter/foreducators/TeachingNotes/Pages/default.aspx

LECTURE PLAN

Course: Fundamentals of Plant Pathology

Code: PP-121

Credit: 3(2+1)

Course Teacher: Dr. Sanjog Chhetri

S. No.	Name of Topic	Teaching Pedagogy	Course Outcome	Assessment Tools	Tentative Weeks
UNIT-I INTRODUCTION TO PLANT PATHOLOGY AND HISTORICAL BACKGROUND					
1	Introduction to Plant Pathology – Scope and Importance	Chalk & Talk and PPT	CO-1	Assignment	-
2	Definitions of Basic Terms in Plant Pathology	Chalk & Talk, Interactive Class	CO-1	Quiz	-
3	History and Development of Plant Pathology – Global & Indian Perspective	PPT, Historical Timeline Chart	CO-1	Assignment	- -
UNIT-II CAUSES AND DEVELOPMENT OF PLANT DISEASES					
4	Animate and Inanimate Causes of Plant Diseases	Video lecture, flip class	CO-2	Quiz	-
5	Classification of Plant Diseases	Classroom lecture, video lecture	CO-3	Quiz	-
6	Parasitism and Pathogenesis	Classroom lecture, Interactive Class	CO-3	Quiz	-
7	Disease Triangle: Concept and Application	Classroom lecture, video lecture	CO-3	Poster	-
8	Disease Cycle: Types and Stages	Classroom lecture, video lecture	CO-3	Assignment	-
					Midterm Examination
UNIT-III PATHOGENS – FUNGI AND BACTERIA					
9	Introduction to Fungi and General	PPT, Visual Aids	CO-2	Quiz	-

	Characteristics				
10	Fungal Classification Systems	Classroom lecture, Flow Chart	CO-2		-
11	Reproduction in Fungi – Asexual	Classroom lecture, Visual Aids	CO-4		-
12	Reproduction in Fungi – Sexual	Classroom lecture, Visual Aids	CO-4		-
13	Important Fungal Plant Pathogens	Classroom lecture and Case Studies, PPT	CO-4		-
14	Introduction to Bacteria – Structure and Characteristics	Classroom lecture, Visual Aids	CO-2		-
15	Reproduction and Classification of Plant Pathogenic Bacteria	Classroom lecture, Visual Aids	CO-2		-
16	Major Bacterial Diseases and Symptoms	Classroom lecture and Field demonstration	CO-4		-
UNIT-IV OTHER PATHOGENS AND HOST-PATHOGEN INTERACTION					
17	Mollicutes and Their Role in Plant Diseases	Classroom lecture and Field demonstration	CO-2	Quiz	-
18	Flagellate Protozoa and Parasitic Higher Plants	Classroom lecture, Visual Aids	CO-2		-
19	FVB, Green Algae as Pathogens	Classroom lecture, Visual Aids	CO-2		-
20	Viruses and Viroids – Basic Structure and Replication	Classroom lecture, Visual Aids	CO-2		-
21	Transmission of Plant Viruses	Classroom lecture, Field demonstration	CO-2	Assignment	-
22	Host-Pathogen Interaction	Classroom lecture	CO-2		-
UNIT-V PRINCIPLES AND PRACTICES OF PLANT DISEASE MANAGEMENT					
23	Principles of Plant Disease Management – Introduction	Video lecture, flip class	CO-5	Unannounced test	-
24	Chemical Methods of Disease Management	Classroom lecture, field demonstrations	CO-5		-
25	Host Resistance and	Classroom lecture	CO-5		-

	Use of Resistant Varieties				
26	Cultural Methods of Disease Management	Classroom lecture	CO-5		-
27	Biological Control and Use of Biocontrol Agents	Classroom lecture	CO-5		-
28	Integrated Disease Management (IDM) – Summary and Approach	Classroom lecture	CO-5	Report Submission	-
End term Examination					

Course Code: NCC-I		Course Name: National Cadet Corps		Semester: I
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**00**	**01**	**01**	**B.Sc. (Hons.) Agriculture**
Curriculum level	Designed to instill values like discipline, leadership, and national integration in cadets through a structured training program		**Student-specific course outcome**	Develop disciplined and well-rounded citizens by focusing on character building, leadership, and teamwork

Course Objectives:

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Practical/ Awareness activities
• Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill. • Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding. • Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG. • Introduction to map, scales, and conventional signs. Topographical forms and technical terms. • The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs. • Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

Course Code: NSS-II		Course Name: National Cadet Corps		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	**00**	**01**	**02**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Undergraduate and Postgraduate Students		**Student-specific course outcome**	• NSS aims to instil a sense of social and civic responsibility, leadership qualities, and a commitment to national integration among students.

Course Objectives:

1. Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skill in programme, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Practical/ Awareness activities
• Importance and role of youth leadership • Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies • Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programs • Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations • Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

Course Code: SEC-V		Course Name: Beneficial Insect Farming		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**00**	**02**	**04**	**B.Sc. (Hons.) Horticulture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. Understand the biology, behavior, and ecology of economically important insects including honey bees, silkworms, and lac insects.
2. Gain hands-on knowledge of beekeeping equipment, seasonal management, and bee diseases and enemies.
3. Explore the types, voltinism, and life cycle of silkworms along with mulberry cultivation, leaf harvesting, and preservation methods.
4. Identify lac insect species and their host plants, and understand lac production methods.
5. Recognize the role of pollinators, natural enemies, weed killers, and scavengers in agroecosystems and mass production techniques of different natural enemies.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Identify different honey bee species and castes, and describe their roles in the colony.
CO-2	Demonstrate understanding of beekeeping appliances, seasonal bee colony management, and control measures for bee enemies and diseases.
CO-3	Distinguish among various silkworm types (e.g., mulberry, tasar, eri, muga) and explain voltinism and life cycle stages.
CO-4	Identify major lac insect species and suitable host plants used for lac cultivation.
CO-5	Implement basic mass multiplication techniques for natural enemies such as parasitoids and predators used in biological control programs.

Teaching Pedagogy	
T1	1. Lab/field Experiments 2. Chalkboard 3. Power Point Presentations
T2	1. ABL activities 2. Assignments

Assessment tools	
AT-1	End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Poster
AT-4	Activity-Based Learning
AT-5	Practical Exam
AT-6	Viva-Voce examination
AT-7	Report Writing
AT-8	Field Visit Report

List of Practical (Field/Lab Exercises)	Assessment tools
1. Importance of beneficial insect in Agriculture 2. Introduction to Apiculture & its history 3. Study of morphology & anatomy of honey bee 4. Study of Bee-biology 5. Study of important species of honey bees and their characteristics 6. Study about the commercial methods of bee rearing and their equipment 7. Study about the seasonal management of honeybee 8. Study about the swarming and its management 9. Study about the methods of honey extraction 10. Study of different types of bee hives 11. Study about the bee pasturage 12. Study about the bee management for pollination 13. Study about the diseases of honey bee & its management 14. Study about the pests of honey bee & its management 15. Study about the history & developments of sericulture in India 16. Study about the different types of silkworms in India 17. Study about the voltinism and biology of silkworm 18. Study about the Mulberry cultivation 19. Study about the different method of irrigation in mulberry cultivation 20. Study about the rearing home management for mulberry silkworm 21. Study about the rearing appliances for rearing of mulberry silkworm 22. Study about the methods of silkworm rearing 23. Study about the diseases of silkworm & its management 24. Study about the Lac culture & its species 25. Study about the different host plants of lac insect 26. Study about the lac Cultivation 27. Study about the composition of lac 28. Study about the extraction of lac and types of lac 29. Study about the lac products and their uses 30. Study about natural enemies of lac 31. Study about the biocontrol agents with successful examples 32. Identification of major parasitoids & predators 33. Procedure for mass production of *Trichogramma* spp. *34.* Mass multiplication of an important parasitoid- *Goniozus nephantidis* 35. Mass multiplication of an important predator- *Chrysoperla carnea* 36. To visit research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report

Suggested reading	1. Essentials of Agricultural entomology by G S Dhaliwal, Ram Singh and B S Chillar 2. Elements of Economic Entomology by David and Ramamurthy Handbook of Entomology by T V Prasad

Suggested resources (Websites/eBooks)	1. https://agritech.tnau.ac.in/crop_protection/crop_prot_bio_mass%20production.html 2. https://agritech.tnau.ac.in/sericulture/seri_index.html 3. https://youtu.be/qo4Vs59ndNU?feature=shared 4. https://youtu.be/koaAaM6vKho?feature=shared

Course Code: AE-211		**Course Name:** Entrepreneurship Development and Business Management		**Semester: III**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Horticulture**
Curriculum level	• Information-based • Basic, applied, and Innovative		**Student-specific course outcome**	Placement Research Higher education Entrepreneurship

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	*Define and describe* key concepts such as entrepreneurship, entrepreneurial development, motivational and environmental factors, and characteristics of successful entrepreneurs.
CO-2	*Explain and discuss* the evolution, objectives, types, and functions of entrepreneurs as well as the process of entrepreneurship development and the significance of opportunity identification.
CO-3	*Apply* the steps involved in setting up an enterprise, including product/service selection, legal registration, site selection, sourcing capital, and packaging and distribution.
CO-4	*Analyze* different management functions in entrepreneurship, including production, financial, personnel, and marketing management, and identify effective strategies to manage crises and ensure enterprise sustainability.

CO-5	*Evaluate* the role of institutional support, government policies, and entrepreneurship development schemes in enhancing entrepreneurial success and sustainability in the agricultural sector.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Whiteboard 3. PowerPoint Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
	Unit – 1 Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and	Presentation

Course Contents	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.	
	Unit-2 Environment scanning and opportunity identification need for scanning: spotting of opportunity, scanning of environment identification of product / service: starting a project; factors influencing sensing the opportunities.	Midterm examination Report writing
	Unit – 3 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.	Assignment
	Unit- 4 Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management: product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management: raw material costing, inventory control.	ABL Quiz

	Unit 5 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, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.	End term examination ABL Viva Voce

List of Practical (Field/Lab Exercises)	**Assessment tools**
1) Visit to small-scale industries/agro-industries 2) Interaction with successful entrepreneurs/agric entrepreneurs 3) Visit to financial institutions and support agencies 4) Preparation of project proposal for funding by different agencies 5) Presentation and discussion on project proposals and feedback from mentors	Practical Activity Practical Record Viva voce

Assignment	As part of their continuous evaluation system, students are required to submit one assignment **a)** Identify a successful entrepreneur (preferably in the agriculture or agro-industry sector). Prepare a report on their background, motivational factors, social and environmental influences, and the entrepreneurial attributes/competencies that contributed to their success. **b)** Tracing the evolution of entrepreneurship. Include various types of entrepreneurs and explain the functions and objectives of entrepreneurial activities with relevant real-life examples.

	c) Select a region and perform a basic environment scan. Identify a viable agro-based product or service idea. Justify your selection by analyzing the factors influencing opportunity sensing and the potential demand. d) Create a detailed chart or report listing various government policies, schemes, and financial institutions supporting entrepreneurship in India. Highlight how these agencies assist entrepreneurs in establishing and managing enterprises. **e)** Prepare a mini project report including the following: selection of product/service, form of ownership, site selection, capital sourcing, and production planning. Include sections on marketing strategy, personnel planning, financial forecasting (costing, pricing), and crisis management plan.
Suggested reading	• Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi. • Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House. • Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons. • Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy. • Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co. • Mehra, P. 2016, Business Communication for Managers. Pearson India, New Delhi. • Pandey, M. and Tewari, D. 2010, The Agribusiness Book. IBDC Publishers, Lucknow. • Singh, D. 1995. Eff ective Managerial Leadership. Deep & Deep Publ. • Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books. • Tripathi, P.C. and Reddy, P.N. 1991. Principles of Management. Tata McGraw Hill. • Vasant Desai, 1997. Small-Scale Industries and Entrepreneurship. Himalaya Publ. House.

Suggested resources (Websites/eBooks)	

Course Code: PE-211		Course Name: Physical Education, First Aid, Yoga Practice and Meditation		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**00**	**02**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Physical Training • Increase stamina and general well-being through yoga.

Course Objectives:

1. To make the students aware about Physical Education, First Aid and Yoga Practices.
2. To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general well-being through yoga.

Practical
Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture **Yoga; History of Yoga, Types of Yoga, Introduction to Yoga:** • Asanas: Definition and Importance, Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan– left leg right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan. • Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari. • Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh. • Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra. • Role of yoga in sports • Teaching of Asanas – demonstration, practice, correction and practice. History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics.

Need and requirement of first aid. First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Course Code: GPB-211		Course Name: Principles of Genetics		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To explain Mendelian laws, chromosomal theory of inheritance, and the mechanisms of genetic transmission across generations.
2. To study the molecular organization of DNA and RNA, gene expression, replication, protein synthesis, and gene regulation.
3. To investigate inheritance beyond Mendelian genetics, including epistasis, linkage, sex-linked traits, and quantitative traits.
4. To develop analytical skills through genetic experiments, probability, chi-square analysis, linkage mapping, and study of model organisms.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Describe Mendelian and non-Mendelian inheritance, chromosomal theory, and gene interactions such as dominance and epistasis.
CO-2	Understanding of DNA and RNA structure, replication, transcription, translation, and gene regulation mechanisms.
CO-3	Use tools like Punnett squares, probability, and chi-square tests to analyze genetic crosses and estimate linkage and recombination frequencies.
CO-4	Categorize types of mutations, understand mutagenic agents, and evaluate their effects on genes and traits.
CO-5	Explain the genetic relevance of organisms like *Drosophila*, *Arabidopsis*, *E. coli*, and mice in research and genetic analysis.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-TermExam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wiseCourse Contents	Assessment tools
Course Contents	**Unit-1(Fundamentals of Cytology, Genetics & Inheritance)** Introduction and definition of cytology, genetics, and cytogenetics; their interrelation, Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Chromosomal theory of inheritance- cell cycle and celldivision-mitosis and meiosis. Dominancerelationships, Epistatic interactions with example, Probabilit and Chi-square.	Mid-term Exams and End-Term Exam Assignments
	Unit-2(Genes and Genetic Material) Gene concept: Gene structure, function andregulation.Nature, structure and replication of genetic material(DNA and RNA), Types of DNA and RNA,Protein synthesis, Transcriptionand translational mechanism of genetic material, Mutation: Definition and classification, Methods of inducing mutations, mutagenic agents and induction of mutation.	Mid-term Exams and End-Term Exam Assignments
	Unit-3(Chromosome Structure and Function) Architecture of chromosomes,chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction andtelomere, special types of chromosomes,Structural and numerical variations in chromosomes and theirimplications, Use of haploids, dihaploids and double haploids in Genetics.	End-Term Exam Assignments
	Unit-4 (Advanced Genetic Principles and Interactions) Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sexlimited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing overmechanism, chromosome mapping.	End-Term Exam Assignments
	Unit-5 (Quantitative Genetics & Cytoplasmic Inheritance) Qualitative andquantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmicinheritance, Study of modelorganisms (Drosophila, Arabidopsis, Garden pea, *E. coli*, and mice).	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**

1. Study and handling of microscope 2. Study of cell structure and prepared slides 3. Practice on Mitosis cell division (Onion root tips etc.) 4. Practice on Meiosis cell division (flower bud etc.) 5. Experiments on monohybrid, dihybrid: Observation and analysis 6. Experiments on trihybrid: Observation and analysis 7. Experiments on test cross and back cross 8. Experiments on epistatic interactions (dominant, recessive, duplicate, complementary, etc.) 9. Experiments on Test cross and back cross in epistatic interactions 10. Determination of linkage and crossing-over analysis (through two-point test cross data) 11. Study of sex-linked inheritance in *Drosophila* (e.g., eye colour inheritance) 12. Study and demonstration of models of DNA and RNA structure 13. Experiments involving probability and chi-square tests for genetic data 14. Validation of Mendelian ratios and interaction ratios using chi-square	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Introduction to Genetics, Cytology, and Cytogenetics b) Mendelian Genetics and Chromosomal Theory c) Structure and Function of Chromosomes and Genes d) Molecular Basis of Inheritance and Mutation e) Non-Mendelian Inheritance and Quantitative Genetics
Suggested reading	1. Fundamentals of Genetics: B. D. Singh 2. Genetics: M. W. Strickberger. 3. Principles of Genetics: Gardner, Simmons and Snustad. 4. Principles of Genetics: Sinnott, Dunn and Dobzhansky
Suggested resources (Websites/eBooks)	1. https://learn.genetics.utah.edu 2. https://www.biointeractive.org 3. https://www.ncbi.nlm.nih.gov/books/

Course Code: AGRON-211		**Course Name:** Crop Production Technology-I (*Kharif* crops)		**Semester:** III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**01**	**02**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course 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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the origin, distribution, and economic importance of major *Kharif* crops including cereals, pulses, oilseeds, millets, fibre, and forage crops.
CO-2	Evaluate the soil and climatic requirements, varieties, and cultural practices of important *Kharif* crops for optimized production.
CO-3	Demonstrate practical knowledge of sowing techniques, nursery management, fertilizer application, and weed identification in *Kharif* cropping systems.
CO-4	Analyze yield components, record biometric observations, and calculate yield of major *Kharif* crops through field-based learning.
CO-5	Apply scientific methods for fodder preservation (silage and hay making), and gain exposure to research trials and crop-specific agronomic practices through field visits.
Teaching Pedagogy	
T1	1. Classroom Teaching 2. Field Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. PBL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools		
AT-1	Mid-term Exams and End-Term Exam	
AT-2	Seminar Presentation and Report	
AT-3	Quiz	
AT-4	Practical Exam	
AT-5	Viva-Voce examination	
AT-6	Report Writing	
AT-7	Field Visit Report	
AT-8	Assignments	
Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit-I** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of kharif cereals crops, viz., Rice and Maize	Mid-term Exams and End-Term Exam Assignments
	Unit-II Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *kharif* millets crops, viz., Sorghum, Pearl Millet, Finger Millet and Other Minor Millets	Mid-term Exams and End-Term Exam Quiz
	Unit-III Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *kharif* pulses crops, viz., Pigeonpea, Mungbean and Urdbean	End-Term Exam Assignments
	Unit-IV Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *kharif* oilseeds crops, viz., Groundnut, Soybean, Sesame and Castor	End-Term Exam Quiz
	Unit-V Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *kharif* fibre and forage crops, viz., Cotton, Jute, Sorghum (fodder), Cowpea, Cluster Bean, Maize (fodder), Guinea and Napier	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**

1. Preparation and management of rice nursery 2. Transplanting of rice 3. Sowing methods of soybean - seed treatment and spacing 4. Sowing techniques for pigeonpea and mungbean 5. Sowing of maize, groundnut, and cotton under *kharif* conditions 6. Study of morphological characteristics of *kharif* cereals (rice and maize) 7. Study of morphological characteristics of *kharif* pulses 8. Study of morphological characteristics of *kharif* oilseeds 9. Identification and classification of common weeds in *kharif* crops 10. Top dressing and foliar application of nutrients in *kharif* crops 11. Study of yield contributing characters and yield calculation in rice, maize, and pulses 12. Identification and study of crop varieties of major *kharif* crops 13. Familiarization with ongoing agronomic experiments at the college experiential farm 14. Recording biometric observations in *kharif* crops (plant height, LAI, tillers, etc.) 15. visit to research centres related to *kharif* crops 16. Silage and hay making techniques 17. Application of FYM and Vermicompost at 30 (Day before sowing (DBS) 18. Pre irrigation given before the time of field preparation 19. Field preparation for the seed sowing 20. Seed rate and sowing methods 21. Nutrient management practices in the crops 22. Water management in different crops 23. Calibration of knapsack sprayer for the spraying. 24. Weed management practices in the crops 25. Thinning practices in different crops 26. Earthing-up in different crops 27. Methods of harvesting of different crops 28. Threshing of different crops 29. Winnowing of the crops 30. Storage of the different type of produce 31. Marketing of produce (MSP) grown by students 32. Preparation of Balance Sheet Including Cost of Cultivation, Net Returns per student as well as per Team of a Group of Students	Practical -Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
Assignment	1. As part of their continuous evaluation system, students are required to submit one assignment 1. Production and productivity trends of rice in India and globally State-wise comparison of rice yield and area in India 2. Hybrid maize cultivation and its impact on productivity in India 3. Water use efficiency in rice cultivation: Indian vs global practices (Include SRI, direct seeding, micro-irrigation cases)

	4. Millets Revival of millets: Role of India in global millet promotion 5. Pulses Trends in pigeonpea production and productivity in India 6. Mungbean and urdbean cropping systems and their role in soil fertility 7. Indias pulse productivity vs global average: Constraints and strategies Oilseeds Soybean production in India: Trends, states involved, export data Role of sesame in India edible oil economy 8. Area and production of castor in India: Scope and challenges 9. Fibre and Forage Crops Bt Cotton cultivation in India: Trends, productivity, and farmer adoption 10. Jute production in Eastern India: State-wise analysis (West Bengal, Assam, Bihar challenges and exports) 11. Forage crop scenario in India: Area, demand, and gap analysis 12. Effect of climate change on kharif crop productivity in India
Suggested reading	1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi. 2. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II 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. 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.
Suggested resources (Websites/eBook)	1. http://www.agritech.tnau.ac.in/pdf/AGRICULTURE.pdf 2. https://bscagriculture.com/crop-production-technology-kharif-crops/ 3. https://hortiagri.weebly.com/uploads/3/0/7/3/30731055/field-crop-kharif.pdf 4. https://www.pau.edu/content/ccil/pf/pp_kharif.pdf

Course Code: HORTI-211		Course Name: Production Technology for Fruit and Plantation Crops		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• **Higher Education** • **Entrepreneurship**

Course Objectives:

1. **To educate about the different forms of classification of fruit crops.**
2. **To educate about the origin, area, climate, soil, improved varieties and cultivation practices of fruit and plantation crops**
3. **To educate about the physiological disorders of fruit crops, palms and plantation crops.Course outcomes: After completion of the course, the student will be able to:**

CO-1	Describe the status and scope of fruit and plantation crops and national and international level
CO-2	Understand the climatic requirement of various fruit and plantation crops.
CO-3	Demonstrate the various intercultural operations practiced in horticultural crops.
CO-4	Analyze the role of canopy management for maximising the yield and quality of fruit and plantation crops produces.
CO-5	Evaluate the impact of various technologies on fruit and plantation production.

Teaching Pedagogy	
T1	1. Classroom Lecture 2. Fieldwork and outdoor learning 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Seminars 4. Quiz

Assessment tools	
AT-1	Assignment
AT-2	Quiz
AT-3	Mid Term Exams
AT-4	End Term Exam
AT-5	Report Writing
AT-6	Activity Based Learning
AT-7	Viva Voce Examination

Prerequisites	Unit-wise Course Contents	Assessment tools
	Unit-1 Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit crops; crops; area, production, productivity and export potential of fruit and plantation crops - High density planting - Canopy management Use of rootstocks in fruit crops. Production technologies of Mango, Banana and Citrus (Big Lemon & Malta) - Botanical name Family Origin- Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Production technology of Grape, Guava, Papaya, Pomegranate and Jackfruit- Botanical name Family – Origin-Introduction- Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.	Mid-term Exams and End-Term Exam Assignments

Course Contents	**Unit-3** Production technology of Temperate Fruit Crops- Apple, Pear, Peach and Strawberry - Botanical name - Family- Origin- Introduction- Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.	End-Term Exam Assignments
	Unit-4 Production technology of Jackfruit, Strawberry, Nut crops (Almond & Walnut) Botanical name- Family- Origin- Introduction- Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.	End-Term Exam Assignments
	Unit-5 Plantation crops- Scope and Importance; Production technology of Palms: Coconut, Arecanut, Oil palm and Palmyrah, Plantation crops: Tea, Coffee, Cocoa, Cashewnut, Rubber. - Botanical name- Family- Origin- Importance- Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing-value addition.	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**

1. Propagation Techniques in Fruit Crops 2. Selection of Planting Material and Nursery Practices 3. Identification and Description of Varieties – Mango, Banana, Papaya, Guava, Sapota 4. Identification and Description of Varieties – Grapes, Citrus (Mandarin, Acid Lime), Pomegranate, Jackfruit 5. Cultural Practices for Mango, Banana, and Papaya 6. Cultural Practices for Guava, Sapota, and Grapes 7. Cultural Practices for Citrus, Pomegranate, and Jackfruit 8. Preparation and Application of Plant Growth Regulators (PGRs) 9. Micropropagation Techniques in Fruit Crops 10. Protocol for Mass Multiplication and Hardening of Fruit crops. 11. Mother Palm and Seed Nut Selection in Coconut 12. Seedling Selection and Fertilizer Application in Fruit Crops 13. Identification of Nutritional Disorders in Coconut, Arecanut, and Cocoa 14. Identification of Pests and Diseases in Coconut, Arecanut, and Cocoa 15. Identification of Pests and Diseases in Tea, Coffee, Rubber, and Cashew 16. Visit to Commercial Orchard and Plantation Industries.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	**As part of their continuous evaluation system, students are required to submit one assignment** a) Area, Production and Productivity of fruits and plantation crops in Indian scenario b) Importance and Scope of Fruits and Plantation Crops in India and World. c) Identification of common pests and diseases in various fruit crops
Suggested reading	1.Banday, F.A. and Sharma, M.K.2010 Advances in temperate fruit production. Kalyani Publishers, Ludhiana 2. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta. 3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture Vol.1. Naya Prokash, Calcutta. 4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi

	5. Chadha, T.R. 2001 Textbook of temperate fruits. ICAR, New Delhi 6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana. 7. Chattopadhyay. 1998. A textbook on pomology (sub-tropical fruits) vol.III. Published by M/s. Kalyani publishers, Ludhiana, New Delhi, Noida. UP. 8. Chudawat, B. S.1990. Arid fruit culture Oxford &IBH, New Delhi 9. Das, B.C. and Das S.N. Cultivation of minor fruits. Kalyani Publishers, Ludhiana 10. David Jackson and N.E. Laone, 1999. Subtropical and temperate fruit production. CABI publications 11. H.P. Singh and M.M. Mustafa 2009. Banana-new innovations Westville publishing House, New Delhi 12. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, Tamil Nadu. 13. Mitra, S.K., T.K. Bose and D.S. Rathore. 1991. Temperate fruits. Horticulture and allied Publishers, Calcutta. 14. Pal, J.S. 1997. Fruit Growing. Kalyani Publishers, New Delhi. 15. Radha, T. and Mathew, L.2007. Fruit crops. New India publishing Agency 16. Rajput, CBS and Srihari babu, R.1985. Citriculture, Kalyani Publishers, Ludhiana 17. Sadhu, M.K. and P.K. Chattopadhyay. 2001. Introductory Fruit Crops. Naya Prokash, Calcutta. 18. Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers, Ludhiana 19. Symmonds. 1996. Banana, II Edn.Longman, London 20. Veeraragavathatham, D., Jawaharlal, M., Jeeva, S., Rabindran, R and Umapathy, G. 2004 (2nd edition). Scientific fruit culture. Published by M/s. Suri associates, 1362/4, Velraj Vihar Complex, Thadagam Road, Coimbatore- 2 21. W.S. Dhillon. 2013. Fruit production in India. Narendra publishing House, New Delhi 22. Kavino, M, V. Jegadeeswari, R. M. Vijayakumar and S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops by Narendra Publishing House. 23. Kumar, N.J. B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi. 24. Nair. 1979. Cashew, CPCRI, Kerela

	25. Sharma, A., Kumar, P., Tripathi, V.K. 2024. Production Technology of Fruits and Plantation Crops. Elite Publishing House 26. Thampan, P.K.1981. Handbook of coconut palm. Oxford &IBH, New Delhi. 27. Thompson, P.K.1980. Coconut. Oxford &IBH, New Delhi 28. V. Ponnuswami, M. Kumar; S. Ramesh Kumar and C. Krishnamoorthy 2015. Fruit and Plantation Crops Narendra Publishing House.
Suggested resources (Websites/eBooks)	1. http://eagri.org/eagri50/HORT181/index.html 2. https://bscagristudy.online/wp-content/uploads/2021/06/HORT-243-PRINTED-NOTES.pdf 3. https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf 4. ICAR e-courses

Course Code: EXT-211		Course Name: Fundamentals of Extension Education		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

- To understand the basics and principles of education and extension education.
- To learn about the evolution of extension systems and major agricultural programmes in India.
- To explore modern trends in agricultural extension and technology dissemination.
- To gain knowledge of rural development, leadership, communication, and innovation adoption.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Remember the concept and need of Extension education.
CO-2	Understand the various tools and elements of extension education.
CO-3	Apply rural and community development Program in village and local area.
CO-4	Analyse the extension system in India and various policies of government.
CO-5	Evaluate new trends and schemes under extension education

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam

AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Practical Exam
AT-6	Viva-Voce examination
AT-7	Report Writing
AT-8	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**UNIT-I:** Education: Meaning, definition & Types; Extension Education- meaning, definition, scope, and process; objectives and principles of Extension Education; Extension Programme planning Meaning, Process, Principles and Steps in Programme Development.	Mid-term Exams and End-Term Exam Assignments
	UNIT II: Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).	Mid-term Exams and End-Term Exam Assignments
	UNIT III: New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.	End-Term Exam Assignments
	UNIT IV: Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions.	End-Term Exam Assignments
	UNIT V: Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, communication:	End-Term Exam Assignments

	meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.	

List of Practical (Field/Lab Exercises)	Assessment tools
1. To study about the preparation of Extension Literature: Leaflet and Folde 2. To study about the preparation of news stories. 3. To study about the group discussion 4. To study about the preparation of power point presentation 5. To study about the Indian agriculture scenario 6. Understand the problem encountered by the farmers 7. Preparation of Interview Schedule and Analysis of Data 8. Study of Cooperative's 9. Study of Non–Governmental Organizations (NGO's) 10. Visit of Krishi Vigyan Kendra (KVK) 11. To study and visit of Agricultural Technology Information Centre 12. PRA Techniques and its Application	Activity-Based Learning Practical Exam Viva-Voce Examination Assignments

Assignment	1. Preparation of leaflet 2. Preparation of folder 3. To prepare a power point presentation
Suggested reading	**A. Textbooks:** 1. Mondal, S. 2018. Fundamental of Agriculture Extension Education. Kalyani Publishers. New Delhi. 2. Ray, G.L. 2017. Extension Communication and management. Kalyani Publishers. New Delhi. 3. Shruti. 2013. Extension Education. New Vishal's. 4. Reddy, MVS. 2020. Fundamental of Agriculture Extension Education. Kalyani Publishers. New Delhi. 5. De, D. and Jirli, B. (2010). A Handbook of Extension Education. Agrobios (India), Jodhpur
Suggested resources (Websites/eBooks)	1. www.ecourses.icar.gov.in 2. www.jnkvv.org.in 3. www.ecoursesonline.iasri.res.in 4. www.libicar.gov.in 5. www.krishi.icar.gov.in

Course Code: NEM-211		Course Name: Fundamentals of Nematology		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.

2. To impart knowledge on nematode pests of different crops of national and local importance and their management.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the history, habitat, diversity, and economic importance of plant parasitic nematodes.
CO-2	Explain the morphology, biology, and classification of nematodes up to the family level, including their feeding and parasitic habits.
CO-3	Identify and describe symptoms caused by nematode infections and understand their interactions with other plant pathogens.
CO-4	Recognize major nematode pests affecting important crops like cereals, vegetables, pulses, oilseeds, fruits, and plantation crops.
CO-5	Apply integrated approaches for nematode management including cultural, physical, biological, chemical, and quarantine measures.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Practical Exam
AT-3	Viva-Voce examination
AT-4	Microscopic Slides preparation
AT-5	Diseases Sample wet Preservation
AT-6	Activity-Based Learning
AT-7	Poster
AT-8	Seminar Presentation and Report
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction: History of phytonematology, habitat and diversity, economic importance of nematodes. General characteristics of plant parasitic nematodes.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Nematode: definition, general morphology and biology. Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes on the basis of feeding/parasitic habit.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Symptomatology, role of nematodes in disease development, Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses.	End-Term Exam Assignments

Unit-4 Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseed and fiber crops, citrus and banana, tea, coffee and coconut.	End-Term Exam Assignments
Unit-5 Different methods of nematode management: Cultural methods, physical; methods, Biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. To familiarize students with the nematology laboratory, its tools, equipment, and safety procedures. 2. To understand and demonstrate appropriate methods for sampling soil and plant roots from the field for nematode analysis. 3. To learn techniques for proper collection, labeling, and handling of soil and plant samples for nematode extraction. 4. To extract nematodes from soil using Cobb's sieving and decanting technique (Part 1 – soil processing). 5. To continue nematode extraction using Cobb's method, focusing on root debris and refined separation (Part 2 – root processing). 6. To extract plant parasitic nematodes from plant tissues using the Baermann funnel technique. 7. To develop skills in observing, picking, and counting nematodes under a microscope. 8. To identify root-knot nematodes (*Meloidogyne* spp.) based on morphological characters and gall symptoms. 9. To identify lesion and cyst nematodes (Pratylenchus and Heterodera) using diagnostic features and identification keys. 10. To study and identify other economically important nematodes such as Tylenchulus, Xiphinema, and Helicotylenchus. 11. To observe and record symptoms caused by plant parasitic nematodes in cereal crops such as rice and wheat.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

12. To examine symptoms of nematode infestation in vegetable and pulse crops and correlate them with specific nematode genera. 13. To study nematode-induced symptoms in fruit and plantation crops including citrus, banana, tea, coffee, and coconut. 14. To understand and demonstrate various methods of nematode management, including the application of nematicides and organic amendments.	
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) History and Scope of Phytonematology b) Economic Importance and General Characteristics of Plant Parasitic Nematodes c) Classification of Nematodes and Feeding Habits d) Symptomatology and Disease Complexes Involving Nematodes e) Nematode Pests of Major Crops f) Integrated Nematode Management (INM)
Suggested reading	1. Economic Nematology-Edited by J.M. Webster 2. Plant Parasitic Nematodes (Vol-1) by Zukerman, Mai, Rohde Introduction to the study of Insects –D. J. Borror and DeLong's. 3. Plant Parasitic Nematodes of India: Problems and Progress by - Gopal Swarup, D. R. Dasgupta, P. K. Koshy. 4. Text book on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj.
Suggested resources (Websites/eBooks)	https://www.researchgate.net/publication/370399065_Nematology_Fundamentals_and_Applications_2nd_Revised_Enlarged_Edition

LECTURE PLAN

Course: Fundamentals of Nematology
Code: NEM-211
Credit: 3 (2+1)
Course Teacher: Dr. Vandana Sahu

S. No.	Name of Topic	Teaching Pedagogy	Course Outcome	Assessment Tools	Tentative Weeks
UNIT-I INTRODUCTION					
1	History of Phyto-nematology	Classroom lecture and PPT	CO-1	Assignment	
2	Habitat of nematodes	Classroom lecture	CO-1		
3	Diversity and economic importance of nematodes	PPT and Flip Class	CO-1	Field visit	
4	General characteristics of plant parasitic nematodes	Video lecture	CO-1	Microscopic slide preparation	
UNIT-II MORPHOLOGY, BIOLOGY AND CLASSIFICATION					
5	General morphology of nematodes	Classroom lecture and PPT	CO-2	Microscopic slide preparation	
6	Biology of nematodes	Classroom lecture	CO-2		
7	Classification up to family level	PPT and Chalkboard	CO-2	Seminar/Presentation	
8	Classification based on feeding	Flip class and collaborative learning	CO-2	Posters	
9	Classification based on parasitic habit	Classroom lecture and PPT	CO-2		
				Midterm Examination	
UNIT-III SYMPTOMATOLOGY AND DISEASE COMPLEXES					
10	Symptoms of nematode infections	Classroom lecture and Image illustration	CO-3	Assignment	
11	Symptomatology-root and shoot system	PPT and Chalkboard	CO-3		
12	Interaction with fungi	Video lecture and ABL	CO-3	Field visit	
13	Interaction with bacteria and viruses	Flip class and collaborative learning	CO-3		

UNIT-IV NEMATODE PESTS OF IMPORTANT CROPS					
14	Nematode pests of rice and wheat	Field photos and case studies	CO-4	Assignment	
15	Nematode pests of vegetables	Field photos and case studies	CO-4		
16	Nematode pests of pulses	Field photos and case studies	CO-4		
17	Nematode pests of oilseeds and fibre crops	PPT and group activity	CO-4	Field visit	
18	Nematode pests of fruits crops (citrus and banana)	Field photos and case studies	CO-4		
19	Nematode pests of plantation crops (tea, coffee and coconut)	Video lecture and field visit	CO-4		
UNIT-V NEMATODE MANAGEMENT					
20	Cultural methods of nematode management	Chalkboard and Demonstration	CO-5	Assignment	
21	Physical methods of nematode management	Chalkboard and Demonstration	CO-5	Demonstration	
22	Biological method of nematode control	Lab experiments and PPT	CO-5	ABL	
23	Chemical method of nematode control	Chalkboard and Demonstration	CO-5		
24	Plant resistant to nematode	Case study and Seminar	CO-5	Seminar/Presentation	
25	Quarantine measures for nematode management	Case study and Seminar	CO-5		
26	Integrated nematode management (INM)	Collaborative learning and group task	CO-5	Field visit report	
27	INM- case studies	Case study and Seminar	CO-5	Assignment	
28	INM- success stories	Case study and Seminar	CO-5		
End term Examination					

Course Code: AGRON-212		Course Name: Principles and Practices of Natural Farming		Semester: III
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**02**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the historical evolution, basic concepts, objectives, and principles of natural farming, and evaluate its significance in the context of climate change, soil health, biodiversity conservation, and sustainable development goals (SDGs).
CO-2	Analyse different methods/schools of natural farming, the design and characteristics of a natural farm, and the role of ecological balance, ecological engineering, and community responsibility in farming systems
CO-3	Apply knowledge of ecosystem services, integration of crops, trees, and animals, indigenous seed production, farm waste recycling, water conservation, and renewable energy use to develop sustainable and ecologically sound farm models
CO-4	Evaluate nutrient, pest, disease, and weed management techniques, mechanization, processing, certification standards, and economic viability of natural farming for its practical implementation and market potential.
CO-5	Assess government and NGO initiatives, successful case studies, and entrepreneurial opportunities in natural farming to promote chemical-free, sustainable agriculture and rural livelihood enhancement

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Field Visit
AT-3	Quiz
AT-4	Assignments
AT-5	Practical Exam
AT-6	Viva-Voce examination

Prerequisites	Unit-wise Course Contents	Assessment tools
	Unit-1 Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming; Definition; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/ schools of natural farming.	Mid-term Exams and End-Term Exam Quiz /Assignments
	Unit-2 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	Mid-term Exams and End-Term Exam Assignments
Course Contents	**Unit-3** Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming	End-Term Exam Quiz/ Assignments
	Unit-4 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.	End-Term Exam Assignments
	Unit-5 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	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Visit of natural farm and chemical free traditional farms. 2. Study the various components and operations of natural farming principles at the farm. 3. Indigenous technical knowledge (ITK) for seed tillage, water, nutrient, insect-pest, disease and weed management. 4. On-farm inputs preparation methods and protocols. 5. Studies in green manuring in-situ and green leaf manuring. 6. 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. 7. Weed management practices in natural farming. 8. Techniques of indigenous seed production, storage and marketing. 9. Partial and complete nutrient and financial budgeting in natural farming 10. Evaluation of ecosystem services in natural farming (Crop, Field and System) 11. Visit of chemical free traditional farms. 12. Indigenous technical knowledge for nutrient. 13. Indigenous technical knowledge for insect-pest, 14. Indigenous technical knowledge for disease 15. Indigenous technical knowledge for weed management 16. Indigenous technical knowledge (ITK) for water.	Practical Exam Viva-Voce Examination Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Nutrient management in natural farming and their sources b) Success stories in natural farming and chemical free traditional farming
Suggested reading	1. Ayachit SM. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205. 2. Boeringa R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp. 3. Dabholkar Shripad A. 2021. Plenty For All: Natural Farming A To Z Prayog Pariwar Methodology and Prayog Pariwar Prayog Pariwar. 4. 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. 5. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace. 6. Faires Nicole. 2016. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides). 7. 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 8. Fukuoka M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp

	9. Fukuoka M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp. 10. Hill S B and Ott P (Eds.). 1982 Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp. 11. HLPE. 2019. Agroeeological 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. 12. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp. 13. Khurana A and Kumar V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi. 14. Lindenmayer David B, Macbeth Suzannah M et al. 2022. Natural Asset Farming: Creating Productive and Biodiverse Farms.
Suggested resources (Websites/eBooks)	1. https://niti.gov.in/ – NITI Aayog documents and policy briefs on natural farming in India. 2. https://www.icar.org.in/ – Indian Council of Agricultural Research (ICAR) for reports and history. 3. https://bhuvan.nrsc.gov.in – For historical land-use patterns related to Indian agriculture. 4. https://www.paramparagat.co.in/ – Paramparagat Krishi Vikas Yojana (PKVY) portal. 5. https://www.kviconline.gov.in/ – Khadi & Village Industries Commission for entrepreneurship.

Course Code: SEC-VI		Course Name: Horticulture Nursery Management		Semester: IV
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**0**	**02**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

- ✓ **To produce and supply healthy, true-to-type, and quality planting materials** of horticultural crops for commercial cultivation and landscaping purposes.
- ✓ **To impart practical knowledge and skills** in plant propagation, nursery layout, media preparation, and pest-disease management for sustainable nursery management and entrepreneurship development.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the principles and practices of nursery establishment, layout planning, and infrastructure development.
CO-2	Acquire practical skills in propagation techniques such as seed sowing, grafting, budding, cutting, and layering.
CO-3	Identify and manage nursery tools, media, plant protection measures, and irrigation systems effectively.
CO-4	Demonstrate ability to manage pest, disease, weed, and nutrient problems in nursery plants using eco-friendly methods.
CO-5	Apply knowledge in planning, budgeting, marketing, and entrepreneurship for establishing and running a successful commercial nursery.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Identification of nursery tools and implements 2. Layout and planning of a model nursery 3. Preparation and sterilization of nursery media 4. Propagation structures – types and uses (mist chamber, polyhouse, etc.) 5. Preparation of nursery beds and pro-trays 6. Seed treatment and sowing techniques 7. Raising seedlings in pro-trays and polybags 8. Preparation and application of organic potting mixtures 9. Preparation of media using cocopeat and vermiculite 10. Hardening techniques for nursery plants 11. Potting and repotting of nursery plants 12. Plant propagation by stem cuttings 13. Propagation by leaf and root cuttings 14. Propagation through layering methods (mound, serpentine, etc.) 15. Budding techniques: T-budding, patch budding 16. Grafting methods: approach, veneer, cleft grafting	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

17. Micropropagation: basic demonstration and media preparation 18. Preparation and application of bio-fertilizers in nursery 19. Identification and control of nursery pests 20. Identification and control of nursery diseases 21. Weed control methods in nursery 22. Water management practices in nursery 23. Nutrient management in nursery plants 24. Use of growth regulators in nursery plant production 25. Labeling and record keeping in nursery management 26. Packaging techniques for nursery plants 27. Transportation of nursery plants – precautions and methods 28. Maintenance of mother block and scion bank 29. Layout and management of shade nets and greenhouses 30. Marketing strategies for nursery plants 31. Cost calculation and economics of nursery establishment 32. Visit to a commercial nursery and report preparation	

Course Code: AS-221		Course Name: Agriculture Informatics and Artificial Intelligence		Semester: IV
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

To provide opportunity to students for learning different methods and programs in computer.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Defining the analogy of computer.
CO-2	Illustration of the basic knowledge of MS Office and MS DOS.
CO-3	Demonstration the use of IT application and different IT tools in Agriculture
CO-4	Analyzing of some basic knowledge of data analysis
CO-5	Assessing the Agriculture Expert System and Soil Information Systems in Agriculture

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit – 1** Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory.	Power and Poster Point Presentation
	Unit – 2 Computer language and basic knowledge of software, hardware.	Mid Term Examination Report writing
	Unit – 3 Introduction of Data Base Management System, Network and virus. Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components.	Assignment Field demonstration
	Unit – 4 Concept and application of e-Agriculture, use of ICT and computer controlled device, Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.	ABL Quiz
	Unit-5 Concept of Decision support system, Agricultural expert system and crop planning using it tools, Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.	End term examination Spotting Viva Voce

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study of computer components, accessories, practice of important DOS commands. 2. Introduction of different operating systems such as windows, Unix, Linux, creating files and folders, file management. 3. Detailed comparative study of MS-Word 4. Detailed study of MS-Excel 5. Detailed study of MS- Powerpoint 6. Detailed study of MS-ACCESS 7. Introduction to World Wide Web (WWW) and its components, 8. creation of scientific website, 9. presentation, and management of health information through web. 10. Use of smart phones and other devices in agriculture and human health warning systems. 11. Hands on practice on preparation of decision support system 1.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Resources:	LCD, OHP, Black Board, Computer laboratory
Assignment	Students are required to submit one assignment and deliver one power point presentation as a part of their continuous evaluation system. 1. MS Word 2. MS Excel 3. MS Access 4. MS Power point 5. Data Analysis 6. MS DOS 7. Crop simulation model
Suggested reading	A. Textbooks: 1. Computer Fundamentals by Pradeep K. Sinha and Priti Sinha, III edition, BPB Publications. 2. Mastering Office Professional for window 95, BPB Publications 3. Statistical Methods for Agricultural workers by V.G. Panse andP.V. Sukhatma, ICAR, New Delhi.

	4. Fundamentals of Computer by V. Rajaroman. 5. Introduction to Information Technology by Pearson. 6. Introduction to Database Management System by C. J. Date. 7. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, B. Reference books: 1. Bangia,Learning Ms Office 2010. 1. Prof. Satish Jain and M.Geetha, MS-Office 2010 Training Guide
Suggested resources (Websites/eBooks)	• www. Agrimoon.com • http://ecourseonline.iasri.res.in

Course Code: HORTI-221		Course Name: Production Technology of Vegetables and Spices		Semester: IV
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

1. To educate about the different forms of classification of vegetables.
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices
3. To educate about the physiological disorders of vegetables and spices.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Explain the importance, classification, and distribution of vegetable and spice crops and their role in human nutrition and the national economy.
CO-2	Apply the principles of crop production by selecting appropriate climate, soil and agronomic practices for vegetable and spice crops.
CO-3	Analyze the cultivation techniques and diagnose physiological disorders of major fruit, leafy and tuber vegetable crops.
CO-4	Evaluate the production technologies of bulb, root, cole and leguminous vegetable crops and recommend solutions to field-related issues.
CO-5	Design comprehensive cultivation plans for important spice and herbal crops, integrating knowledge of their ecological and economic significance.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Field Experiments 3. Chalkboard/Smartboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
	Unit-1 Importance of vegetables and spices in human nutrition and the national economy. It also introduces kitchen gardening, classification of vegetables and spices, and provides a brief overview of their origin, area, and distribution.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 General cultivation requirements of vegetable and spice crops, including suitable climate and soil, land preparation, time of sowing, transplanting techniques, spacing, fertilizer application, irrigation, weed management, harvesting, and estimation of yield.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Cultivation practices and physiological disorders of major fruit vegetables such as tomato, okra, brinjal, chili, capsicum, cucumber, bitter gourd, bottle gourd; leafy vegetables like amaranth, palak, and moringa; and tuber crops including sweet potato, cassava, and potato.	End-Term Exam Assignments

Course Contents	**Unit-4** Bulb crops like onion and garlic; root vegetables such as carrot, radish, and beetroot; cole crops including cabbage, cauliflower, and knol-khol; and leguminous vegetables like French bean and peas, along with their cultivation practices and common physiological disorders.	End-Term Exam Assignments
	Unit-5 Cultivation practices and physiological disorders of important spice crops such as turmeric, ginger, coriander, cumin, garlic, black pepper, cardamom, fenugreek, and fennel, as well as tree spices including clove, nutmeg, cinnamon, curry leaf, and tamarind, along with an introduction to herbal spices and their uses.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)		**Assessment tools**
Practical	Classes	
1. Identification of vegetables & spice crops and their seeds.	2	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
2. Description of varieties.	1	
3. Propagation methods - rapid multiplication techniques –	1	
4. Seed collection and extraction.	1	
5. Nursery raising.	1	
6. Direct seed sowing and transplanting.	1	
7. Study of morphological characters of different vegetables & spices.	2	
8. Fertilizers applications and use of growth regulators	1	
9. Harvesting and post-harvest practices.	2	
10. Economics of vegetables and spices cultivation	1	
11. Visit to spice gardens	1	
	1	
	15	

Assignment	As part of their continuous evaluation system, students are required to submit one assignment: 1. Importance of vegetables and spices in daily life 2. Steps of vegetable cultivation from sowing to harvesting 3. Common vegetable crops and their improved varieties 4. Physiological disorders in vegetables and how to manage them 5. Major spice crops and their uses in food and health

Suggested reading	**A. Textbooks:** 1. Thamburaj, S. and Singh, N. (eds.) (2001) Textbook of vegetables, tuber crops and spices. New Delhi: Indian Council of Agricultural Research (ICAR). 2. Hazra, P., Chattopadhyay, A., Karmakar, K. and Dutta, S. (2011) Modern technology in vegetable production. New Delhi: New India Publishing Agency. 3. Peter, K.V. (ed.) (2009) *Basics of horticulture*. New Delhi: New India Publishing Agency.
Suggested resources (Websites/eBooks)	1.http://agricoop.gov.in/Documents/Horticulture%20Statistics%20at%20a%20Glance-2018.pdf 2.http://agricoop.gov.in/en/StatHortEst#gsc.tab=0 3.https://shm.uk.gov.in/files/Books/Check_List_of_Commercial_Varieties_of_Vegetables_(pdf_8.22_MB).pdf

Course Code: AE-221		**Course Name:** Principles of Agricultural Economics and Farm Management		**Semester: IV**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**02**	**00**	**2**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Basic, applied, and Innovative		**Student-specific course outcome**	Placement Research Higher education Entrepreneurship

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	*Define and describe* the fundamental concepts of economics, including goods, services, demand, utility, wealth, capital, income, and welfare, along with the meaning and characteristics of agricultural economics.
CO-2	*Explain and illustrate* the laws of supply and demand, elasticity, utility theory, consumer equilibrium, and the role of agriculture in economic development and planning.
CO-3	*Apply* the concepts of cost, production, and input-output relationships to real-world agricultural and economic scenarios to analyze the impact on productivity and profitability.
CO-4	*Analyze* the theories of population, national income, and distribution, and compare different economic systems (capitalist, socialist, mixed) in the context of Indian agriculture and development.

CO-5	*Evaluate* the implications of GST, inflation, monetary systems, and international trade on the Indian agricultural economy and justify the importance of effective agricultural planning and policy measures.

Teaching Pedagogy	
T1	1. Activity-based learning through a visit to various fields. 2. PowerPoint Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/ Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Viva-Voce examination
AT-7	Report Writing
AT-8	Surplus Calculation
AT-9	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
	Unit 1: Economics: Meaning, scope and subject matter, definitions, activities,	Assignment, Mid-term examinations

Course Contents	approaches to economic analysis; micro- and macro-economics, positive and normative analysis. Nature of economic theory: rationality assumption, concept of equilibrium, economic laws as a generalization of human behaviour. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income, and welfare.	
	Unit 2: Agricultural economics: meaning, definition, characteristics of agriculture, importance, and its role in economic development. Agricultural planning and development in the country.	Assignment, Unannounced test Mid and End Term Examinations
	Unit 3: 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 derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity, and cross elasticity.	Skill test, Quiz. end-term examinations
	Unit 4: 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.	Assignment, End Term Examinations

	Unit 5: Distribution theory: meaning, factor market, and pricing of factors of production. 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, natural and socio-economic determinants, current policies and programs on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic, and mixed economies, elements of economic planning. Forms of business organizations, international trade and balance of payments. GST and its implication on the Indian economy.	End term examination

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) *Difference between Microeconomics and Macroeconomics with Examples* b) *Role of Agriculture in Economic Development* c) *Law of Demand and Elasticity of Demand* d) *Cost and Production Analysis in Agriculture* e) *National Income and GST: Concepts and Relevance in the Indian Economy*
Suggested reading	1. Johl, S.S. and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers 2. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd

Suggested resources (Websites/eBooks)	

Course Code: AGRON-221		**Course Name:** Crop Production Technology-II (***Rabi*** crops)		**Semester:** IV
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
03	**01**	**02**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course 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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the origin, distribution, economic importance, and agro-climatic requirements of major *rabi* cereal, pulse, oilseed, sugar, medicinal, aromatic, and forage crops.
CO-2	Identify and evaluate varieties and cultural practices for enhancing the productivity and sustainability of *rabi* cropping systems.
CO-3	Demonstrate practical knowledge on sowing methods, morphological traits, and yield-contributing characters of rabi crops through hands-on field and lab exercises.
CO-4	Analyze yield components and quality traits of *rabi* crops using scientific techniques.
CO-5	Critically assess current trends in *rabi* crop research and cultivation through experiential learning, field visits, and agronomic trials.
Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard
T2	1. PBL activities 2. Assignments 3. Flip Class 4. Quiz

Assessment tools

AT-1	Mid-term Exams and End-Term Exam
AT-2	Report
AT-3	Quiz
AT-4	Activity-Based Learning
AT-5	Practical Exam
AT-6	Viva-Voce examination
AT-7	Report Writing
AT-8	Field Visit Report
AT-9	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit-I** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* cereals crops, viz., wheat and barley	Mid-term Exams and End-Term Exam Assignments
	Unit-II Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* pulses crops, viz., chickpea, lentil, peas. *Rabi* redgram and, rajmash	Mid-term Exams and End-Term Exam Quiz
	Unit-III Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* oilseed crops, viz., rapeseed, mustard, sunflower, safflower; and linseed	End-Term Exam Assignments
	Unit-IV Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* sugar, medicinal and aromatic crops, viz., sugarcane, sugar beet, mentha, lemon grass and citronella	End-Term Exam Quiz
	Unit-V Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* forage and other Specialty crops - barseem, lucerne and oat; potato, quinoa, tobacco.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Sowing methods of wheat 2. Sowing methods of sugarcane	Activity-Based

3. Seed treatment and sowing of *rabi* pulses (chickpea, lentil, pea) 4. Sowing and spacing techniques of *rabi* oilseeds (mustard, linseed, sunflower) 5. Identification and classification of common weeds in rabi crops 6. Study of morphological characteristics of *rabi* cereals (wheat and barley) 7. Study of morphological characteristics of *rabi* pulses (chickpea, lentil, pea) 8. Study of morphological characteristics of *rabi* oilseeds (mustard, linseed, safflower) 9. Study of yield contributing characters in *rabi* cereals and pulses 10. Yield and juice quality analysis of sugarcane (Brix reading, CCS estimation) 11. Study of important agronomic experiments on *rabi* crops at the college farm 12. Study of *rabi* forage experiments (berseem, oat, lucerne) - sowing to harvest 13. Oil extraction or processing techniques for menthe and citronella 14. Visit to research stations or KVKs for *rabi* crops 15. Recording biometric observations in *rabi* crops (plant height, branching, pod number etc.) 16. Study of fertilizer application methods in major *rabi* crops 17. Application of FYM and Vermicompost at 30 (Day before sowing (DBS) 18. Pre irrigation given before the time of field preparation 19. Field preparation for the seed sowing 20. Seed rate and sowing methods 21. Nutrient management practices in the crops 22. Water management in different crops 23. Calibration of knapsack sprayer for the spraying. 24. Weed management practices in the crops 25. Thinning practices in different crops 26. Earthing-up in different crops 27. Methods of harvesting of different crops 28. Threshing of different crops 29. Winnowing of the crops 30. Storage of the different type of produce 31. Marketing of produce (MSP) grown by students 32. Preparation of Balance Sheet Including Cost of Cultivation, Net Returns per student as well as per Team of a Group of Students	Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Production and Productivity Trends of Wheat in India and Major Wheat-growing States 2. Impact of Climate Change on Wheat Production: A Global Perspective 3. Major Constraints and Opportunities in Chickpea Cultivation in India 4. Residual Benefits of Pulses in Rabi Cropping Systems 5. Trends in Area, Production, and Productivity of Mustard in India 6. Role of Rapeseed-Mustard in Edible Oil Security of India 7. Comparative Study of Traditional vs Improved Practices in Safflower Cultivation

Suggested reading	1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. 2. Kalyani Publishers, New Delhi. 3. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 4. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication. 5. Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.
Suggested resources (Websites/eBook)	i. https://bscagriculture.com/crop-production-technology-ii-rabi-crops/#google_vignette ii. http://www.agritech.tnau.ac.in/pdf/AGRICULTURE.pdf iii. https://agrifair.in/crop-production-technology-rabi-crops-pdf-book/ iv. https://www.scribd.com/document/725395720/Crop-Production-Technology-II-Rabi-crops

Course Code: AENG-221		Course Name: Name: Farm Machinery and Power		Semester: IV
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Placement • Research • Higher education

Course Objectives:

1. To understand the importance of farm power and the basic principles of internal combustion (IC) engines.
2. To learn about different agricultural equipment for tillage, sowing, intercultural operations, and plant protection.
3. To gain knowledge of the working principles of threshers and harvesting techniques for field and horticultural crops..

Course outcomes: After completion of the course, the student will be able to:

CO-1	Define the farm power sources and describe the different operations in farm machinery
CO-2	Understand the principles of farm machinery management for different soil, crops and operations
CO-3	Calculate the performance of farm machinery under actual field conditions
CO-4	Examine the working principle of different system of tractor & parts of internal combustion engines
CO-5	Evaluate the performance of harvesting, threshing and special equipment for various farm operations.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations 5. Video 6. Interactive Lecture 7. Problem Solving

T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit – 1** Status of Farm Power in India; Sources of Farm Power, I.C. engines, working principles of I C stroke cycle engines, Study of different components of I.C. engine terminology and solved problems; Familiarization with different systems fuel supply and hydraulic control system of a with Power transmission system : clutch; gear box, differential and final	Power and Poster Point Presentation
	Unit – 2 Tractor types; Cost analysis of tractor power and attached implement; Criteria	Mid Term examination Report writing
	Unit – 3 Familiarization with Primary and Secondary Tillage implement; Implement for hill agriculture; implement for intercultural operations.	Assignment Field demonstration

	Unit – 4 Familiarization with sowing and planting equipment; calibration of a seed drill and solved equipment.	ABL Quiz
	Unit-5 Familiarization with harvesting and threshing equipment.	End term examination Spotting Viva Voce

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. To study the different components of engines. 2. To study air cleaning and cooling system of engine. 3. To familiarization with clutch, transmission, differential and final drive of a tractor. 4. To familiarization with lubrication and fuel supply system of engine. 5. To familiarization with brake, steering, hydraulic control system of engine, 6. To study the learning of tractor driving. 7. To familiarization with operation of power tiller and mplements for hill agriculture. 8. To familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow. 9. To familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and trans planter. 10. To familiarization with different types of sprayers and dusters. 11. To familiarization with different inter-cultivation equipment. 12. To familiarization with harvesting and threshing machinery. 13. To study the calculation of power requirement for different implements.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Calibration of seed drill b) Calculate the cost of tractor and other field machinery.
Suggested reading	**Textbooks:** 1. Elements of Agricultural Engineering, Dr. Jagdishwar Sahay, Standard Publisher Distributor. 2. Farm Power and Machinery, Er. Sanjay Kumar, Kalyani Publication. 3. Farm machinery- An Approach, S.C Jain and Grace Philip. 4. Principles of Agricultural Engineering, Volume -1, TP Ojha and AM Michael, Jain Brothers.

	Reference books: 1. Principles of Farm Machinery, RA kepner, Roy Bainer, B.L Barger. 2. Tractors and Their Power Units, John B. Liljedahl, Paul K. Turnquist, David W. Smith, and Makoto Hoki. 3. Handbook of Agricultural Engineering, ICAR, New Delhi. 4. Agricultural Engineering Data Book, CIAE, ICAR, Bhopal.
Suggested resources (Websites/eBooks))	1. http://www. agrimoon.com 2. http://ecourseonline.iasri.res.in

Course Code: AGRON - 222		**Course Name:** Water Management		**Semester:** IV
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	01	01	03	B.Sc. (Hons.) Agriculture
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course 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 crops and drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the principles, objectives, and importance of irrigation in agriculture, including soil-plant-water relationships and the role of water in crop growth and development.
CO-2	Analyze various methods of estimating soil moisture, evapotranspiration, and determining crop water requirements, including scheduling of irrigation based on climatic and soil parameters.
CO-3	Evaluate different irrigation methods (surface, sub-surface, sprinkler, and drip), including their design, layout, efficiency, advantages, limitations, and suitability for different crops and soil types.
CO-4	Apply knowledge of irrigation water quality, fertigation, and water budgeting to develop efficient and sustainable water management plans for major crops like rice, wheat, maize, sugarcane, and horticultural crops.
CO-5	Demonstrate the ability to design and manage modern irrigation systems including underground pipeline layout, automation, and AI-based irrigation practices for enhancing water use efficiency and adapting to climate variability.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Field Visit/ Lab Experiments 3. Chalkboard 4. Power Point Presentations

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-3	Practical Exam
AT-4	Viva-Voce examination
AT-5	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1: Introduction to Irrigation and Water-Plant Relationships** Irrigation: definition and objectives; Importance: Function of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships.	Mid-term Exams and End-Term Exam Quiz/Assignments
	Unit 2: Soil Moisture and Crop Water Requirement 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, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation;	Mid-term Exams and End-Term Exam Assignments
	Unit 3: Irrigation Methods and Efficiency Methods of irrigation: surface and sub-surface, pressurized methods, viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water; Layout of different irrigation systems, Irrigation efficiency and water use efficiency.	End-Term Exam Quiz/Assignments

	Unit 4: Irrigation Water Quality and Management Practices Conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); quality of irrigation water, irrigation management practices for different soils and crops, drip, sprinkler.	End-Term Exam Assignments
	Unit 5: Modern Irrigation Systems and Automation Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Determination of Bulk Density by Field Method 2. Determination of Soil Moisture Content by Gravimetric Method 3. Determination of Soil Moisture Content Using Tensiometer 4. Measurement of Soil Moisture by Electrical Resistance Block 5. Measurement of Soil Moisture by Neutron Moisture Meter 6. Determination of Field Capacity by Field Method 7. Determination of Permanent Wilting Point 8. Measurement of Irrigation Water Using Water Measuring Devices 9. Calculation of Irrigation Water Requirement 10. Determination of Infiltration Rate 11. Demonstration of Furrow Method of Irrigation 12. Demonstration of Check Basin and Basin Method of Irrigation 13. Cost Estimation and Visit to Farmers' Field for Drip Irrigation System 14. Demonstration of Filter Cleaning, Fertigation, Injection and Flushing of Laterals 15. Layout for Different Methods of Irrigation 16. Erection and Operation of Sprinkler Irrigation System and Emitter Evaluation .	Practical Exam Viva-Voce Examination Field Visit Report

Assignment	As part of their continuous evaluation system, students are required to submit one 1. Role of Irrigation in Enhancing Crop Productivity and Water-Plant Relationships 2. Estimation of Crop Water Requirement and Scheduling of Irrigation 3. Comparative Study of Surface, Sprinkler, and Drip Irrigation Methods 4. Water Management Practices for Major Crops under Different Soil and

	Water Conditions 5. Application of Artificial Intelligence in Modern Irrigation System
Suggested reading	1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing 2. Dilipkumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt. Ltd., 3. S.V. Patil &Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish serial 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.
Suggested resources (Websites/eBooks)	1. https://wwd.ca.gov/wp-content/uploads/2015/09/water-management-handbook-2013.pdf 2. https://agrimoon.com/wp-content/uploads/Water-Management-including-Micro-Irrigation.pdf

Course Code: SS- 221		Course Name: Problematic Soils and their Management		Semester: IVth
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
02	**01**	**01**	**02**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives: To identify the problem and what are the reclamation method requires improving the soil health & improve soil fertility, that necessary to improve the yield.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the concepts of soil quality and health, and classify problem soils in India based on their physical and chemical properties.
CO-2	Explain the causes, reclamation techniques, and management practices for acid, saline, sodic, acid sulfate, eroded, compacted, and polluted soils.
CO-3	Analyze the impact of pesticide and heavy metal contamination in soils, and describe management strategies for mined, riverine, and waterlogged soils
CO-4	Evaluate the quality of irrigation water and explain the use of saline water in agriculture; apply remote sensing and GIS tools for diagnosing and managing problem soils
CO-5	Demonstrate knowledge of multipurpose tree (MPT) species and their role in bioremediation; interpret land capability and suitability classification for sustainable land use planning..

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, and Waterlogged soils.	End-Term Exam Assignments
	Unit-4 Irrigation water – quality and standards, utilization of saline water in agriculture , Use of Remote sensing and GIS in diagnosis and management of problem soils	End-Term Exam Assignments
	Unit-5 Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Determination of pH of saturation extract of problematic soil 2. Determination of EC of saturation extract of problematic soil 3. Determination of redox potential in soil 4. Estimation of water soluble and exchangeable cations in soil 5. Determination the computation of SAR and ESP and characterization of problematic soil. 6. Determination of Gypsum requirement of alkali / sodic soil. 7. Determination of lime requirement of acidic soil 8. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO_3, HCO_3, Cl, SAR and RSC). 9. Determination of nitrate (NO_3^-) from irrigation water. 10. Determination of dissolved oxygen and free carbon dioxide levels in water samples.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Role of remote sensing and GIS in diagnosis of problematic soil. b) Discuss parameter of soil quality and health
Suggested reading	1. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, Agrobios (India). 2. Brady Nyle C and Ray R Well., 2014. Nature and properties of soils. Pearson Education Inc.,New D Delhi. 3. Cirsan J. Paul., 1985, Principles of Remote Sensing. Longman, New York 4. Indian Society of Soil Science. 2002. Fundamentals of Soil Science. IARI, New Delhi 5. Osman, Khan Towhid., 2018. Management of Soil Problems. Springer publication 6. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi
Suggested resources (Websites/eBooks)	1. http://ecoursesonline.iasri.res.in/course/view.php?id=125 2. http://cattheni.edu.in/wp-content/uploads/2018/09/SAC-301.pdf 3. https://agritech.tnau.ac.in/pdf/3.pdf 4. https://coabnau.in/uploads/1631006625_UG_Ag.Chem.3.3_Problematic Soils_theorynotes.pdf

Course Code: GPB-221		Course Name: Basics of Plant Breeding		Semester: IV
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Field work based • Research-based		**Student-specific course outcome**	• Research • Placement • Higher education

Course Objectives:

1. 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.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Describe the history, role, and achievements of plant breeding.
CO-2	Explain genetic concepts related to breeding of self-, cross-, and asexually propagated crops.
CO-3	Apply knowledge of breeding methods like mass selection, pure line selection, and recurrent selection.
CO-4	Demonstrate skills in hybridization, segregation handling, and estimation of genetic parameters.
CO-5	Evaluate the significance of polyploidy, mutation, and biotechnology tools in modern breeding.

Teaching Pedagogy	
T1	Activity based learning through lab experimentation Lecture with PowerPoint and board explanation
T2	Lab demonstrations and field-based learning Assignments Assignments, group discussion, quizzes Seminar presentations and report writing

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit – 1** 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, selfincompatibility and male-sterility-genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction.	Power and Poster Point Presentation
	Unit – 2 Centres of origin/diversity, Components of Genetic variation. Heritability and genetic advance. Pre-breeding and Universal Plant Breeder's equation.	Mid Term examination Report writing
	Unit – 3 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	Assignment Field demonstration
	Unit – 4 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.	ABL Quiz
	Unit-5 Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding- methods and uses. Breeding for important biotic and abiotic stresses. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.	End term examination Spotting Viva Voce

List of Practical (Field/Lab Exercises)	Assessment tools
1. Plant Breeder's kit, 2. Study of germplasm of various crops. 3. Study of floral structures of selfpollinated 4. Study of floral structures cross-pollinated crops. 5. Emasculation and hybridization techniques in self pollinated crops. 6. Emasculation and hybridization techniques in cross pollinated crops, 7. Consequences of inbreeding on genetic structure of resulting populations, 8. Study of male sterility system, Handling of segregating populations, Methods of calculating mean, range, 9. Variance, standard deviation, heritability, Designs used in plant breeding experiments, 10. Analysis of Randomized Block Design. 11. To work out the mode of pollination in a given crop and extent of natural out-crossing, 12. Prediction of performance of double cross hybrids. 13. Maintenance of breeding 14. Records and data collection, Screening tests for biotic and abiotic stresses	Practical Activity Practical Record Viva voce Spot Identification

Assignment	As part of their continuous evaluation system, students are required to submit one assignment One assignment and PowerPoint seminar mandatory per student on: 1. History of plant breeding 2. Selection methods 3. Heterosis breeding 4. Marker-assisted selection
Suggested reading	**Textbooks:** 1. Plant Breeding: Principles and Methods – B.D. Singh 2. Elementary Principles of Plant Breeding – H.K. Choudhary 3. Breeding Field Crops – Poehlman & Sleper 4. Principles of Plant Breeding – R.W. Allard 5. Principles of Genetics and Plant Breeding – Acquaah **Reference books:** 1. Quantitative Genetics in Plant Breeding – Mather & Jinks 2. Genetics and Analysis of Quantitative Traits – Lynch & Walsh 1. ICAR e-Course Material on Plant Breeding – IASRI, New Delhi
Suggested resources (Websites/eBooks)	• www. Agrimoon.com • http://ecourseonline.iasri.res.in

Course Code: AE-311		**Course Name:** Agricultural Marketing and Trade		**Semester: V**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Basic, applied, and Innovative		**Student-specific course outcome**	Placement Research Higher education Entrepreneurship

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	*Define and describe* key concepts such as market, agricultural marketing, market structure, marketing mix, and different classifications of agricultural markets.
CO-2	*Explain and illustrate* the nature of demand, supply, producer's surplus, marketing channels, and functions of marketing in the context of agricultural commodities.
CO-3	*Apply* pricing and promotion strategies, market integration concepts, and marketing functions like storage, transport, packaging, and grading to real-world agricultural marketing systems.
CO-4	*Analyze* the roles and efficiency of various market functionaries, public institutions (CWC, SWC, FCI, CACP, DMI), and cooperative marketing in enhancing agricultural market performance.

CO-5	*Evaluate* the implications of WTO agreements, administered pricing policies, APMC reforms, and international trade theories (absolute and comparative advantage) on Indian agriculture and global trade in agri-commodities.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Whiteboard 3. PowerPoint Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and end-term exams
AT-2	Seminar Presentation
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Viva voce examination
AT-7	Report writing
AT-8	Surplus Calculation
AT-9	Identification of Market

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1** Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix, and market segmentation, classification, and characteristics of agricultural markets;	Presentation
	Unit 2 Demand, supply, and producers' surplus of agri commodities: nature and determinants of demand and supply of farm products, producers' surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agricultural commodities;	Mid Term examination Report writing
	Unit 3 Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark);	Assignment
	Unit – 4 Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost	ABL Quiz

	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 and DMI – their objectives and functions; cooperative marketing in India;	
	Unit 5 Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR; Role of government in agricultural marketing; Role of APMC and its relevance in the present-day context.	End term examination ABL Viva Voce
List of Practical (Field/Lab Exercises)		**Assessment tools**

1. Plotting and study of demand and supply curves and calculation of elasticities. 2. Study of the relationship between market arrivals and prices of some selected commodities. 3. Computation of marketable and marketed surplus of important commodities. 4. Study of price behaviour over time for some selected commodities. 5. Construction of index numbers. 6. Visit to a local market to study various marketing functions performed by different agencies. 7. Identification of marketing channels for a selected commodity. 8. Collection of data regarding marketing costs, margins, and price spread. 9. Presentation of the report in the class based on the market visit and collected data. 10. Visit to market institutions such as NAFED, SWC, CWC, cooperative marketing society, etc., to study their organization and functioning. 11. Application of principles of comparative advantage in international trade.	Practical Activity Practical Record Viva voce Identification of the channel
Assignment	As part of their continuous evaluation system, students are required to submit one assignment **a)** Market Structure and Classification of Agricultural Markets: A Comparative Study **b)** Demand, Supply, and Producer's Surplus in Agricultural Commodities: An Analytical Approach **c)** Marketing Channels and Price Spread Analysis for a Selected Agricultural Commodity **d)** Role of Government and Public Sector Institutions in Agricultural Marketing in India.

	e) Implications of WTO's Agreement on Agriculture (AoA) on Indian Agriculture and Trade Prospects.
Suggested reading	• Acharya, S.S. and Agarwal, N.L. 2006. 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, Microeconomic Theory. • Kohls Richard, L. and Uhl Josheph, 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 Singh, Joginder. 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.
Suggested resources (Websites/eBooks)	1. https://agmarknet.gov.in/ 2. https://vikaspedia.in/agriculture/market-information/market-information-related-websites 3. http://cacp.dacnet.nic.in/content.aspx?pid=32# 4. http://dmi.gov.in/About.aspx

Course Code: AGM-311		Course Name: Introduction to Agro-meteorology		Semester: V
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand Meaning and scope of agricultural meteorology.	
CO-2	Analyzing albedo and sunshine duration, computation of Radiation Intensity using BSS	
CO-3	Recognize Planck's intensity law for measuring the total, shortwave and long wave radiation	
CO-4	Development of weather forecasting-types and methods; crop weather calendar	
CO-5	Application of Thermal time concept and Crop/Pest weather calendar	

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1-** Meaning and scope of agricultural meteorology; Earth atmosphere: its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height.	Mid-term Exams and End-Term Exam Assignments
	Unit-2- 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, short wave, longwave and thermal radiation, net radiation,	Mid-term Exams and End-Term Exam Assignments
	Unit-3- albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Application of Thermal time concept and Crop/Pest weather calendar. Energy balance of earth; Atmospheric humidity, concept of saturation, vapour 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 rainmaking.	End-Term Exam Assignments
	Unit-4- 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 normal for crop and livestock production.	End-Term Exam Assignments
	Unit-5- 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.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Visit of Agrometeorological Observatory, 2. Site selection of observatory, 3. Exposure of instruments and weather data recording, 4. Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law, 5. Measurement of albedo and sunshine duration, 6. Computation of Radiation Intensity using BSS; 7. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, 8. Measurement of soil temperature and computation of soil heat flux, 9. Determination of vapor pressure and relative humidity, 10. Determination of dew point temperature, 11. Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of windrose, 12. Measurement, tabulation and analysis of rain, 13. Measurement of open pan evaporation and evapotranspiration, 14. Computation of PET and AET, 15. Use of synoptic charts and weather reports, 16. Weather forecasting-types and methods, crop weather calendar.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Scope of agricultural meteorology 2. Application of Thermal time concept and Crop/Pest weather calendar 3. Monsoon- mechanism and importance in Indian agriculture 4. Weather forecasting- types of weather forecast and their uses 5. Climate change, climatic variability, global warming, 6. Causes of climate change and its impact on regional and national agriculture
Suggested reading	1. Agricultural Meteorology by G.S.L.H.V. Prasado Rao 2. Fundamentals of Agrometeorology and Climate Change by G. S. Mahi and P. K. Kingra 3. Introduction to Agrometeorology and Climate Change by Alok Kumar Patra 4. Introduction to Agrometeorology by H. S. Mavi 5. Text Book of Agricultural Meteorology by M. C.Varshneya and P.B. Pillai

Suggested resources (Websites/eBooks)	1. https://www.aau.in/sites/default/files/AGRI%20221_0.pdf 2. https://www.bamis.gov.bd/res/attachment/2020/02/16/13328.pdf 3. https://gargicollege.in/wp-content/uploads/2020/03/weather_forecast.pdf 4. https://justagriculture.in/files/newsletter/2021/jan/021.pdf

Course Code: CP-311		Course Name: Fundamentals of Crop Physiology		Semester: V
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

1. To Understand Fundamental Physiological Processes in Plants
2. To Explore the Role of Water and Nutrients in Crop Performance
3. To Analyze Plant Growth, Development, and Productivity
4. To Link Plant Physiology with Crop Science and Practical Agriculture
5. To Develop Practical Skills in Plant Physiology Techniques

Course outcomes: After completion of the course, the student will be able to:

CO-1	Describe the fundamentals of plant and crop physiology, their significance in agriculture, and their relationship with other crop sciences, including a detailed overview of plant cell structure, organelles, and their functions.
CO-2	Explain the physiological aspects of water in plants—diffusion, osmosis, water potential, water absorption and loss mechanisms, transpiration, stomatal physiology, guttation—and analyze their role in water use efficiency and plant-water relations including concepts like ascent of sap, SPAC, cavitation, antitranspirants, field capacity, wilting point, and available soil moisture.
CO-3	Discuss essential and beneficial nutrients, their functions, uptake mechanisms, deficiency symptoms, and correction strategies including foliar nutrition, root feeding, hydroponics, and sand culture; and demonstrate understanding of related experimental methods.
CO-4	Evaluate the processes of photosynthesis and respiration—covering pigment systems, photochemical reactions, C3, C4, and CAM pathways, photorespiration, and energy production—and analyze environmental and physiological factors affecting these processes.
CO-5	Assess plant growth and development processes, including growth analysis, photoperiodism, vernalization, senescence, abscission, and hormonal regulation; describe the roles and applications of plant growth regulators (auxins, gibberellins, cytokinins, ethylene, ABA), and demonstrate their effects through laboratory-based experiments

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Interactive Lectures 4. Chalkboard 5. Power Point Presentations
T2	1. ABL activities 2. Interactive Lectures 3. Assignments 4. Flip Class/Seminars 5. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1: Foundations of Plant and Crop Physiology** • Definitions of plant physiology and crop physiology • Importance of crop physiology • Relationship of crop physiology with other branches of crop science • Overview of plant cell: organelles and their functions	Mid-term Exams and End-Term Exam Assignments
	Unit 2: Water Relations and Mineral Nutrition in Plants • Diffusion and osmosis • Imbibition • Physiological roles of water to crop plants • Definition and components of water potential • Water absorption: active and passive absorption • Water loss: transpiration, stomatal physiology, guttation • Water use efficiency • Field capacity, permanent wilting point, available soil moisture • Apoplast, symplast, transmembrane pathways • Ascent of sap: theories and mechanisms • Soil-plant-atmospheric continuum • Significance of transpiration • Stomatal opening and closing mechanisms • Cavitation and embolism • Antitranspirants: types and examples • Essential and beneficial elements • Passive and active transport of mineral elements • Functions of essential elements • Criteria of essentiality of nutrients • Correction measures for nutrient deficiency symptoms • Foliar nutrition and root feeding: significance • Hydroponics and sand culture • Aeroponics.	Mid-term Exams and End-Term Exam Assignments
	Unit 3: Photosynthesis: Mechanisms and Adaptations • Photosynthetic apparatus and pigments (chlorophyll, carotenoids, phycobilins) • Differences and structures of chlorophyll a and b • Quantum requirement and quantum yield • Red drop and Emerson enhancement effect • Pigment system I and II	End-Term Exam Assignments

	• Light reaction: absorption, energy transfer, Hill reaction • Cyclic and non-cyclic photophosphorylation; assimilatory powers • C3, C4, and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle • Significance of pathways: photorespiration, productivity, adaptation • Factors affecting photosynthesis (light, temperature, CO_2, O_2).	
	Unit 4: Respiration and Plant Growth Analysis • Outline of respiration: definition, importance • Glycolysis, Krebs Cycle, Electron Transport Chain (ETC) • Factors affecting respiration (O_2, temperature, CO_2) • Definitions: growth, development, differentiation • Measurement of plant growth (fresh weight, dry weight, linear dimension, area) • Growth analysis: CGR (Crop Growth Rate), RGR (Relative Growth Rate), NAR (Net Assimilation Rate)	End-Term Exam Assignments
	Unit 5: Plant Growth Regulation, Senescence, and Adaptations • Photoperiodism: classification (Short Day, Long Day, Day Neutral), photoperiodic induction, site of perception, role of phytochrome • Vernalization: meaning, classification, relation with abscission, devernalization • Senescence: physiological and biochemical changes, abscission, significance, stay green, hormonal regulation • Plant hormones and growth regulators (PGRs): definitions, classes (Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid), physiological roles • Agricultural uses of PGRs (IBA, NAA, 2,4-D, GAs, Kinetin)	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
Practical 1: Study of Stomatal Structure and Distribution Practical 2: Demonstration of Imbibition Practical 3: Demonstration of Osmosis Practical 4: Demonstration of Plasmolysis Practical 5: Estimation of Water Potential Practical 6: Determination of Relative Water Content (RWC) Practical 7: Tissue Test for Detection of Mineral Nutrients Practical 8: Identification of Nutrient Deficiency and Toxicity Symptoms Practical 9: Nutrient Identification Using Hydroponics Practical 10: Estimation of Photosynthetic Pigments Practical 11: Measurement of Photosynthesis, Respiration, and Transpiration Rates Practical 12: Plant Growth Analysis Practical 13: Study of Senescence and Hormonal Regulation of Abscission Practical 14: Effect of Different Plant Growth Regulators (PGRs) on Plant Growth	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Role and Relevance of Crop Physiology in Modern Agriculture. b) Physiological Approaches to Climate-Resilient Agriculture. c) Water Relations in Plants: Mechanisms, Adaptations, and Agricultural Applications. d) Mineral Nutrition in Plants: Essential Elements, Deficiency Symptoms, and Corrective Measures e) Photosynthesis and Respiration in Crop Plants: Pathways, Efficiency, and Environmental Influence. f) Growth and Development in Plants: Role of Plant Growth Regulators and Environmental Cues

Suggested reading	1. Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F. Blaydes 2. Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Mølle and Angus Murphy 3. Plant Physiology by Robert M. Devlin and Francis H. Witham 4. Plant Physiology by Lincoln Taiz and Eduardo Zeiger 5. Plant physiology by Frank B. Salisbury and Cleon W. Ross
Suggested resources (Websites/eBooks)	https://www.youtube.com/watch?v=VGlYZFk23JQ&t=211s 2. https://www.youtube.com/watch?v=4kkkVOZherU&t=138s 3. https://www.youtube.com/watch?v=cgQUhin849o&t=2808s 4. https://www.youtube.com/watch?v=vUjAcu-6DQ0 5. https://www.youtube.com/watch?v=n1e4mXYLq0U&t=11s

Course Code: ENT-121		Course Name: Pest management in crops and stored grains		Semester: II
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. Diagnosis and management of major insect and non-insect pests of crops in field and storage

Course outcomes: After completion of the course, the student will be able to:

CO-1	Familiarized with identification of different insect pest of field, horticulture, ornamentals, vegetables and stored grains at the field level.	
CO-2	Understand how insects affect animal and Plant health and agricultural production, and be able to safely manipulate populations of beneficial and destructive species in habitats and in production agroecosystems with minimal environmental impact.	
CO-3	To be aware about the biology, diversity, distribution of insects, and their relationships to crop and the environment condition of a particular area.	
CO-4	To understand identification of nature of damage and symptoms caused by the pest so suitable technique of pest management can be apply for effective control.	
CO-5	Management of crop pest through Integrated Pest Management approach without side effect on plant, animal and environment health	

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** 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 & vegetable crops.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 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 fruit & plantation crops.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 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 ornamental, spice and condiment crops.	End-Term Exam Assignments
	Unit-4 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. Management of non-insect pests: mites, snails and slugs.	End-Term Exam Assignments
	Unit-5 Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants. Use of drones and AI in pest management.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Field Visit for Insect Pest Survey 2. Collection of Insect Pests 3. Preservation Methods for Insects 4. Damage Sample Collection 5. Preparation of Insect Damage Herbarium 6. In-situ Pest Monitoring Techniques 7. Crop-wise Insect Pest Management 8. IPM Strategy Design 9. Storage Pest Identification and Damage Assessment 10. Storage Structures and Grain Protection Methods 11. Spraying Equipment Use and Calibration 12. Mass Multiplication of Biocontrol Agents (NPV & EPNs)	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Nature and Types of Damage by Arthropod Pests b) Scientific Classification and Bionomics c) Major Insect Pests of Field Crops d) Pests of Vegetable, Fruit, and Plantation Crops e) Pests of Ornamental, Spice, and Condiment Crops f) Structural Entomology and Household Pests g) Stored Grain Pests and Loss Factors h) Storage Structures and Grain Management i) Insecticides and Biorational Pesticides j) IPM and Emerging Technologies
Suggested reading	1. A Textbook of Insect Pest and Disease Management, 2021. Somnath Sen, and Mohd. Sameer, S. Kataria & Sons publish. 2. Agricultural Pests of India and South east Asia, A.S. Athwal, Kalyani Publishers. 3. A Textbook of Applied Entomology, K.P. Srivastava and G. S. Dhaliwal, Kalyani Publish.

	4. Essentials of Pest Management: Key Information on Pest Identification and its Management, 2022. Prakash Rambhat Thalya and Ravi Chandra 5. Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora Pest Management: Methods, 6. Applications and Challenges, Tarique Hassan Askary, Agriculture, Agriculture Issues and policies, Books, Nova, Pest Control, Science and Technology,2022
Suggested resources (Websites/eBooks)	1. https://www.agrostudy.in/2021/10/fundamentals-of-entomology.html#google_vignette 2. https://www.iaritoppers.com/2019/06/fundamentals-of-entomology-icar-ecourse-pdf-download.html

Course Code: PP-311		Course Name: Diseases of Field and Horticultural Crops and their Management		Semester: V
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To study the symptoms produced on the host
2. To study the etiology of the diseases
3. To know about the disease cycle of the pathogens during pathogenesis
4. To study the epidemiological factors responsible for disease development
5. To study the management techniques for curbing the major diseases of field and horticultural Crops

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the symptoms, etiology, disease cycles, and epidemiology of major diseases affecting cereal crops, including rice, wheat, maize, sorghum, bajra, and finger millet.
CO-2	Describe the major diseases of pulses, oilseeds, and sugarcane, and explain their development and appropriate management strategies.
CO-3	Identify and explain diseases in commercial and fiber crops such as cotton, banana, citrus, and guava, and recommend integrated management practices.
CO-4	Gain knowledge of diseases in temperate and subtropical fruit crops such as apple, mango, grapevine, and their control measures.
CO-5	Diagnose and manage common diseases in vegetables, spices, and ornamental crops through understanding pathogen biology and integrated plant protection methods.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Field visit

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit-1** 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, southern and northern blight, downy mildew); Sorghum (smuts, grain mold, anthracnose); Bajra (downy mildew, ergot) and Finger millet (blast, leaf spot).	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Groundnut (early and late leaf spots, rust, wilt); Soybean (rhizoctonia blight, bacterial spot, seed and 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, PokahBoeng); Mustard (Alternaria blight, white rust, downy mildew, sclerotinia stem rot) and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, black arm).	Mid-term Exams and End-Term Exam Assignments

	Unit-3 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).	End-Term Exam Assignments
	Unit-4 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).	End-Term Exam Assignments
	Unit-5 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).	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. To study the symptoms and field diagnosis of blast and brown spot disease in rice. 2. To examine and record the symptoms of sheath blight and bacterial leaf blight of rice. 3. To identify downy mildew and powdery mildew symptoms in cucurbit crops. 4. To study rhizoctonia web blight and Cercospora leaf spot in green gram or black gram crops. 5. To observe and describe Alternaria blight and downy mildew symptoms in mustard. 6. To differentiate between early blight and late blight symptoms in potato.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

7. To identify and compare early blight and late blight symptoms in tomato. 8. To study symptoms and fruit lesions caused by Phomopsis blight of brinjal. 9. To identify powdery mildew and rust symptoms in pea crops. 10. To study stem gall symptoms of coriander and understand its disease development pattern. 11. To examine anthracnose and fruit rot symptoms in chilli and relate them to field occurrence. 12. To identify Taphrina leaf spot symptoms in turmeric and understand its unique signs. 13. To study symptoms and signs of red rot disease in sugarcane and its impact on yield. 14. To become acquainted with commonly used fungicides, antibiotics, and biopesticides and understand their role in managing horticultural crop diseases; to carry out identification and basic histopathological studies of selected diseases covered in theory.	
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Comparative Study of Major Rice Diseases b) Rust Diseases of Cereal Crops – Wheat, Maize, and Sorghum c) Disease Complexes in Leguminous Crops d) Management of Wilt and Rot Diseases in Horticultural Fruit Crops e) Disease Management in Solanaceous Vegetable Crops f) Integrated Disease Management in Plantation and Spice Crops
Suggested reading	1. Integrated Plant Disease Management By R.C. Sharma 2. Plant Diseases By R.S. Singh 3. Plant Disease Management: Principles and Practices By Hriday Chaube 4. Plant Pathology By G.N. Agrios
Suggested resources (Websites/eBooks)	https://davuniversity.org/images/files/study-material/AGS%20322-%20Disease-of-Horticultural-Crops-their-Management.pdf

Course Code: GPB-311		Course Name: Crop Improvement I (Kharif Crop)		Semester: V
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To provide knowledge about self-pollinated and cross-pollinated kharif crops.
2. To understand origin, distribution, and diversity of major kharif crops.
3. To design breeding objectives and learn breeding methods for kharif crops.
4. To introduce improved varieties and hybrid seed production technologies.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the origin, distribution, and classification of kharif crops.
CO-2	Describe breeding objectives and methods suitable for self, cross, and vegetatively propagated crops.
CO-3	Identify appropriate breeding techniques for crop improvement in kharif crops.
CO-4	Develop understanding of hybrid seed production, heterosis, and quality traits.
CO-5	Acquire practical knowledge on emasculation, hybridization, and maintenance breeding.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	**Unit-wiseCourse Contents**	**Assessment tools**
Course Contents	**Unit-1:** Centres of origin and distribution of species; wild relatives in cereals, pulses, oilseeds, fibres, fodders, and cash crops; diversity in vegetable and horticultural crops of the Kharif season.	Mid-term Exams and End-Term Exam Assignments
	Unit-2: Plant genetic resources, their conservation and utilization; genetics of qualitative and quantitative characters; breeding concepts in self-pollinated, cross-pollinated, and vegetatively propagated crops.	Mid-term Exams and End-Term Exam Assignments
	Unit-3: Major breeding objectives and procedures; breeding for yield, stability, and tolerance to biotic and abiotic stresses; quality traits including physical, chemical, and nutritional aspects.	End-Term Exam Assignments
	Unit-4: Hybrid seed production technology in crops like maize, rice, sorghum, pearl millet, and pigeonpea; estimation of heterosis, inbreeding depression, and heritability.	End-Term Exam Assignments

	Unit-5: Ideotype concept and development of climate-resilient crop varieties; layout of field experiments; donor parents for quality traits; visits to seed production and AICRP plots.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Study of botany and floral biology of kharif crops 2. Hybridization techniques in rice, jute, maize, sorghum 3. Hybridization techniques in pearl millet, ragi, pigeonpea, urdbean 4. Hybridization techniques in mungbean, soybean, groundnut, sesame 5. Hybridization techniques in castor, cotton, cowpea, brinjal, okra 6. Techniques of maintenance breeding 7. Handling and evaluation of germplasm 8. Pedigree method in population management 9. Bulk and SSD methods in population management 10. Seed production techniques in kharif crops 11. Hybrid seed production in kharif crops 12. Estimation of heterosis and heritability 13. Field experiment layout and design 14. Evaluation of donors and field visits	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	Students are required to submit at least one assignment related to: (a) origin and distribution of any kharif crop, (b) breeding objectives and methods for selected crops, or (c) comparison of hybrid seed production practices.
Suggested reading	1. Breeding Field Crops – *V.L. Chopra* 2. Genetic Improvement of Field Crops – *C.B. Singh & D. Khare* 3. Genetics and Breeding of Pulse Crops – *D.P. Singh* 4. Vegetable Breeding: Principles and Practices – *Hari Har Ram* 5. Breeding Field Crops – *D.A. Sleper & J.M. Poehlman* 6. Plant Breeding: Theory and Practice – *S.K. Gupta* 7. Breeding Asian Field Crops – *J.M. Poehlman & D.N. Barthakur* 8. Practical Manual on Crop Improvement – I (Kharif) – *Rajendra Kumar Yadav*

Suggested resources (Websites/eBooks)	• https://icar.org.in/resources/ • https://agritech.tnau.ac.in/ • https://ecourses.icar.gov.in/ • https://www.agrifarming.in/ • http://plantbreeding.coe.uga.edu/

Course Code: AGRON - 311		**Course Name:** Weed Management		**Semester:** V
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
01	01	01	03	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Identify and classify weeds and explain their role in the ecosystem.
CO-2	Understand crop-weed competition and factors affecting weed growth.
CO-3	Apply various weed management methods in different farming systems.
CO-4	Explain herbicide types, their action, and modern application techniques.
CO-5	Develop weed control strategies for different crops and manage resistance.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Field Visit/ Lab Experiments 3. Chalkboard 4. Power Point Presentations

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-3	Herbarium
AT-4	Practical Exam

AT-5	Viva-Voce examination
AT-6	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit 1: Introduction to Weeds and Their Impact** Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem.	Mid-term Exams and End-Term Exam Quiz/Assignments
	Unit 2: Weed Biology and Ecology Classification, reproduction and dissemination of weeds, crop-weed completion, factors of competition, factors affecting growth and development. Studies on weed seed bank, weed shifts.	Mid-term Exams and End-Term Exam Assignments
	Unit 3: Principles and Methods of Weed Management 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.	End-Term Exam Quiz/Assignments
	Unit 4: Herbicides and Their Use Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management; Mode of action of herbicides and selectivity phenomenon.	End-Term Exam Assignments
	Unit 5: Advanced Concepts in Weed Management 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, weed management in cropping systems.	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**

1. To learn methods of weed collection, drying, pressing, and preservation for herbarium preparation. 2. Identification of important weeds in different crops 3. Classification of weeds 4. Assessment of crop losses due to weed competition 5. Study of growth stages, reproduction, seed dormancy, and dispersal mechanisms of major weeds. 6. Identification and recording of weeds in irrigated fields, drylands, orchards, gardens, and aquatic systems. 7. Examination of different commercial herbicide formulations, label interpretation, and their uses. 8. Understanding tank mixtures, ready-mix formulations, and compatibility/incompatibility among herbicides. 9. Demonstration and understanding of soil application, foliar spray, band, spot, and blanket applications. 10. Study of parts, function, and operation of sprayers 11. Sprayer maintenance procedures and calibration for accurate and uniform herbicide application. 12. Study of traditional and modern mechanical weed control tools 13. Calculation of correct herbicide dosage, weed control efficiency, weed index, and herbicide requirement per hectare. 14. Identification of phytotoxic effects of herbicides on crops and methods to minimize crop injury. 15. Weed management in fallow and non-cropped areas. 16. Study and control of problematic (Cyperus, Cynodon) and parasitic weeds (Cuscuta, Orobanche).	Herbarium Practical Exam Viva-Voce Examination Field Visit Report
Assignment	1. Ecological Impact of Weeds: Harmful and Beneficial Roles in Agroecosystems 2. Weed Reproduction and Dissemination: Mechanisms and Influence on Weed Dynamics 3. Integrated Weed Management (IWM): A Sustainable Approach to Weed Control 4. Nano Herbicides and Precision Weed Management: Innovations for Future Agriculture 5. Herbicide Resistance in Weeds: Causes, Consequences, and Management Strategies
Suggested reading	1. Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi. 3. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur. 4. Naidu, V.S.G.R. Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.

	5. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. 2015. Weed management of Horticultural Crops. Agrobios (India), Jodhpur. 6. Ramamoorthy, K. and Subbian, P. Predominant Weed flora in hill –ecosystems. Agrobios (India), Jodhpur. 7. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi. 8. Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. All About Weed Control. Kalyani Publishers, Ludhiana. 9. Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Press, Madras. 10. Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.
Suggested resources (Websites/eBooks)	1. https://agritech.tnau.ac.in/ta/Agriculture/pdf/final%20e book%20with%20cover%20page.pdf 2. https://agrimoon.com/wp-content/uploads/Weed-Management.pdf

Course Code: HORTI-311		Course Name: Ornamental Crops, MAP and Landscaping		Semester: V
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs.
2. To educate about concept, designing principles and components of landscaping.
3. To educate about the physiological disorders of commercial flowers.
4. To educate about the post-harvest management and value addition in flower crops and MAP.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Identify the different ornamental, medicinal and aromatic plants with their respective uses
CO-2	Understand the basic principles of landscaping used for planning and layout of gardens.
CO-3	Demonstrate various intercultural operations and postharvest practices used in ornamental, medicinal and aromatic crops
CO-4	Analyse the challenges and opportunities in marketing of ornamental, medicinal and aromatic crops produces
CO-5	Determine the cost of cultivation of different ornamental, medicinal and aromatic crops

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Package of practices for loose flowers like marigold and jasmine under open conditions.	TEnd-Term Exam Assignments
	Unit-4 Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium and vetiver.	End-Term Exam Assignments
	Unit-5 Processing and value addition in ornamental crops and MAPs produce.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools

1. Identification of Ornamental and MAP plants. 2. Nursery bed preparation 3. Seed sowing. 4. Training of Ornamental plants 5. Pruning of Ornamental plants. 6. Planning and layout of garden. 7. Bed preparation and planting of MAP. 8. Protected structures care and maintenance. 9. Intercultural operations in flowers and MAP. 10. Harvesting of cut and loose flowers 11. Post-harvesthandling of cut and loose flowers. 12. Processing of MAP. 13. Visit to commercial flower/MAP unit.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
Assignment	Students are required to submit the given assignments and deliver one power point presentation as a part of their continuous evaluation system. 1. Preparation of plant identification database for the assign plant species along with identification name plate with In-built barcode 2. Varietal health of ornamental and MAP crops. 3. Value addition process of assign crop
Suggested reading	Randhawa and Mukhopadhay. 2003. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi N. Kumar. 2018. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Scientific International Pvt. Ltd., New Delhi. J.S. Arora. 2020. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi H.C. Srivastava. 2014. Medicinal and Aromatic Plants. ICAR, New Delhi.
Suggested resources (Websites/eBooks)	1. http://naac.gov.in/images/docs/campus/Ornamental%20plants%20at%20NAAC.pdf http://agricoop.gov.in/Documents/Horticulture%20Statistics%20at%20a%20Glance-2018.pdf http://agricoop.gov.in/en/StatHortEst#gsc.tab=0 https://agriexchange.apeda.gov.in/indexp/genReport_combined.aspx#content

Course Code: AGRON-312		Course Name: Introductory Agroforestry		Semester: V
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course 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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the concepts, scope, and classification of agroforestry systems
CO-2	Identify and evaluate Multipurpose Tree Species (MPTS) and their role in agroforestry systems
CO-3	Analyze ecological interactions in agroforestry systems including competition, nutrient cycling, and biodiversity conservation
CO-4	Demonstrate practical skills in propagation, nursery management, and tree species identification for agroforestry applications
CO-5	Design, diagnose, and evaluate agroforestry systems based on agro-climatic conditions and socio-economic aspects
Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Assignments 5. Quiz
Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-3	Practical Exam
AT-4	Viva-Voce examination
AT-5	Field Visit Report
AT-6	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-I Agroforestry: Definition, Scope and Classification** Definition and scope of agroforestry; Types of agroforestry systems; Potential of agroforestry in India; Prevailing agroforestry systems in different regions of India; Traditional agroforestry as a viable choice to conserve agro-biodiversity of India.	Mid-term Exams, End-Term Exam And Quiz
	Unit-II Multipurpose Tree Species (MPTS) and Ecological Aspects Definition and role of MPTS in agroforestry; Criteria for selection of MPTS for various systems; Common MPTS of India; Ecological aspects of agroforestry; Tree-crop interactions - competition, allelopathy, nutrient recycling.	Mid-term Exams and End-Term Exam
	Unit-III Management, Conservation and Socio-economic Dimensions Management of agroforestry systems; Role in soil and water conservation; Windbreaks and shelterbelts - definitions and objectives; Socio-economic aspects of agroforestry; Design and diagnostic study of agroforestry systems.	End-Term Exam and Quiz
	Unit-IV Silviculture and Tree Propagation Techniques Silviculture: Definition and scope; Tree propagation methods - seed, coppice, root suckers, stump, rhizomes, cuttings, transplanting; Nursery bed preparation and management; Cultural practices for bare root and seedlings; Field handling of nursery stock.	End-Term Exam Assignments
	Unit-V Tree Management and Agroforestry Models Management of tree species - species-site matching, root and crown characteristics, phenology, nutrition and water needs, harvesting and utility; Silviculture of important tree species; Agroforestry models developed by ICAR-IGFRI and ICFRE including horticultural and forage-based systems.	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**
1. Identification of tree species in agroforestry 2. Measurement of tree growth parameters 3. Study of environmental parameters affecting agroforestry system 4. Study of plant propagation methods		

5. Pre-sowing seed treatment 6. Nursery bed preparation and management 7. Practicing vegetative propagation techniques for trees 8. Study of afforestation methods 9. Practical training on pruning of trees 10. Practice of coppicing and pollarding 11. Study of planting patterns and design for plantation 12. Study of natural and artificial regeneration 13. Design and diagnostic survey of agroforestry system 14. Evaluation of agroforestry systems in different agro-climatic zones 15. Exposure visit to prevailing agroforestry systems of the state 16. Virtual visit of agroforestry models (ICAR-IGFRI, ICFRE)	Practical Exam Viva-Voce Examination Field Visit Report Assignments
Assignment	**As part of their continuous evaluation system, students are required to submit one assignment** 1. Classification and Comparative Study of Agroforestry Systems in India. 2. Role and Selection Criteria of Multipurpose Tree Species (MPTS) in Agroforestry. Tree-Crop Interaction in Agroforestry: Competition and Complementarity. 3. Design and Diagnostic Survey of a Local Agroforestry System: A Case Study Approach. 4. Agroforestry Models Developed by ICAR-IGFRI and ICFRE: A Comparative Review.
Suggested reading	1. Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher 2. Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing, (ISBN: 9788120408326) 3. Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p 4. Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. Satish Serial Publishing, New Delhi (ISBN: 9384988952).
Suggested resources (Websites/eBook)	1. http://ecoursesonline.iasri.res.in/course/view.php?id=157 2. https://agritech.tnau.ac.in/forestry/agroforestry_index.html 3. https://www.researchgate.net/publication/364327450_Introductory_Agroforestry 4. https://apps.worldagroforestry.org/Units/Library/Books/PDFs/32_An_introduction_to_agroforestry.pdf?n=161 5. https://bscagriculture.com/introduction-to-forestry-notes/

Course Code: ABT-321		Course Name: Fundamentals of Agricultural Biotechnology		Semester: VI
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives: s

1. To familiarize the students with the fundamental principles of biotechnology, various developments in biotechnology and its potential applications

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the basics and historical evolution of plant tissue culture and biotechnology
CO-2	Demonstrate knowledge of various plant tissue culture techniques.
CO-3	Analyze advanced in vitro techniques for genetic enhancement
CO-4	Apply knowledge of advanced tissue culture techniques
CO-5	Assess the role of transgenics in agriculture.

Teaching Pedagogy	
T1	1. Brainstorming 2. Group Discussion 3. Guided Questioning 4. Stimulus activities 5. Case studies 6. Talks and presentations:

Assessment tools	
AT-1	Mid-term Examination and End-Term Examination
AT-3	Quiz
AT-6	Practical Examination
AT-7	Viva-Voce examination
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction to Plant Tissue Culture and Genetic Engineering: History; Cellular totipotency and cytodifferentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Embryo rescue technique and its significance in hybrid development; In vitro fertilization, ovule culture and its significance in hybrid development; Protoplast isolation, culture and regeneration; Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement; Anther and pollen culture for haploid production; Development of disease-free (virus free) plants through apical meristem culture; Micropropagation technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants-secondary metabolite production- in vitro germplasm conservation..	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Introduction to Molecular Biology: DNA structure, structure and function; DNA replication, transcription and translation, RNA, types and function; Structure of prokaryotic and eukaryotic gene; Central dogma of life - DNA replication, transcription, genetic codes translation and protein synthesis; Lac Operon concept	End-Term Exam Assignments
	Unit-4 Introduction to recombinant DNA technology: DNA modifying enzymes and vectors; plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated gene transfer methods; Transgenic and its importance in crop improvement with successful stories; biosafety.	End-Term Exam Assignments

	Unit-5 Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Introduction to Plant Tissue Culture Laboratory and demonstration of Good Laboratory Practices 2. Preparation and Sterilization of Tissue Culture Media (MS Medium) 3. Glassware and Instrument Sterilization Techniques 4. Micropropagation: Initiation and Subculturing of Explants 5. Callus Induction from Leaf/Stem Explants 6. Anther Culture for Haploid Plant Production 7. Apical Meristem Culture for Virus-Free Plant Development 8. Preparation of Synthetic Seeds 9. Visit to a Commercial Tissue Culture Unit or Biotechnology Lab 10. Isolation of Plasmid DNA from Bacterial Cells 11. Quantification of Isolated DNA Using Spectrophotometry 12. Agarose Gel Electrophoresis of Plasmid DNA 13. Restriction Digestion of Plasmid DNA and Gel Electrophoresis 14. Isolation of Plant Genomic DNA and PCR Amplification	Practical Based Learning Practical Exam Viva-Voce Examination Practical Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit assignment 1. Role of Plant Tissue Culture Techniques in Crop Improvement 2. Genetic Engineering in Plants: Tools, Techniques, and Successful Transgenic Crop Development. 3. Molecular Markers in Plant Breeding: Types, Techniques, and Applications in Marker-Assisted Selection
Suggested reading	1. Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier. 2. Singh BD. 2007. Biotechnology: Expanding Horiozon. Kalyani. 3. Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons. 4. Lewin B. 2008. Gene IX. Peterson Publications/ Panima. W.H. Freeman & Co. 5. Primrose SB. 2001. Molecular Biotechnology. Panima.

Suggested resources (Websites/eBooks)	1. https://www.isaaa.org/ 2. https://www.fao.org/biotechnology/en/ 3. https://www.ncbi.nlm.nih.gov/

Course Code: AS-321		Course Name: Basic and Applied Agricultural Statistics		Semester: VI
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

To provide an idea on statistical concepts of both descriptive and inference Statistics which will be useful to do statistical analysis

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the **scope and importance of statistics** in agricultural sciences
CO-2	Understand the knowledge of **types of data**, their organization, and summary measures like mean, median, mode, and dispersion.
CO-3	Understand key **probability distributions**: Binomial, Poisson, Normal, Exponential, etc.
CO-4	Understand **sampling techniques**: simple, stratified, systematic.
CO-5	Understand principles of **design of experiments**: randomization, replication, and local control.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median- Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution. Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability-Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability.	End-Term Exam Assignments
	Unit-4 Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution- Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve. Correlation	End-Term Exam Assignments

	and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients. Tests of Significance. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance.	
	Unit-5 One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance. ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Diagrammatic and Graphical representation of data. 2. Calculation of A.M., 3. Calculation of Median 4. Calculation of and Mode (Ungrouped and Grouped data). 5. Calculation of S.D. 6. Calculation of C.V. (Ungrouped and Grouped data). 7. Correlation analysis. 8. Regression analysis. 9. Application of t-test (one sample). 10. Application of t-test (two sample independent). 11. Application of t-test (two sample dependent). 12. Analysis of variance one-way classification. 13. CRD. 14. Selection of random sample using simple random sampling.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Types of Correlation Coefficient b) Sampling Theory c) ANOVA and Experimental Designs
Suggested reading	a) Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers. b) Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons. c) Basic Statistics by B. L. Agarwal, New Age International Publishers. d) Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House. e) Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers. f) Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers
Suggested resources (Websites/eBooks)	a) https://mospi.gov.in/agriculture-statistics b) http://eagri.org/eagri50/MATH/index.html c) http://eagri.org/eagri50/STAM101/index.html

Course Code: GPB-321		Course Name: Crop Improvement II (Rabi Crop)		Semester: VI
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To provide knowledge about self-pollinated and cross-pollinated rabi crops.
2. To learn about origin and distribution of rabi crops.
3. To design breeding objectives of major rabi crops.
4. To impart information on different crop varieties for rabi season.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand origin, distribution, and diversity of major rabi crops.
CO-2	Explain breeding objectives and identify suitable methods for rabi crop improvement.
CO-3	Demonstrate knowledge of hybrid seed production in rabi crops.
CO-4	Analyse quality parameters and stress tolerance.
CO-5	Apply emasculation, hybridization, and breeding techniques in the field.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wiseCourse Contents	Assessment tools
Course Contents	**Unit-1:** Centres of origin and distribution of species; wild relatives in cereals, pulses, oilseeds, fibres, fodders, and cash crops; diversity in vegetable and horticultural crops of the rabi season.	Mid-term Exams and End-Term Exam Assignments
	Unit-2: Plant genetic resources, their conservation and utilization; genetics of qualitative and quantitative characters; breeding concepts in self-pollinated, cross-pollinated, and vegetatively propagated crops.	Mid-term Exams and End-Term Exam Assignments
	Unit-3: Major breeding objectives and procedures; breeding for yield, stability, and tolerance to biotic and abiotic stresses; quality traits including physical, chemical, and nutritional aspects.	End-Term Exam Assignments
	Unit-4: Hybrid seed production technology in crops like wheat, oat, chickpea, rapeseed, and mustard; estimation of heterosis, inbreeding depression, and heritability.	End-Term Exam Assignments
	Unit-5: Ideotype concept and development of climate-resilient crop varieties; layout of field experiments; donor parents for quality traits; visits to seed production and AICRP plots.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study of crop botany and floral biology 2. Hybridization techniques in wheat and oat 3. Hybridization techniques in rapeseed and mustard 4. Hybridization techniques in pulses 5. Hybridization techniques in potato and sugarcane 6. Hybridization techniques in tomato, chilli, and onion 7. Techniques of seed production in rabi crops 8. Hybrid seed production methods in rabi crops 9. Estimation of heterosis and inbreeding depression 10. Estimation of heritability and quality traits 11. Identification of donor parents 12. Field layout and experimental design 13. Visit to seed production plots 14. Visit to AICRP breeding plots	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	Students are required to submit at least one assignment related to: 1. Origin and distribution of a rabi cereal crop (e.g., wheat). 2. Comparison of self- and cross-pollinated rabi crops. 3. Conservation strategies of plant genetic resources. 4. Breeding objectives in a major rabi pulse crop. 5. Hybrid seed production steps in wheat/mustard.
Suggested reading	1. Breeding Field Crops – V.L. Chopra 2. Genetic Improvement of Field Crops – C.B. Singh and D. Khare 3. Genetics and Breeding of Pulse Crops – D.P. Singh 4. Vegetable Breeding – Principles and Practices – Hari Har Ram 5. Breeding Field Crops – D.A. Sleper and J.M. Poehlman 6. Plant Breeding – Theory and Practice – S.K. Gupta 7. Breeding Asian Field Crops – J.M. Poehlman and D.N. Barthakur 8. Practical Manual on Crop Improvement – II (Rabi Crops) – Rajendra Kumar Yadav 9. Practical Manual on Crop Improvement – I (Kharif) – *Rajendra Kumar Yadav*

Suggested resources (Websites/eBooks)	• https://icar.org.in/resources/ • https://agritech.tnau.ac.in/ • https://ecourses.icar.gov.in/ • https://www.agrifarming.in/ • http://plantbreeding.coe.uga.edu/

Course Code: AENG-321		Course Name: Renewable energy in Agriculture and Allied Sector		Semester: VI
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Placement • Research • Higher education

Course Objectives:

1. To gain the knowledge on different types of materials used in Renewable Energy
2. To understand the importance of Renewable Energy technology and its applications
3. To train the students on the applications of solar thermal technology

Course outcomes: After completion of the course, the student will be able to:

CO-1	Recall key concepts and foundational facts, such as types of energy sources, biogas, and solar energy technologies.
CO-2	Understand the fundamentals of renewable energy sources, their classification, and contributions to sectors such as agriculture.
CO-3	Apply knowledge of biomass and bioenergy resources for sustainable fuel production and utilization.
CO-4	Critically evaluate the effectiveness, efficiency, and sustainability of renewable energy systems and their applications.
CO-5	Develop practical skills through hands-on experience with renewable energy gadgets, biogas plants, and energy production processes.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations 5. Flowchart 6. Video 7. Discussion 8. Hands on Practice

T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**Unit – 1** Classification of energy sources, contribution of these of sources in agricultural sector	Assignment Quiz
	Unit – 2 Familiarization with biomass utilization for biofuel production and their application; Availability of bio mass and their application in places.	Mid Term Examination
	Unit – 3 Familiarization with types of biogas plants and gasifiers, biogas, bio-alcohol, biodiesel and bio-oil production and their utilization as bioenergy resource	Assignments Quiz
	Unit – 4 Introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater.	ABL Flip Class/ Seminars Quiz

	Unit-5 Application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.	Flip Class/ Seminars End Term Examination

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. To familiarization with renewable energy gadgets 2. To study biogas plants 3. To study gasifier 4. To study the production process of biodiesel 5. To study the production process of bio-fuels 6. To familiarization with Different Solar Energy Gadgets 7. To study solar photovoltaic system 8. To study about solar lighting 9. To study about solar pumping 10. To study solar fencing. 11. To study solar cooker 12. To study solar drying system. 13. To study solar distillation, solar pond and solar wind hybrid system. 14. To field visit to Solar –Wind farm.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Solar Energy and its Impact on Environment b) A World with 100% Renewable Energy c) Solar Energy in India and its Influence on Climate Change d) Renewable Energy Programs in Developing Countries
Suggested reading	**Textbooks:** 1. Chakraverty, A. 1989. Biotechnology and other alternate technology. Oxford & IBH Publishing Co., New Delhi. 2. Rai, G. D. 1984. Non-Conventional Energy Sources. Khanna Publishers, New Delhi. 3. Vijayalakshmi, Meena Devi, and Nagendra Prasad. 2007. Production of biodiesel from Jatropha carcus oil by using pilot biodiesel plant. AGROBIOS (India), Jodhpur, India. 4. Rai, G. D. 1995. Solar Energy and Its Utilisation. Khanna Publishers, New Delhi. 5. Sukatme, S.P. 1985. Solar Energy. TATA McGraw Hill Publishing Company Limited, New Delhi.

Suggested resources (Websites/eBooks)	https://agrimoon.com/wp-content/uploads/Renewable-Energy.pdf http://ecoursesonline.iasri.res.in/course/view.php?id=35

Course Code: AGRON-321		**Course Name:** Dryland Agriculture/ Rainfed agriculture and watershed management		**Semester: VI**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	01	01	03	B.Sc. (Hons.) Agriculture
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

1. To learn about characteristics and conditions of dryland/rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management
4. To enhance the livelihoods of farmers in rainfed regions by promoting diversified farming systems, agroforestry, and allied activities.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Define the characteristics, constraints, and significance of dryland and rainfed farming systems in sustainable agricultural development.
CO-2	Understand various in-situ and ex-situ soil and water conservation methods suitable for dryland areas to improve water-use efficiency and crop productivity.
CO-3	To design and implement integrated watershed management strategies for enhancing land and water resources in rainfed regions.
CO-4	Development of identifying types of drought, assessing their impact on agriculture, and formulating appropriate mitigation and contingency measures.
CO-5	Formulate Recommend appropriate cropping systems, agroforestry, and livelihood enhancement practices for improving income and resilience of farming communities in dryland areas.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations 5. Field visit 6. Flipped class

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-3	Practical Exam
AT-4	Viva-Voce examination
AT-5	Field Visit Report
AT-6	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Dryland/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 prevalent in dry land/rainfed areas.	Mid-term Exams and End-Term Exam Quiz/Assignments
	Unit-2 Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system; Soil and water conservation techniques; Drought: types, effect of water deficit on physio-morphological characteristics of the plants.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 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 for aberrant weather conditions.	End-Term Exam Quiz /Assignments
	Unit-4 Concept, history, objective, principles and components of watershed management, factors affecting watershed management. Log term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities.	End-Term Exam Assignments
	Unit-5 Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Studies on climate classification 2. Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. 3. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA) 4. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. 5. Critical analysis of rainfall and possible drought period in the country 6. Effective rainfall and its calculation 7. Studies on cultural practices for mitigating moisture stress. 8. Studies on mechanical and agronomic measure for mitigating moisture stress 9. Soil moisture determination under different land situations 10. Importance of seed priming to mitigate drought 11. Assessment of meteorological drought 12. Characterization and delineation of model watershed. 13. Seed treatment, viz., seed hardening and seed priming techniques 14. Field demonstration on construction of water harvesting structures. 15. Visit to rainfed research station/watershed	Practical Exam Viva-Voce Examination

Assignment	**As part of their continuous evaluation system, students are required to submit one assignment** 1. Problems and prospects of dry land/rainfed agriculture in India; Soil and climatic conditions prevalent in dry land/rainfed areas. 2. Drought: types, effect of water deficit on physio- morphological characteristics of the plants. 3. Management of crops in dry land/rainfed areas; Contingent crop planning for aberrant weather conditions. 4. Concept, history, objective, principles and components of watershed management 5. principles and practices for profitable and sustainable dryland farming and allied enterprises

Suggested reading	1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi. 2. T. Yellamanda Reddy and G.H. Sankara Reddi. 2010. Principles of Agronomy. Kalyani Publishers, New Delhi.
Suggested resources (Websites/eBooks)	1. https://buat.edu.in/wp-content/uploads/2023/10/001-Final-MS_Rainfes-Agriculture_AniketKalhapure.pdf?utm_source=chatgpt.com 2. https://www.tnu.in/wp-content/uploads/2021/09/Rainfed-Agriculture-manual-1-converted.pdf?utm_source=chatgpt.com

Course Code: PP-321		Course Name: Agricultural Microbiology and Phyto-remediation		Semester: VI
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**02**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course 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.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the basic concepts, history, and importance of microbiology in agricultural sciences.
CO-2	Describe the structure, types, and genetics of microorganisms, with a focus on agriculturally important microbes.
CO-3	Identify the roles of soil, air, water, and food microbiology and their implications in agricultural ecosystems.
CO-4	Explain the concepts of rhizosphere microbiology, plant growth promoting rhizobacteria (PGPR), and their role in soil health and sustainability.
CO-5	Demonstrate knowledge of biological control, biopesticides, bioremediation, and phytoremediation for sustainable plant disease and environmental management.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, genetic engineering.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Soil Microbiology: Nutrient mineralization and transformation, 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.	End-Term Exam Assignments
	Unit-4 Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management.	End-Term Exam Assignments
	Unit-5 Concepts of rhizosphere microbiology- Rhizodeposits - biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiomeresidents 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.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Study and handling of compound microscope 2. Familiarization with common laboratory materials and equipment 3. Microscopic observation of moulds (Fungi) 4. Direct staining of bacteria using crystal violet 5. Negative (indirect) staining of bacteria using nigrosin 6. Gram staining of bacteria 7. Isolation and enumeration of phyllosphere microflora 8. Isolation and enumeration of rhizosphere microflora 9. Measurement of microorganisms using micrometry 10. Preparation of culture media (solid and liquid) 11. Isolation and purification of rhizospheric microbes 12. Isolation and purification of nitrogen-fixing bacteria 13. Isolation and purification of nutrient-solubilizing microorganisms 14. Isolation and purification of endophytic microbes	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	**1.** Draw and Label the Structure of a Phytopathogenic Bacterial Cell **2.** List of Important Bacterial Plant Diseases **(Host, Pathogen, Symptoms, Control)** **3.** Methods of Transmission of Bacterial Plant Pathogens **4.** Use of Biocontrol Agents Against Bacterial Diseases and in Place of Pesticides **5.** Role of Plant Growth Promoting Rhizobacteria (PGPR) in Plant Health and Soil Fertility 6. Bioremediation: Role of Microbes in Cleaning Polluted Soils and Water
Suggested reading	• Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2002. Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi. • Rangaswami, G. and Bagyaraj, D. J. 2005. Agricultural Microbiology. PrenticeHall of India Pvt. Ltd., New Delhi. • Mukherjee, N. and 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. and 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
Suggested resources (Websites/eBooks)	1. https://agrimoon.com/wp-content/uploads/AGRICULTURAL-MICROBIOLOGY.pdf 2. https://agrimoon.com/wp-content/uploads/Introductory-MicroBiology-With-Practicals.pdf 3. https://agrimoon.com/wp-content/uploads/Fundamentals-of-Microbiology.pdf 4. https://www.agrimoon.com/wp-content/uploads/FOOD-AND-INDUSTRIAL-MICROBIOLOGY.pdf

LECTURE PLAN

Course: **Agricultural Microbiology and Phyto-remediation**

Code: PP-321

Credit: 2(1+1)

Course Teacher: Dr. Sanjog Chhetri

S. No.	Name of Topic	Teaching Pedagogy	Course Outcome	Assessment Tools	Tentative Weeks
UNIT-I INTRODUCTION TO MICROBIOLOGY					
1	Introduction, Definition & Scope of Agricultural Microbiology	Video lecture	CO-1	Quiz	-
2	History: Discovery, Germ Theory, Fermentation, Immunization	Video lecture, Storytelling, Timeline Chart	CO-1	Assignment	-
3	Applied Fields: Agricultural, Food, Industrial, Medical Microbiology	Classroom lecture, video lecture, Real-life Case Studies	CO-1	Seminar	-
UNIT-II BACTERIAL STRUCTURE, GROWTH & GENETICS					
4	Bacterial Cell Structure and Components	Video lecture, Diagram-Based Teaching, Chalk & Talk	CO-2	Quiz	-
5	Bacterial Metabolism: Chemoautotrophy & Photoautotrophy, Growth Curve	Video lecture, Flowcharts, PPT	CO-2	Quiz	-
6	Genetic Recombination: Transformation, Conjugation, Transduction	Classroom lecture, video lecture	CO-2	Quiz	-
Midterm Examination					
UNIT-III ENVIRONMENTAL MICROBIOLOGY (SOIL, AIR, FOOD, WATER)					

7	Soil Microbiology: Nutrient Mineralization & Transformation	Classroom lecture, Discussion	CO-3	Assignment	-
8	Air Microbiology: Phylloplane, Phyllosphere, Floral Microflora	PPT, Classroom lecture	CO-3		-
9	Food Microbiology: Spoilage & Food Preservation	Real-life Examples, PPT	CO-3	Quiz	-
10	Water Microbiology: Water Types, Coliform Test & Purification	Classroom lecture and Flowchart demonstration	CO-3		-
UNIT-IV INDUSTRIAL MICROBIOLOGY & BIOCONTROL					
11	Industrial Microbiology: Microbial Products, Biodegradation, Biogas	Classroom lecture and Case Studies	CO-5	Assignment	-
12	Biodegradable Plastics and Innovations	Classroom lecture and Flip Class	CO-5	Poster	-
13	Biological Control and Biopesticides	Classroom lecture and Field demonstration	CO-5		-
UNIT-V RHIZOSPHERE MICROBIOLOGY AND PHYTOREMEDIATION					
14	Rhizosphere Microbiology, Rhizodeposits, and Rhizosphere Residents	class Flow Diagram, PPT	CO-4		-
15	PGPRs and Endophytes: Role in Soil Health & Sustainability	Classroom lecture, Group Activity + Case Discussion	CO-4	Unannounced test	-
16	Phytoremediation and Bioremediation: Concepts, Mechanism, Applications	Video lecture, Case Study	CO-5		-
					End term Examination

Course Code: AE-321		**Course Name:** Agricultural Finance and Cooperation		**Semester: VI**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Basic, applied, and Innovative		**Student-specific course outcome**	Placement Research Higher education Entrepreneurship

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	*Define and describe* the meaning, scope, classification, and sources of agricultural finance and cooperation, including institutions like RBI, NABARD, and World Bank.
CO-2	*Explain and illustrate* the credit needs of Indian agriculture, microfinance schemes like Kisan Credit Card (KCC), crop insurance programs, and the role of cooperative systems such as AMUL, Aavin, and Nandini.
CO-3	*Apply* the principles of credit analysis (3 C's, 4 R's, 3 R's, 5 C's, and 7 P's), lead bank scheme, and scale of finance in practical contexts, including preparation of financial statements and project reports.
CO-4	*Analyze* the functions and performance of institutional and non-institutional sources of credit, cooperative structures, and the operational strategies of key financial institutions in supporting Indian agriculture.

CO-5	*Evaluate* recent developments in agricultural credit, the effectiveness of crop insurance schemes like PMFBY, and the strengths and weaknesses of agricultural cooperative systems across different Indian states using SWOT analysis and bank norms.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Whiteboard 3. PowerPoint Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and end-term exams
AT-2	Seminar Presentation
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Viva voce examination
AT-7	Report writing
AT-8	Balance Sheet Preparation
AT-9	Repayment calculation

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1:** Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits.	Classroom teaching ABL
	Unit 2: 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, Scale of finance and unit cost.	Assignment Mid Term examination
	Unit 3: An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit.	Quiz Assignment
	Unit 4: Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports. Bank norms – SWOT analysis. Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.	ABL Assignment Quiz

	Unit 5: Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3 R's, 5 C's and 7 P's of credit. Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.	End term examination ABL Viva Voce

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Optimum allocation of the limited amount of capital among different enterprises. 2. Analysis of progress and performance of cooperatives using published data. 3. Analysis of progress and performance of commercial banks and RRBs using published data. 4. Visit a commercial bank to acquire first-hand knowledge of their management, schemes, and procedures. 5. Visit a cooperative bank to acquire first-hand knowledge of their management, schemes, and procedures. 6. Visit to a cooperative society to acquire first-hand knowledge of their management, schemes, and procedures. 7. Estimation of credit requirement of farm business – A case study. 8. Preparation and analysis of balance sheet – A case study. 9. Preparation and analysis of income statement – A case study. 10. Appraisal of a loan proposal – A case study.	Practical Activity Practical Record Viva voce

11. Techno-economic parameters for the preparation of projects. Preparation of Bankable projects for various agricultural products and their value-added products. 12. Seminar on selected topics. Different types of repayment plans.	
Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) **Role and Importance of Agricultural Finance and Credit in Indian Agriculture** (Include the meaning, scope, credit needs, classification, and significance in agricultural development.) b) **Comparative Analysis of Institutional and Non-Institutional Sources of Agricultural Finance in India** (Cover sources such as commercial banks, cooperative banks, RRBs, NABARD, and informal lenders.) c) **A Study on the Structure and Performance of Agricultural Cooperatives in India** (Discuss types of cooperatives, their objectives, principles, significance, and contributions to agriculture.) d) **Evaluation of the Pradhan Mantri Fasal Bima Yojana: Scope, Benefits, and Challenges** (Analyze its features, implementation, impact on farmers, and limitations.) e) **Preparation and Analysis of a Bankable Project Report for an Agricultural Enterprise** (Include financial statements, techno-economic parameters, SWOT analysis, and credit appraisal elements.)

Suggested reading	1) Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects**.** The Johns Hopkins Univ. Press. 2) Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH.
Suggested resources (Websites/eBooks)	1. https://agricoop.gov.in/sites/default/files/Annexure_Overview.pdf 2. https://www.nabard.org/auth/writereaddata/tender/2501235626trends-and-patterns-in-agriculture-credit-in-india.pdf

Course Code: BIOCHEM-321		Course Name: Essentials of Plant Biochemistry		Semester: VI
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
03	**02**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives: To impart the fundamental knowledge on structure and function of cellular components, biomolecules and the biological processes in plants

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the fundamental concepts of biochemistry including the properties of water, pH, buffer systems, and components of plant cells.
CO-2	Explain the structure, classification, properties, and biological roles of carbohydrates, lipids, proteins, amino acids, nucleic acids, and vitamins.
CO-3	Apply biochemical principles to describe the properties, classification, and mechanisms of enzyme action, including enzyme kinetics and allosteric regulation.
CO-4	Analyze the pathways involved in energy generation and metabolism, including glycolysis, the citric acid cycle, oxidative phosphorylation, and fatty acid oxidation.
CO-5	Evaluate biosynthetic pathways such as photosynthesis, gluconeogenesis, nitrogen fixation, and the synthesis of fatty acids and starch with reference to metabolic regulation.

Teaching Pedagogy	
T1	1. Brainstorming 2. Group Discussion 3. Guided Questioning 4. Stimulus activities 5. Case studies 6. Talks and presentations:

Assessment tools	
AT-1	Mid-term Examination and End-Term Examination
AT-3	Quiz
AT-6	Practical Examination
AT-7	Viva-Voce examination
AT-10	Assignments

Prerequisites	Unit-wiseCourse Contents	Assessment tools
Course Contents	**Unit-1** Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components.	Assignments
	Unit-2 Bio-molecules – Structure, classification, properties and function of carbohydrates,amino acids, proteins, lipids and nucleic acids. Vitamins – physiological and metabolic role	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes. Metabolic energy and its generation	Assignments
	Unit-4 Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. Biosynthetic Pathways, Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation	Assignments
	Unit-5 Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.	End-Term Exam Quiz

List of Practical (Field/Lab Exercises)	Assessment tools
1. Preparation of Standard Solutions and Reagents 2. Determination of pH of Solutions 3. Qualitative Tests for Carbohydrates 4. Qualitative Tests for Amino Acids and Proteins 5. Quantitative Estimation of Soluble Sugars 6. Quantitative Estimation of Starch 7. Estimation of Protein by Kjeldahl Method 8. Estimation of Protein by Lowry's Method 9. Preparation of Mineral Solution from Ash 10. Estimation of Fat Content by Soxhlet Extraction Method 11. Determination of Acid Value of Fats/Oils 12. Determination of Saponification Value of Fats/Oils 13. Determination of Iodine Number of Fats/Oils 14. Estimation of Ascorbic Acid (Vitamin C) 15. Qualitative and Quantitative Tests of Secondary Metabolites	Practical Based Learning Practical Exam Viva-Voce Examination Practical Report writing Assignments

Assignment	1. Prepare a detailed comparative table of biomolecule types including examples, structure diagrams, and functions. 2. Write a case study on any one secondary metabolite used in medicine or food preservation.
Suggested reading	1. Nelson and Cox. 2008. Lehninger Principles of Biochemistry. Fourth/Fifth edition. Freeman 2. Conn, Stumpf, Bruening and Doi. 2006. Outlines of Biochemistry. Fifth Edition. Wiley 3. Horton, Moran, Rawn, Scrimgeour, Perry. 2011. Principles of Biochemistry. Fifth Edition. Pearson/Prentice Hall 4. Heldt. 2005. Plant Biochemistry. Elsevier 5. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.
Suggested resources (Websites/eBooks)	

Course Code: GPB-322		**Course Name:** Fundamentals of Seed Science and Technology		**Semester: VI**
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
02	**01**	**01**	**03**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Technical Skill Development • Entrepreneurship • Research and Higher Education • Regulatory and Policy Awareness

Course Objectives:

1. To impart basic and fundamental knowledge on principles and practices seed science and technology
2. To report the practical skills on scientific seed production and post-harvest quality management

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the principles and significance of seed technology, including seed quality attributes and their management.
CO-2	Identify and apply scientific techniques for seed production, classification, and field inspection.
CO-3	Perform post-harvest operations such as drying, processing, treatment, and packing.
CO-4	Understand the protocols of seed testing, certification, and quality regulation under legislative frameworks.
CO-5	Acquire hands-on skills in testing seed viability, vigor, purity, and health for quality assurance.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Laboratory Experiments 3. Field Based Experiments 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Quiz 4. PBL activities

Assessment tools	
AT-1	Mid-term Exams and End-TermExam
AT-3	Quiz
AT-4	Poster Presentation
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wiseCourse Contents	Assessment tools
Course Contents	**Unit-1** **Introduction to Seed Technology** – Definition, importance, objectives. Seed quality – definition and characteristics of good quality seed.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 **Seed Deterioration and Classification** – Causes of deterioration, maintenance of genetic purity, different classes of seed: nucleus, breeder, foundation and certified.	Mid-term Exams, Quiz and End-Term Exam Assignments
	Unit-3 **Scientific Seed Production** – Foundation and certified seed production techniques for major cereals, pulses, and oilseeds. Field standards, field inspections, procedures and importance.	Mid-term Exams, End-Term Exam Assignments and ABL
	Unit-4 **Post-Harvest Seed Management** – Seed drying, processing, treatment (methods and importance), packing and storage. Seed longevity and health during storage.	End-Term Exam Assignments and ABL

	Unit-5 **Seed Legislation and Quality Assurance** – Seed certification, Seed Act 1966 and enforcement, duties of seed inspector, penalties, Seeds Control Order 1983, New Seed Bill 2019.	End-Term Exam Assignments and ABL
	Unit-6 **Seed Quality Testing and Enhancement** – Physical purity, moisture, germination, seed vigor, viability, genetic purity (grow-out test), seed health testing methods.	End-Term Exam Assignments and ABL

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Study of seed structure 2. Seed sampling techniques 3. Physical purity analysis 4. Determination of seed moisture content 5. Germination testing methods 6. Seed and seedling vigor test 7. Seed viability test 8. Genetic purity test using Grow Out Test 9. Field inspection methods for seed production 10. Seed health testing – blotter and agar plate methods 11. Visit to seed production farms 12. Visit to seed testing laboratories 13. Visit to seed processing plants **Note: Assessment:** AT-6, AT-7, AT-8, AT-9 will be done by the hands on practicals	❖ Activity-Based Learning ❖ Project-Based Learning ❖ Practical Exam ❖ Viva-Voce Examination ❖ Field Visit Report ❖ Assignments

Assignment	**Assignment Topics** ***(Student to submit any one as part of evaluation)*** a) Seed quality parameters and their impact on crop yield b) Procedure and standards for foundation seed production in any one pulse crop c) Comparative study of seed processing methods d) Seed health issues during storage and their mitigation

	e) Legislative frameworks governing seed quality in India
Suggested reading	**Suggested Readings** 1. Agarwal, R.L. (1995). *Seed Technology* (2nd Edition). Oxford & IBH Publishing Co., New Delhi. 2. Khare, D. and Bhale, M.S. (2019). *Seed Technology* (2nd Revised & Enlarged Edition). Scientific Publishers, Jodhpur. 3. Vanangamudi, K. (2014). *Seed Technology (An Illustrated Book)*. New India Publishing Agency, New Delhi. 4. Bhojwani, S.S. and Bhatnagar, S.P. (1999). *The Embryology of Angiosperms*. Vikas Publishing. 5. McDonald, M.B. Jr. & Copeland, L.O. (1997). *Seed Production: Principles and Practices*. Chapman & Hall. 6. Tunwar, N.S. and Singh, S.N. (1988). *Indian Minimum Seed Certification Standards*. CSCB, Ministry of Agriculture, New Delhi.
Suggested resources (Websites/eBooks)	https://seednet.gov.in/ https://nsai.co.in/ https://icar.org.in/ https://www.manage.gov.in/ https://ncof.dacnet.nic.in/

Course Code: ELCT-AE-411		**Course Name:** Agribusiness Management		**Semester: VII**
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Basic, applied, and Innovative		**Student-specific course outcome**	Placement Higher education Entrepreneurship

Course Objectives:

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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Define and describe the concept of agribusiness, agro-based industries, the New Agricultural Policy, and the importance of agribusiness in the Indian economy.
CO-2	Explain and summarize the components of agribusiness systems, agri-value chains, and the business environment using tools like PEST and SWOT analysis.
CO-3	Apply principles of business planning and management functions (planning, staffing, directing, controlling) in establishing and running agribusiness enterprises.
CO-4	Analyze organizational culture, marketing strategies, consumer behavior, and the financial statements of agribusiness firms to understand internal and external business dynamics.
CO-5	Evaluate agro-industry project proposals using project management techniques, including project appraisal, formulation, implementation, and financial analysis.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Smart Board 3. PowerPoint Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and end-term exams
AT-2	Seminar Presentation
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Viva voce examination
AT-7	Report writing
AT-8	Economics Models
AT-9	Project Appraisal Training

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit 1** Transformation of agriculture into agribusiness, various stakeholders, and components of agribusiness systems. Importance of agribusiness in the Indian economy and the New Agricultural Policy. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries. Classification of industries and types of agro-based industries.	Quiz Mid term Assignment exercise
	Unit 2 Institutional arrangements and procedures to set up agro-based industries. Constraints in establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages.	Mid term Assignment exercise
	Unit 3 Business environment: PEST and SWOT analysis. Management functions: Roles and activities, Organization culture. Planning, meaning, definition, and types of plans. Purpose or mission, goals or objectives, Strategies, polices, procedures, rules, programs and budget.	Quiz Assignment exercise
	Unit 4 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.	Quiz Economic Model

	Unit 5 Marketing Management: Segmentation, targeting and positioning. Marketing mix and marketing strategies. Consumer behavior analysis, Product Life Cycle (PLC). Sales and Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.	Activity-Based Learning

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Study of seed input markets – availability, pricing, and distribution. 2. Study of fertilizer input markets – types, brands, marketing, and access. 3. Study of pesticide input markets – demand, supply, and regulatory aspects. 4. Study of output markets for grains – structure, pricing, and seasonal variations. 5. Study of output markets for fruits and vegetables – handling, pricing, and perishability. 6. Study of output markets for flowers – demand, supply chains, and export potential. 7. Study of product markets and retail trade in agricultural commodities. 8. Study of commodity trading and marketing of value-added agricultural products. 9. Study of cooperative credit institutions and their role in agribusiness finance. 10. Study of commercial banks, RRBs, NABARD, and Agribusiness Finance Limited in agri-financing.	Practical Exercise Viva voce Assignments Presentation

11. Preparation of project reports and feasibility studies for agribusiness entrepreneurs. 12. Evaluation of agribusiness projects using non-discounting appraisal techniques (e.g., Payback Period, Average Rate of Return). 13. Case study analysis of a selected agro-based industry (e.g., dairy, food processing, etc.). 14. Analysis of trends and growth rates of prices of selected agricultural commodities over time.	
Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Transformation of Agriculture into Agribusiness: Analyze the shift from traditional farming to agribusiness in India. Discuss the role of stakeholders and the impact of the New Agricultural Policy on agribusiness systems. 2. Agro-Based Industries in India: Classify different types of agro-based industries. Discuss the institutional procedures and challenges in setting up such industries with examples." Agri-Value Chain Analysis: Examine the primary and support activities in the agri-value chain. Illustrate how value is added at each stage with examples from any specific commodity." 3. Business Environment and Management Functions in Agribusiness: Conduct a PEST and SWOT analysis for an agribusiness enterprise. Explain how

	management functions such as planning, organizing, and controlling are applied." 4. Marketing and Financial Management in Agribusiness: Prepare a mini business plan including segmentation, targeting, positioning, marketing mix, and basic financial statements. Evaluate the project's viability using project appraisal techniques.
Suggested reading	1. Broadway, A.C. and Broadway, Arif, A. 2002. A textbook of Agri-Business Management. Kalyani Publishers 2. Bairwa, S.L. 2016. Objective on Fundamentals of Agri-business Management. Kalyani Publishers 3. Anjan Nishra, Debasish Biswas, and Arunangshu Giri. 2019. Agribusiness Management, Himalaya Publishing House, 220p. 4. Shoji Lal Bairwa, Chandra Sen, L.K. Meena, and Meera Kumari. 2018. Agribusiness Management Theory and Practices, Write and Print Publications. 5. Virender Kamalvanshi. Agribusiness Management. Random.
Suggested resources (Websites/eBooks)	1. https://zalamsyah.files.wordpress.com/2018/02/6-agribusiness-management.pdf 2. https://www.manage.gov.in/publications/eBooks/Agri-business%20Management%20Opportunities%20for%20Youth.pdf

Course Code: ELCT -AGRON - 411		Course Name: Management of natural resources		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course 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.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the concept, classification, and interrelationship of natural resources, and analyse factors influencing their availability, distribution, and usage.
CO-2	Describe and evaluate land and water resources, including land degradation, soil erosion, desertification, water utilization, and ecological impacts of infrastructure like dams.
CO-3	Identify and analyze different energy resources, including renewable and non-renewable sources, and explain their significance in sustainable development.
CO-4	Assess resource management paradigms and approaches (ecological, economic, ethnological), including conflict resolution strategies and integrated resource management.
CO-5	Apply practical skills in surveying, soil and water management, and land resource analysis, including contour mapping, erosion assessment, and farm pond design.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. Assignments 2. Flip Class

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-3	Practical Exam
AT-4	Viva-Voce examination
AT-5	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit - 1** 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.	Mid-term Exams and End-Term Exam Assignments
	Unit - 2 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 and management.	Mid-term Exams and End-Term Exam Quiz/Assignments
	Unit-3 Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management.	End-Term Exam Assignments
	Unit-4 Energy resources: Growing energy needs, renewable and nonrenewable 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, economic, and ethnological approaches; implications; integrated resource management strategies	End-Term Exam Quiz/Assignments

	Unit-5 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.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Identifying natural resources and their utility. 2. Practicing survey - Principles and educating to use pacing technique for measurement. 3. Area calculations through chain survey - GPS demo for tracking and area measurement. 4. Estimation of soil loss and calculation of erosion index. 5. Leveling concepts and practical utility in agriculture. 6. Preparation of contour maps. 7. Concept of vegetative water ways and design of grassed water ways. 8. Wind erosion and estimation process. 9. Different irrigation pumps and their constructional differences. 10. Farm pond construction and its design aspects. 11. Visit to nearby farm pond. 12. Visit to an erosion site. 13. Exposure to strip cropping/contour bunding. 14. Identification and classification of water erosion forms and gully control measures. 15. Demonstration of soil loss estimation using USLE method. 16. Design and layout of water harvesting structures like ponds and tanks .	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Classify natural resources and explain factors affecting their availability and interrelationships. 2. Discuss land degradation types, their causes, and landscape management strategies.

	3. Analyze the overutilization of water resources, major conflicts, and conservation techniques. 4. Compare renewable and non-renewable energy sources and suggest sustainable alternatives. 5. Explain soil erosion types, causes, and methods of soil and water conservation.
Suggested reading	1. Sustainable Natural Resource Management by Danill R. Lynch. 2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and B S Rathor, Daya Publishing House. 3. Managing Natural Resources: Focus on Land and Water. Ed. Harikesh N. Mishra. PHI, Learning, 496p.
Suggested resources (Websites/eBooks)	• **Soil and Water Conservation: A Celebration of 75 Years** – Soil and Water Conservation Society Rich in history, technical details, and field-level applications. nibmehub.com+13swcs.org+13nishat2013.files.wordpress.com+13 • **Soil and Water Conservation – FAO Knowledge Repository** Covers practical water harvesting & soil moisture retention techniques—great for your watershed and erosion units. en.wikipedia.org+10openknowledge.fao.org+10hindi.icfre.gov.in+10 • **A Textbook on Soil and Water Conservation Engineering** – ResearchGate (Ayare) Covers soil erosion fundamentals and conservation engineering methods. constitutionnet.org+14researchgate.net+14agrimoon.com+14 • **Soil Conservation Handbook** Design manual with applied insights on gully control, drainage, windbreaks—very useful for contouring and bunding topics. troopwebhost.blob.core.windows.net+3nishat2013.files.wordpress.com+3cifor-icraf.org+3

Course Code: ELCT-ENT-411		Course Name: Agrochemicals		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

To impart knowledge on different classes of agrochemicals

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand Core Concepts
CO-2	Evaluate Soil and Plant Health
CO-3	Apply Analytical Techniques
CO-4	Assess Environmental Impact
CO-5	Explore Research and Innovation

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Introduction and classification and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.	End-Term Exam Assignments
	Unit-4 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.	End-Term Exam Assignments
	Unit-5 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.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Sampling of fertilizers and pesticides. **2.** Pesticides application technology **3.** to study about various pesticides appliances. **4.** Quick tests for identification of common fertilizers. **5.** Identification of anion and cation in fertilizer. **6.** Calculation of doses of insecticides to be used. **7.** To study and identify various formulations of insecticide available kin market. **8.** Estimation of nitrogen in Urea. **9.** Estimation of water soluble P2 O5 and citrate soluble P2 O5 in single super phosphate. **10.** Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. **11.** Determination of copper content in copper oxychloride. **12.** Determination of sulphur content in sulphur fungicide.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a. Fate of herbicides b. Classification and insecticides c. Insecticide Act and rules d. Mixed and complex fertilizers e. Fertilizer control order
Suggested reading	1. Buchel, K.H. (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.
Suggested resources (Websites/eBooks)	1. https://agrimoon.com/manures-fertilizers-agrochemicals-pdf-book/ 2. https://www.teachmint.com/tfile/studymaterial/class-6th/soilscience/agrochemicalspdf/83bdc4ec-f18e-40f6-a46a-4033eb2576f1

Course Code: ELCT-AEXT-411		Course Name: Agricultural Journalism		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

- To understand the nature, scope, and significance of agricultural journalism in rural communication.
- To analyze the structure, functions, and role of newspapers and magazines as mass communication media.
- To develop knowledge of writing styles, language use, and content structure in print media.
- To acquire skills for gathering, organizing, and presenting agricultural information effectively.
- To enhance competency in writing, illustrating, and editing agricultural news stories for better readability and impact

Course outcomes: After completion of the course, the student will be able to:

CO-1	Know about basics of agricultural journalism.
CO-2	Understand the difference between different types of journalism.
CO-3	Apply their knowledge in communication media
CO-4	Improve readability measures
CO-5	Analyze the source of information and their role in agricultural journalism
CO-6	Develop better sources of agriculture information.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Assignments

Prerequisites	Unit-wiseCourse Contents	Assessment tools
Course Contents	**UNIT-I** Journalism – Meaning, nature, importance, and types of journalism. Agricultural Journalism – Meaning, definition, principle, objectives, types, and scope. Similarities and difference between agricultural journalism and other types of journalism. Role of agricultural journalist, Training of agricultural journalist. Qualities of journalist, Role of journalist /journalism in agricultural development and development of newspaper and magazines readers.	Mid-term Exams and End-Term Exam Assignments
	UNIT-II Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers. Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines.	Mid-term Exams and End-Term Exam Assignments
	UNIT-III The agricultural story: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story. Gathering farm information -Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events. Other sources: electronic media, field study. Success stories definition, nature, components, guidelines of writing a success story	End-Term Exam Assignments
	UNIT-IV Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body. Readability measure-readability ease score, automated readability index, gunning fog index, How to improve readability of	End-Term Exam Assignments

	articles and stories.	
	UNIT-V Use of photograph in agricultural journalism- Basic principles of photography – composition, exposure, lens, light. Use of artwork (Graphs, charts maps, etc.). Writing the captions. Editorial mechanism: Copy reading, headline and title writing. Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader. Layout – meaning, principles of layout and design.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
Demonstration & Report Preparation 1. To study about a news story 2. To study about radio script writing 3. To study about the practicing in interviewing 4. To study about the covering agriculture events 5. To study about the writing different types of agricultural stories 6. To study about visit to the publishing office 7. To study about practicing in editing, copy reading, headline and title writing, proofreading and lay outing. 8. Selecting pictures and art work for the agricultural stories.	Activity-Based Learning Practical Exam Viva-Voce Examination Assignments

Assignment	1. Cover an agriculture event and prepare a news report 2. To prepare a power point presentation 3. To study about the magazine story.
Suggested reading	**A. Textbooks:** 1. Bhaskaran, C, Prakash, R. & Kishore Kumar, N. 2008. Farm Journalism in Media Management. Agro-Tech. Publishing Academy. 2. Chattergee, P.C. 1991. Broadcasting in India. Sage Publication. 125 3. Chiranjeev, A. 1999. Electronic Media Management. Authors Press. 4. D'Souza, Y.K. 1998. Principles and Ethics of Journalism and Mass Communication. Commonwealth Publication. 5. Defleur, M.L. & Dennis, E.E. 2001. Understanding Mass Communications. Goyal saab Publication. 6. Jain, S.C. 2006. International Marketing Management. CBS Publication.
Suggested resources (Websites/eBooks)	1. www.ecourses.icar.gov.in 2. www.jnkvv.org.in 3. www.ecoursesonline.iasri.res.in 4. www.libicar.gov.in 5. www.krishi.icar.gov.in

Course Code: ELCT-HORTI-411		Course Name: Landscaping		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**3**	**1**	**5**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• **Higher Education** • **Placement** • **Entrepreneurship**

Course Objectives:

1.To educate the students on designing different styles and types of gardens
2.To enable the students to identify different ornamental plants and their utilization in landscaping design
3.To enable students to design landscapes in software like AUTOCAD, ARCHCADE etc.

CO-1	Understand the importance, scope, and principles of landscaping, including various garden styles and types.
CO-2	Identify and design key components of gardens such as lawns, rockeries, water features, and constructed elements.
CO-3	Select, propagate, and manage different types of plants used in landscaping, including trees, shrubs, climbers, and annuals.
CO-4	Apply landscaping techniques to urban, rural, and special-purpose areas such as schools, hospitals, and public spaces.
CO-5	Demonstrate practical skills in pot plant management, bonsai techniques, and use of CAD in landscape planning.

Teaching Pedagogy	
T1	1. Classroom Lecture 2. Fieldwork and outdoor learning 3. Chalkboard 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Seminars 4. Quiz

Assessment tools	
AT-1	Assignment
AT-2	Quiz
AT-3	Mid Term Exams
AT-4	End Term Exam
AT-5	Report Writing
AT-6	Activity Based Learning
AT-7	Viva Voce Examination

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
	Unit-1 Importance and scope of landscaping-Principles of landscaping-Garden styles and types-Gardens for special purposes-Bio-aesthetic planning: definition, need, and planning	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Terrace gardening and vertical gardening-Garden components and adornments-Lawn making: establishment and maintenance-Rockery, water gardens-Walk-paths, bridges, and other constructed features-Bonsai: principles and management	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Trees: selection, propagation, planting schemes, canopy management-Shrubs and herbaceous perennials: selection, propagation, architecture-Climbers and creepers: importance, selection, propagation, planting	End-Term Exam Assignments

Course Contents	**Unit-4** Annuals: selection, propagation, planting schemes- Other garden plants: palms, ferns, grasses, cacti, and succulents-Pot plants: selection, arrangement, and management	End-Term Exam Assignments
	Unit-5 Landscaping of urban, rural, and peri-urban areas-Landscaping of schools, public places (bus stations, railway stations, hospitals, etc.)-Landscaping for industries, institutions, playgrounds, airports, and riverbanks-Introduction to CAD (Computer-Aided Design) applications in landscaping	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Identification of Trees used in Landscaping 2. Identification of Shrubs, Annuals, and Pot Plants used in Landscaping. 3. Propagation Techniques for Trees, Shrubs, and Annuals 4. Potting, Repotting, and General Plant Maintenance 5. Identification and Use of Tools and Implements in Landscaping 6. Training and Pruning of Plants for Special Effects 7. Lawn Establishment: Methods and Grass Types 8. Lawn Maintenance: Mowing, Fertilization, and Weed Control 9. Layout and Features of Formal Gardens 10. Layout and Features of Informal Gardens 11. Design and Layout of Special Gardens: Sunken and Terrace Gardens 12. Design and Layout of Special Gardens: Rock Garden and Water Features 13. Designing and Maintenance of Conservatory and Lathe House	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

14. Use of Computer Software in Landscape Design 15. Design Project: Preparation of a Garden Layout Plan (Manual or Software-based) 16. Visit to Important Gardens, Parks, and Landscaping Institutes.	
Assignment	**As part of their continuous evaluation system, students are required to submit one assignment** a) Plant Selection and Planting Schemes in Landscape Design b) Role and application of CAD (Computer-Aided Design) in modern landscape planning
Suggested reading	1. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia 2.Principles of Landscape Gardening: Y. Chandrasekhar and Hemla Naik B. 2020. ICAR. 3.Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh. 2020, Bio-Green Books. 4.Principles of Landscape Architecture: Pragnyashree Mishra and Bhimasen Naik. 2022. New India Publishing Agency. 5.Landscape Gardening: Sudhir Pradhan. 2018. Scientific Publishers India.
Suggested resources (Websites/eBooks)	1. http://eagri.org/eagri50/HORT181/index.html 2. https://bscagristudy.online/wp-content/uploads/2021/06/HORT-243-PRINTED-NOTES.pdf 3. https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf 4. ICAR e-course

Course Code: ELCT-GPB-411		Course Name: ELCT-GPB-411 Commercial Plant breeding		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Technical Skill Development • Entrepreneurship • Research and Higher Education • Regulatory and Policy Awareness

Objectives

1. 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.

2. To provide understanding on tissue culture and biotechnological approaches as alternative strategies for development of line and cultivars

3. To impart knowledge on seed production, release and notification of varieties and PPV&FR Act, 2001

Course outcomes: After completion of the course, the student will be able to:

CO-1	**Understand** the types of crops, modes of reproduction, and line development systems (A/B/R, two-line system) used in hybrid breeding.
CO-2	**Apply** techniques of selfing, crossing, and hybrid seed production using male sterility systems in field and vegetable crops.
CO-3	**Analyze** the role of tissue culture, haploid induction, speed breeding, and biotechnological tools in commercial cultivar development.
CO-4	**Evaluate** IPR-related issues including PPV&FR Act, 2001, DUS testing, and variety release and notification systems in India.
CO-5	**Perform** seed quality analysis, including sampling, purity testing, drying, storage, and processing, and **propose** strategies for optimizing hybrid seed production.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Laboratory Experiments 3. Field Based Experiments 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Quiz 4. PBL activities

Assessment tools	
AT-1	Mid-term Exams and End-TermExam
AT-3	Quiz
AT-4	Poster Presentation
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	**Unit-wiseCourse Contents**	**Assessment tools**
	Unit I: Fundamentals of Commercial Plant Breeding: This unit covers the types of crops and modes of plant reproduction. It explains the principles of line development and maintenance breeding in self- and cross-pollinated crops, focusing on A/B/R and two-line systems used in hybrid development. The unit also includes genetic testing methods for commercial hybrids.	Mid-term Exams and End-Term Exam Assignments
	Unit II: Hybrid Breeding in Major Crops: This unit deals with advances in hybrid seed production techniques in crops such as maize, rice, sorghum, pearl millet, castor, sunflower, cotton, pigeonpea, and Brassica. It also discusses quality seed production methods in vegetable crops under both open field and protected environments. The importance of pollinators and pollination control mechanisms in hybrid seed production is also discussed..	Mid-term Exams, Quiz and End-Term Exam Assignments

Course Contents	**Unit III: Modern Tools and Techniques in Breeding**: This unit introduces speed breeding and breeding management systems, along with the use of high-throughput phenotyping and genotyping platforms. It also covers alternative strategies for line development, including haploid inducer techniques, tissue culture methods, and various biotechnological tools applicable in commercial plant breeding.	Mid-term Exams, End-Term Exam Assignments and ABL
	Unit IV: Seed Production and Quality Assurance: This unit focuses on the principles and techniques involved in seed production. It elaborates on the classification and types of seeds and discusses methods of quality testing in both self- and cross-pollinated crops. Additional topics include seed drying, storage, and modern seed processing techniques to maintain genetic purity and viability.	End-Term Exam Assignments and ABL
	Unit V: Policy, Legal, and Regulatory Framework: This unit discusses the intellectual property rights issues related to commercial plant breeding. It includes detailed coverage of DUS testing and the registration of varieties under the PPV&FR Act, 2001. It also describes the process of variety testing, release, and notification systems in India, along with the role of public and private institutions in seed commercialization.	End-Term Exam Assignments and ABL

List of Practical (Field/Lab Exercises)	**Assessment tools**

Practical Exercises 1. Study of floral biology in self- and cross-pollinated species 2. Practice of selfing and crossing techniques in field crops 3. Techniques of seed production using A/B/R and two-line systems 4. Hybrid seed production using male sterility systems 5. Identification of difficulties in hybrid seed production 6. Tools and techniques for optimizing hybrid seed production 7. Concept and practice of rouging in seed production plots 8. Line multiplication and purification methods in hybrid seed production 9. Study of pollinators and their role in hybrid seed production 10. Demonstration of hybrid seed production in sorghum, maize, rice, pearl millet, sunflower, cotton, pigeonpea, rapeseed-mustard, and castor 11. Quality seed production techniques in vegetable crops 12. Sampling procedures and detection of spurious seeds in hybrid seed lots 13. Analytical tests for seed purity, viability, and vigor 14. Techniques for seed drying, grading, packaging, and storage 15. Visit to public and private seed production and processing plants **Note: Assessment:** AT-6, AT-7, AT-8, AT-9 will be done by the hands on practicals	❖ Activity-Based Learning ❖ Project-Based Learning ❖ Practical Exam ❖ Viva-Voce Examination ❖ Field Visit Report ❖ Assignments
Assignment	**Assignment Topics *(Student to submit any one as part of evaluation)*** 1. Classification of crops based on pollination and hybrid breeding systems. 2. Case study on hybrid seed production in a selected crop (e.g., maize, rice, pigeonpea). 3. Report on modern tools and techniques used in commercial plant breeding. 4. Step-by-step procedure for variety release and registration under the PPV&FR Act, 2001. 5. Reflection report on seed production and processing unit visit. 6. Comparative analysis of A/B/R and two-line breeding systems. 7. Documentation of tissue culture and haploid induction techniques in breeding. 8. Assignment on quality seed production practices in vegetable crops. 9. Report on the role of pollinators in hybrid seed production. 10. Compilation of purity testing methods and detection of spurious seeds.
Suggested reading	**Suggested Readings** **Suggested readings** **Suggested readings** 1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. DayaPublishing House.

	2. Plant Breeding: Principles and Methods by B. D. Singh. Kalyani Publishers. 3. Principles of Plant Breeding (1st & 2nd Edition) by R.W. Allard. 4. Breeding Field Crops by J.M. Poehlman. 5. Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh. Astral Publishing, 160p. 6. Breeding and Crop Production: H. Padmalatha, Random. 7. Biotechnology for Agricultural Breeding: Mangal, S. K. GeneTech Books.
Suggested resources (Websites/eBooks)	**Websites** 1. **ICAR - Indian Council of Agricultural Research** https://icar.org.in Authoritative source for national crop improvement programs, variety release procedures, and seed technology updates. 2. **PPV&FR Authority (Protection of Plant Varieties and Farmers' Rights)** https://www.plantauthority.gov.in Official site for DUS testing, variety registration, breeders' rights, and legal frameworks in India. 3. **IARI - Indian Agricultural Research Institute** https://www.iari.res.in Offers access to research papers, breeder seed availability, and hybrid development programs. 4. **FAO - Food and Agriculture Organization** https://www.fao.org International insights on plant breeding policies, biotechnology, and seed systems. 5. **IRRI - International Rice Research Institute** https://www.irri.org Rich database on hybrid rice, breeding tools, and genetic innovations. --- **e-Books & PDFs** 1. **Principles of Plant Breeding** by R.W. Allard Foundational book for understanding classical and commercial breeding approaches. 2. **Plant Breeding: Principles and Methods** by B.D. Singh Widely used in Indian universities, includes chapters on hybrid development and seed production. 3. **ICAR eCourse: Commercial Plant Breeding** Available on: https://ecourses.icar.gov.in Full module-based content with animations, diagrams, and assessments.

	4. **Seed Production and Certification** – TNAU Notes Downloadable PDFs from Tamil Nadu Agricultural University http://agritech.tnau.ac.in 5. **Biotechnology in Crop Improvement** – eBook by FAO or Springer (through academic access) Explores the role of biotechnology, tissue culture, and molecular tools in plant breeding.

Course Code: FST-411		Course Name: Food Safety and Standards		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**04**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To develop the skills to convert raw materials into safe, attractive food products
2. To manage the production of food products
3. To use scientific knowledge to develop new products.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Define food safety, hazards and risks factors
CO-2	Understand importance of hygiene, sanitation in food service establishments and national-international food laws and standards
CO-3	Utilize food safety management tools and their need for food quality maintenance
CO-4	Examine water quality, sanitation, hygiene and waste disposal of food processing unit
CO-5	Judge packaging, product, nutritional labelling and recent outbreaks

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Industrial Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit I:** Food Safety – Definition, Importance, Scope and Factors affecting Food Safety. Hazards and Risks, Types of hazards - Biological, Chemical, Physical hazards. Management of hazards - Need. Control of parameters. Temperature control. Food storage and Product design.	Mid-term Exams and End-Term Exam Assignments
	Unit II: Hygiene and Sanitation in Food Service Establishments- Introduction. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control.	Mid-term Exams and End-Term Exam Assignments
	Unit III: Water Analysis, Surface Sanitation and Personnel Hygiene. Food Safety Measures. Food Safety Management Tools- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc.	End-Term Exam Assignments
	Unit IV: HACCP. ISO series. TQM - concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Food laws and Standards Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food.	End-Term Exam Assignments
	Unit V: Recent concerns- New and Emerging Pathogens. Packaging, Product labelling and Nutritional labelling. Genetically modified foods\ transgenics. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Water quality analysis 2. Physico-chemical properties of fruits and vegetables 3. Physico-chemical properties of cereals and pulses 4. Microbiological Examination of different food samples. 5. Preparation of different types of media. 6. Assessment of surface sanitation by swab/rinse method. 7. Assessment of personal hygiene. 8. Assessment of surface sanitation 9. Biochemical tests for identification of bacteria. 10. Scheme for the detection of food borne pathogens. 11. Preparation of plans for Implementation of FSMS - HACCP, 12. Preparation of plans for Implementation of ISO: 22000.	1. Spot Identification 2. Practical Activity 3. Practical Record 4. Regularity 5. Viva voce

Assignment	As part of their continuous evaluation system, students are required to submit one assignment **a)** Labeling and Legal Standards Label design as per FSSAI/APEDA; practice barcode & QR labeling b) Case Study Analysis **(**Evaluating real packaging problems (e.g., apple export loss due to poor packaging).
Suggested reading	1. Text book of Food Science and Technology: Avantina Sharma. 2. Handbook of Food Safety: D.S.L. Khatekar and N. Sarkate. Step Up Academy, 576p. 3. Food and Beverage Management: Bernard Davis. Andrew Lockwood, Ioannis Pantelidis, Peter Alcott Routle.dge 4. Food safety and Quality Control: Pulkit Mathur. The Orient Blackswan.332p. 5. Safe Food Handling: HACCP booklet for Food Handlers. Cletus Fernandes, Notion Press.
Suggested resources (Websites/eBooks)	1. https://www.agrostudy.in/2021/10/fundamentals-of-entomology.html#google_vignette 2. https://www.iaritoppers.com/2019/06/fundamentals-of-entomology-icar-ecourse-pdf-download.html

Course Code: ELCT- ENT-412		Course Name: Bioformulation and Nanoformulation		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To enable students to acquire expertise and skill to develop bioformulation and Nanoformulation
2. To know the importance of biopesticides and biofertilizers
3. To make the students know about various techniques involved in biofertilizers and biopesticides production
4. To get knowledge on essential oils, botanicals, predators, parasitoids, pheromones, and parapheromone and their application in insect pest management
5. To get concepts on agrochemical formulations with nanoparticles and acquaint them with nanotechnology

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the history and principles of biological control of pests and diseases, including classical, augmentative, and conservation approaches.
CO-2	Describe the importance of biopesticides in organic farming, including their compatibility with ecological practices.
CO-3	Identifying and differentiating phytopathogenic and entomopathogenic biocontrol agents, and explaining their modes of action such as antibiosis, competition, parasitism, and induced resistance.
CO-4	Demonstrate production techniques, quality assessment, and application methods for biopesticides and biofertilizers.
CO-5	Understand the regulatory framework for biopesticides in India, including registration procedures and quality standards.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction and history of biological control of pests and diseases; Microbial biopesticides: the global and Indian market scenario; biopesticides for organic agriculture; Different phytopathogenic biocontrol agents: Mode of action.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Different entomopathogenic biocontrol agents: Mode of action; Microbial inoculants as biofertilizer candidates, Production, quality assessment and methods of application of biopesticides and biofertilizers.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Regulatory system of biopesticides in India; Formulations of plant essential oils, botanicals, pheromone, and parapheromone and their application in insect pest management; Use of predators and parasitoids for insect pest management.	End-Term Exam Assignments
	Unit-4 Nanotechnology: its applications in pest and disease diagnosis and management; Nano biopesticides: Concept and importance, different techniques of producing nano biopesticides; Nano Fertilizers: Concept and importance.	End-Term Exam Assignments
	Unit-5 Types of nano fertilizers; Different techniques of producing nano fertilizers; Green synthesis of nano fertilizers; green slow-release fertilizer composition based on urea-modified hydroxyapatite nanoparticles.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Introduction and acquaintance with biopesticide laboratory. 2. Preparation of culture media. 3. Isolation and purification of bioagent from soil and infected insects 4. Microscopic study of different microbial bioagents. 5. In vitro assay of microbial bioagents against plant pathogens. 6. In vitro compatibility study among different microbial bioagents. 7. Mass multiplication of biopesticides. 8. Population enumeration of biocontrol agents in different biopesticides. 9. Preparation of plant extracts and their efficacy test against insect pests. 10. Use of pheromone parapheromone for monitoring and management of insect pests. 11. Bioassay of Entomopathogenic biocontrol agents on insect pests. 12. Preparation of microbial inoculants of biofertilizer microbes. 13. Compatibility of biofertilizer microbes. 14. Preparation of solid and liquid consortia of biofertilizer microbes.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Microbial Biopesticides: Global and Indian Market Scenario 2. Bioformulation and Nanoformulation course outcome 3. Biopesticides for Organic Agriculture 4. Entomopathogenic Biocontrol Agents: Mode of Action 5. Production, Quality Assessment, and Application Biopesticides
Suggested reading	1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society. 2. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology. 3. Boland, G.J. and David, L.1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC. 4. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer. 5. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural products. 6. Gnanamanickam, S.S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.

	7. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services, Bengaluru. 8. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services, Bengaluru. 9. Allhoff, Fritz and Lin, Patrick (Eds). 2009. Nanotechnology and Society. ISBN: 978-1-4020- 6208-7 Springer Publications, UK. 10. Prasad, Ram, Vivek Kumar, Manoj Kumar and Devendra Choudhary Eds, 2019. Nanobiotechnology in Bioformulations, Kindle Edition 11. Koul, Opender Ed, 2019. Nano-biopesticides Today and Future Perspectives. Academic Press. 12. Shah, M. A. and Tokeer Ahmad. Nano Science and Technology, Wiley India.
Suggested resources (Websites/eBooks)	• https://link.springer.com/book/10.1007/978-3-030-17061-5 • https://www.overdrive.com/media/4951305/nanobiotechnology-in-bioformulations

Course Code: ELCT-PP-411		Course Name: Biopesticides and Biofertilizers		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

- To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases
- To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the concept, classification, scope, and importance of biofertilizers in improving soil fertility and sustainable agriculture.
CO-2	Identify and describe different groups of microorganisms involved in nitrogen fixation, phosphate solubilization, and plant growth promotion.
CO-3	Demonstrate proficiency in the isolation, culturing, and identification techniques of beneficial microbial species such as *Azospirillum*, *Azotobacter*, *Rhizobium*, etc.
CO-4	Acquire skills for mass production, carrier-based formulation, and quality control of biofertilizers as per recommended standards.
CO-5	Apply suitable methods for the field application of biofertilizers including seed treatment, root dip, and soil amendment techniques.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Skill demonstration (Lab Performance)
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** • Definition and concept of biofertilizer • Scope and importance of biofertilizers • History of biofertilizer development • Current status and future prospects of biofertilizers • Role of biofertilizers in sustainable agriculture and environmental safety	Mid-term Exams and End-Term Exam Assignments

	Unit-2 • Types of nitrogen fixers: Symbiotic nitrogen fixers (*Rhizobium*, *Frankia*) Associative symbiotic (*Azospirillum*) • Free-living nitrogen fixers (*Azotobacter*, *Clostridium*) • Nitrogen fixation mechanisms and nodulation • Characteristics of *Azospirillum*, *Azotobacter*, *Rhizobium*, and *Frankia* • Classification and symbiotic associations • Bacterial culture techniques and identification • Effect of abiotic factors and biotic factors. Categories of pests.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 • Phosphate solubilizing microorganisms (PSM): types and mechanisms • Zinc solubilizing bacteria (ZSB), Potash solubilizers, Iron solubilizers • Organic acid production and mode of solubilization • Media used for isolation of PSM, ZSB, KSB, ISM • Role of PGPR (Plant Growth Promoting Rhizobacteria) in nutrient mobilization	End-Term Exam Assignments
	Unit-4 • Introduction to Blue Green Algae (BGA) and its nitrogen-fixing ability • Structure and characteristics of *Azolla-Anabaena* association • Cyanobacterial role in rice fields • Mass production and application of BGA and Azolla • Mycorrhizal fungi: types (AM, ECM) and importance in plant nutrition • Techniques for isolation and identification of AM fungi	End-Term Exam Assignments
	Unit-5 • Mass multiplication techniques of *Rhizobium*, *Azospirillum*, *Azotobacter*, BGA, and others • Liquid biofertilizers: characteristics and advantages • Carrier materials: types, properties, and sterilization • Quality control and BIS standards for biofertilizers	End-Term Exam Assignments

	• Shelf life, packaging, and storage of inoculants
	• **Application methods**:
	  ○ Seed treatment
	  ○ Seedling root dip
	  ○ Soil application
	• Constraints and limitations in biofertilizer use
	• Strategies for effective field-level adoption	

List of Practical (Field/Lab Exercises)	Assessment tools
1. Isolation and identification of Azospirillum 2. Isolation and identification of Azotobacter 3. Isolation and identification of Rhizobium 4. Isolation of Blue Green Algae (BGA) 5. Isolation and identification of Azolla 6. Isolation and identification of Phosphate Solubilizing Microorganisms 7. Isolation of Zinc Solubilizing Microorganisms 8. Isolation of Potash Solubilizing Microorganisms 9. Isolation of Iron Solubilizing Microorganisms 10. Isolation and identification of Mycorrhizal fungi 11. Mass multiplication and carrier-based formulation of Azospirillum 12. Mass multiplication and carrier-based formulation of Azotobacter 13. Mass multiplication and carrier-based formulation of Rhizobium 14. Mass multiplication and carrier-based formulation of Blue Green Algae (BGA)	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Introduction and Importance of Biofertilizers in Sustainable AgricultureInsect wing: structure and its modifications b) Microbial Groups Used in Nitrogen Fixation and Nutrient Solubilization c) Production and Field Application of Biofertilizers
Suggested reading	1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society 2. Bhatnagar, R.K. and Palta, R.K. Earthworm Vermiculture and Vermicomposting. KalyaniPublishers. 3. Boland, G.J. and David, L.1998. Plant Microbe Interactions and Biological Control. Kuykendall Marel Dekker, INC. 4. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology.

	5. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer. 6. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural Products. 7. Gehlot, Dushyent. Organic Farming: Standards, Accreditation, Certification and Inspection. Agrobios (India). 8. Gnanamanickam, S.S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC. 9. Nehra, Sampat. Biofertilizers for Sustainable Agriculture. Aavishkar Publishers, Jaipur, India. 10. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease 11. Nematodes and Weeds. Precision Fototype Services, Bengaluru. 12. Trivedi, P.C. Fungal Biopesticides and VAM applications. Pointer Publishers, Jaipur, India.
Suggested resources (Websites/eBooks)	1. https://www.agrostudy.in/2021/10/fundamentals-of-entomology.html#google_vignette 2. https://www.iaritoppers.com/2019/06/fundamentals-of-entomology-icar-ecourse-pdf-download.html 3. https://agrimoon.com/wp-content/uploads/Insect-Ecology-Integrated-Pest-Management.pdf 4. https://niphm.gov.in/Recruitments/ASO-Pathology.pdf

Course Code: ELCT-AGRON-412		Course Name: System Simulation and Agroadvisory		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course 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 the insect classes and their importance for the Classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development, and the communication of insects
4. To study the characteristics of commonly observed insect orders and their economically important families.

Course outcomes: After completion of the course, the student will be able to:

CO1	To know the basic concepts of various System simulation tools and techniques used in agriculture fields
CO2	Understanding the various simulation systems with their pros and cons
CO3	Demonstrate the use of various software for crop modelling, weather forecasting, dissemination of agro-advisor
CO4	Analyse the results obtained from different simulation systems with scientific interpretation
CO5	Evaluate the suitability of different systems in optimum crop modelling diseases forecasting and weather forecasting

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. Assignments 2. Flip Class/Seminars

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Quiz
AT-3	Poster
AT-4	Practical Exam
AT-5	Viva-Voce examination
AT-6	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** System approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis.	Mid-term Exams and End-Term Exam Quiz/Assignments

	Unit-3 Potential and achievable crop production- concept and modelling, techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance.	End-Term Exam Assignments
	Unit-4 Weather forecasting, types methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity.	End-Term Exam Quiz/Assignments
	Unit-5 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.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Collection and Preparation of Historical Meteorological Data 2. Preparation of Crop Weather Calendars 3. Interpretation of Synoptic Weather Charts and Weather Forecasts 4. Preparation of Agro-Advisories Based on Weather Forecasts 5. Feedback Collection and Analysis from Farmers on Agroadvisories 6. Introduction to Crop Simulation Models (e.g., DSSAT, INFOCROP) 7. Preparation of Input Files for Crop Simulation (Soil, Weather, Crop) 8. Simulation of Crop Growth Under Optimal Conditions 9. Simulation of Crop Growth Under Water and Nutrient Limitations 10. Sensitivity Analysis of Crop Models 11. Statistical Approaches for Yield Forecasting 12. Insect and Disease Forecasting Models 13. Working with Medium-Range Weather Forecast Data 14. Preparation of Historical and Present Weather Data Sets	Practical Exam Viva-Voce Examination Assignments

15. Use of Decision Support Systems for Agro-Advisory 16. Preparation and Presentation of Agro-Advisory Bulletins	
Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. ITK for weather forecast in India 2. Crop models, concepts & techniques 3. Preparation of crop weather calendars. 4. Use of crop simulation model for preparation of Agro-advisory and its effective dissemination 5. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance
Suggested reading	Text and Reference books: 1. Averill M.L. and Kelton D. 2005. Simulation, Modelling and Analysis. Tata McGraw Hill. Gordan G. 2007. 2. System Simulation. Pearson Edu Applied Agroclimatology by O.P.Bishnoi, Oxford Book Company, Jaipur, India302108, Edition 2010. 3. Remote Sensing Techniques in Agriculture by D.D.Sahoo, R.M.Solanki, Agrobios (India), Jodhpur, 2008.
Suggested resources (Websites/eBooks)	1. https://sari.umd.edu/sites/default/files/Baxla.pdf.pdf 2. http://apps.iasri.res.in/ebook/TEFCPI_sampling/WEATHER%20FORECASTING%20AND%20AG 3. https://krishi.icar.gov.in/jspui/bitstream/123456789/31188/1/CWM%20Lecture%20notes.pdf

Course Code: ELCT-HORT-412		Course Name: Hi-tech. Horticulture		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• **Higher education** • **Entrepreneurship**

Course Objectives:

1. To educate the students on the latest technology of hi-tech horticulture.
2. To educate students on the concepts and prospects of hi-tech horticulture.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Explain the significance of modern horticultural practices and technologies.
CO-2	Apply field preparation, planting, and micro-irrigation techniques.
CO-3	Analyse canopy management and high-density planting systems.
CO-4	Evaluate precision farming tools and their applications in horticulture.
CO-5	Assess smart technologies for reducing labor and post-harvest losses in horticulture.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report

AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction and importance of modern horticultural practices, focusing on efficient nursery management. Mechanization in nursery operations and micropropagation techniques used for rapid and disease-free multiplication of horticultural crops.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Modern methods of field preparation and advanced planting techniques in horticulture. It also introduces protected cultivation, explaining its advantages, the concept of controlled conditions, and the various methods and techniques used to optimize plant growth in protected environments.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Micro-irrigation systems and their components, highlighting their role in water-use efficiency. Fertilizer scheduling based on electrical conductivity (EC) and pH levels, integrating fertigation strategies to ensure balanced nutrition management.	End-Term Exam Assignments
	Unit-4 Principles and techniques of canopy management in fruit crops, along with the concept and layout of high-density orchards. Training, pruning, and growth regulation to enhance productivity and fruit quality.	End-Term Exam Assignments

	Unit-5 Key components of precision farming, including Remote Sensing, Geographic Information Systems (GIS), Differential Geo-positioning System (DGPS), and Variable Rate Applicator (VRA). Application of these technologies in fruits, vegetables, and ornamental crops, concluding with methods of mechanized harvesting to reduce labor and post-harvest losses.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)		**Assessment tools**
Practical	Classes	
1. Types and Identification of Polyhouses and Shade Net Houses	2	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments
2. Layout and Construction of Protected Cultivation Structures	1	
3. Intercultural Operations in Protected Cultivation	2	
4. Identification and Use of Horticultural Tools and Equipment	1	
5. Basics of Micropropagation Techniques	2	
6. Nursery Management Using Portrays and	2	
7. Protrays Installation and Operation of Micro-Irrigation Systems	1	
8. EC and pH-Based Fertilizer Scheduling	2	
9. Canopy Management Practices in Fruit Crops	1	
10. Visit to a Hi-Tech Orchard or Nursery	1	
	15	

Assignment	As part of their continuous evaluation system, students are required to submit one assignment: 1. Scope of hi-tech horticulture in India 2. Discuss the role and advantages of protected cultivation in modern horticulture. 3. Evaluate the application of precision farming technologies (Remote Sensing, GIS, DGPS, VRA) in horticultural crop production. 4. Design a micro-irrigation and fertigation plan for a one-acre horticultural crop, based on EC and pH-based scheduling.
Suggested reading	1. More, T. A., Karale, A. R. and Patil, M.T. 2001. Hi-tech Horticulture, CAFT (Fruits), MPKV, Rahuri. 2. Singh, B.2005. Protected cultivation of vegetable crops, Kalyani Publishers, New Delhi. 3. Patil, M.T and Patil, P.V. 2004. Commercial Protected Floriculture, MPKV, Rahuri.

Course Code: ELCT-HORT-413		Course Name: Protected Cultivation		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

- ✓ For understanding of basic protected cultivation and nursery management.
- ✓ To determine the cladding materials and its importance.
- ✓ To learn about designing the protected structures.
- ✓ To educate students on the scientific and commercial cultivation of important value-added products in protected cultivation

Course outcomes: After completion of the course, the student will be able to:

CO-1	To list out and remember the importance of Protected cultivation and its scope in India.
CO-2	To classify the concept of classifications of protected structures.
CO-3	To apply the concept of protected cultivation for major crops.
CO-4	To examine the Basics of nursery management under protected structures.
CO-5	To evaluate the utility of growing media and growing condition under protected structures.
CO-6	To create the budget and design for protected cultivation and structures.

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-I: Introduction to Protected cultivation** Protected cultivation- importance and scope, Status of protected cultivation in India and World	Mid-term Exams and End-Term Exam Assignments
	Unit-II: Construction and types of protected structures Cladding materials involved in greenhouse/ poly house. Greenhouse design, environment control, artificial lights, Automation, Soil preparation and management, Substrate management. Types of benches and containers. Types of protected structure based on site and climate	Mid-term Exams and End-Term Exam Assignments
	Unit-III: Irrigation and propagation under protected structures Irrigation and fertigation management, Propagation and production of quality planting material of horticultural crops	End-Term Exam Assignments
	Unit-IV: Greenhouse cultivation of important horticultural crops Greenhouse cultivation of important horticultural crops – rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants, etc.	End-Term Exam Assignments
	Unit-V: Cultivation of economically important crops Cultivation of economically important medicinal and aromatic plants. Off-season production of flowers and vegetables. Insect pest and disease management under protected structures.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Preparation and nursery management under Protected structures 2. Propagation and nursery management under Protected structures 3. Bed preparation and planting of crops for productions 4. Intercultural operations 5. Soil EC and pH measurement 6. Regulation of irrigation and fertilizers through drip, fogging ad misting 7. Propagation and management of Ornamental and medicinal/Aromatic crops. 8. Visit to Protected structure	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) **Types and Design of Greenhouses Used in Protected Cultivation** *(Explore low-tech to hi-tech greenhouses, structural components, and climate control systems.)* b) **Protected Cultivation of High-Value Vegetables: Techniques and Economics** *(Focus on crops like capsicum, tomato, cucumber grown under polyhouses.)* c) **Role of Climate Control in Greenhouse Productivity** *(Study the influence of temperature, humidity, CO_2 enrichment, and light management.)* d) **Integrated Pest and Disease Management (IPDM) in Protected Structures** *(Emphasize non-chemical methods like sticky traps, bioagents, and insect-proof nets.)* e) **Hydroponics and Soilless Cultivation in Protected Environments** *(Explain NFT, cocopeat, and other methods used for growing crops without soil.)* f) **Water and Nutrient Management in Protected Cultivation** *(Include fertigation systems, drip irrigation, and use of water-soluble fertilizers.)* g) **Protected Cultivation of Flowers: Opportunities and Challenges** *(Cover crops like gerbera, carnation, rose, and chrysanthemum.)* h) **Impact of Protected Cultivation on Yield and Quality of Horticultural Crops** *(Compare open-field vs. protected cultivation results.)* i) **Automation and Smart Technologies in Greenhouse Management** *(Study sensors, controllers, mobile apps, and AI-based systems.)* j) **Government Schemes and Subsidies for Promoting Protected Cultivation in India** *(Include MIDH, NHM, and other relevant policies and incentives.)*
Suggested reading	1. Greenhouse operation and management by Paul V. Nelson. 2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu. 3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS. 4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA,252p. 5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar. New Delhi Publishers, 263p. 6. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V. Jain Brothers.

Suggested resources (Websites/eBooks)	1. https://bscagristudy.online/wp-content/uploads/2021/09/ELE-HORT-355-PRINTED-LONG-NOTE-2.pdf 2. https://course.cutm.ac.in/wp-content/uploads/2020/06/protected-cultivation-Methods-and-technique.pdf 3. https://ncert.nic.in/vocational/pdf/kepc101.pdf 4. https://agrimoon.com/wp-content/uploads/Protected-Cultivation-Post-Harvest-Technology.pdf 5. https://www.ramauniversity.ac.in/online-study-material/agriculture/agriculturec/visemester/protectedcultivationandsecondaryagriculture/lecture-1.pdf

Course Code: ELCT-AGM-411		Course Name: Climate Resilient Agriculture		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course 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

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the climate change and impacts of climate change on agriculture.	
CO-2	Analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture.	
CO-3	Recognize climate resilient technologies for enhancing crop productivity and sustainability.	
CO-4	Development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.	
CO-5	Application of organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM),	

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1-** 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-2- 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.	Mid-term Exams and End-Term Exam Assignments
	Unit-3- 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 and climatic information, agroadvisories, ICTs and simulation models.	End-Term Exam Assignments
	Unit-4- 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.	End-Term Exam Assignments
	Unit-5- 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.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	Assessment tools
1. Acquaintance with meteorological instruments including AWS, 2. Statistical techniques to study trend of climatic parameters, 3. Analysis of extreme weather events using non-parametric tests, 4. Building climate change scenarios under different futuristic emission of GHGs, 5. Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars, 6. Climate resilient technologies and manipulation of cropping patterns, 7. Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories, 8. Analysing carbon sequestration potential of different agro-ecosystems; 9. Designing climate smart village model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment 1. Climate change and impacts of climate change on agriculture and food security. 2. Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India. 3. Water management practices – rain water harvesting, 4. Breeding strategies for development of climate change resilient crops and varieties. 5. Development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.
Suggested reading	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 Sourcebook. FAO (2013). 4. Implications for Climate Smart Agriculture by Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari. Biotech Books, 357p. 5. Climate Resilient Agriculture, Adaptation and Mitigation Strategies by Manish Bhan. New India Publishing Agency, 294p.

	6. Climate Change and Agriculture Over India by Prasad Rao. PHI Learning, 352p. 7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M. Satish Serial Publishing House.178p.
Suggested resources (Websites/eBooks)	1. https://www.sciencedirect.com/science/article/pii/S266604902500009X. 2. https://www.researchgate.net/publication/329870678_Climate_Change_Agriculture_and_Food_Security. 3. https://openknowledge.fao.org/server/api/core/bitstreams/a4fd8ac5-4582-4a66-91b0-55abf642a400/content. 4. https://dst.gov.in/sites/default/files/Report_DST_CC_Agriculture.pdf.

Course Code: ELCT-GPB-412		Course Name: Biotechnology of Crop Improvement		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

- To acquaint with biotechnological tools of crop improvement
- To know about direct and indirect methods of gene transfer
- To introduce about gene editing in plants
- To provide knowledge about marker assisted breeding and genomic selection

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the impact of biotechnology on crop improvement and societal perspectives
CO-2	Describe various biotechnological tools and techniques used in crop improvement
CO-3	Apply genome editing approaches for crop improvement
CO-4	Evaluate biosafety regulations and ethical issues associated with GM crops and genome editing in Indian agriculture
CO-5	Design marker-assisted and genomic selection strategies using molecular markers for crop improvement

Teaching Pedagogy	
T1	1. Brainstorming 2. Group Discussion 3. Guided Questioning 4. Stimulus activities 5. Case studies 6. Talks and presentations 7. Problem-based learning 8. Fieldwork and outdoor learning

Assessment tools	
AT-1	Mid-term Examination and End-Term Examination
AT-3	Quiz
AT-6	Practical Examination
AT-7	Viva-Voce examination
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Impact of Biotechnology on crop improvement and the perspective of society; Various biotechnological techniques available for crop improvement – Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection. Biosafety regulations and their application in Agricultural Biotechnology.	Assignments
	Unit-2 Somaclonal variation and its use in crop improvement; embryo culture; anther/pollen culture; somatic embryogenesis; artificial seeds; techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants.	Mid-term Examination
	Unit-3 Direct and Indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots; Direct DNA delivery methods (microinjection, particle gun method, electroporation); gene targeting; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems	Assignments

Unit-4 Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into CRISPR/Cas9 plasmids; electroporation of Cas9 plasmids into cells; purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing; in vitro synthesis of single guide RNA (sgRNA); using Cas9/sgRNA complexes to test for activity on DNA substrates; evaluate Cas9 activity by T7E1 assays and DNA sequence analysis; Applications of CRISPR/cas9 technology in crop plants.	Quiz
Unit-5 Marker Assisted Breeding and Genomic Selection: Introduction to various DNA-based markers and their use in marker-assisted breeding; Foreground Selection, Recombinant Selection and background Selection; Marker-assisted backcross breeding, marker-assisted selection – success stories; Introduction to Genomic Selection.	End-Term Examination

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Isolation and Purification of Plasmid DNA 2. Preparation and Construction of Plant Expression Vector 3. Preparation of Explants for transformation 4. Transformation of Agrobacterium tumefaciens 5. Inoculation and Co-Cultivation with Agrobacterium 6. Selection of Transformed Explants Using Antibiotic-Based Screening 7. Molecular Validation of Transformants by Polymerase chain reaction 8. Preparation and construction of CRISPR/Cas9 Vector 9. Design and Synthesis of Guide RNA (gRNA) for Target Gene 10. Direct Delivery of CRISPR/Cas Construct into Plant Tissue 11. Target Analysis in Edited Plants 12. Selection of Parents for Marker-Assisted Backcross Breeding (MABB) Program 13. Controlled Hybridization and Development of F1 Population 14. Marker Analysis of F1 and Backcross Generations	Practical Based Learning Practical Exam Viva-Voce Examination Practical Report

Assignment	As part of their continuous evaluation system, students are required to submit assignment 1. Role of Plant Tissue Culture Techniques in Crop Improvement

	2. Genetic Engineering in Plants: Tools, Techniques, and Successful Transgenic Crop Development. 3. Molecular Markers in Plant Breeding: Types, Techniques, and Applications in Marker-Assisted Selection
Suggested reading	1. Brown, T. A. (2006). Genomes (3rd edn). New York: Garland Science Pub. 2. Gene Cloning and DNA Analysis, (2010). Retrieved from http:// biolab.szu.edu.cn/ other web/lzc/genetic%20engineering/courseware/b1.pdf. 3. Green, M. R., and Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. Cold 1. Spring Harbor, NY: Cold Spring Harbor Laboratory Press. 4. Old, R. W., Primrose, S. B., and Twyman, R. M. (2001). Principles of Gene Manipulation and Genomics, 7th Edition: Oxford: Blackwell Scientific Publications. 5. Sander JD and Joung JK. (2014). CRISPR-Cas Systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.
Suggested resources (Websites/eBooks)	1. https://www.isaaa.org/ 2. https://www.fao.org/biotechnology/en/ 3. https://www.ncbi.nlm.nih.gov/ 4. https://www.yourgenome.org/theme/what-is-crispr-cas9/

Course Code: ELCT-AENG-411		Course Name: Geoinformatics and remote sensing, precision farming		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours(per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

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

2. To provide a comprehensive knowledge of machine learning and its benefits in improving crop production and soil health management

Course outcomes: After completion of the course, the student will be able to:

CO-1	Describe the fundamental concept of remote sensing.
CO-2	Apply remote sensing techniques in soil and crop research
CO-3	Analyze the architecture and functioning of expert systems
CO-4	Examine the Crop stress and Yield forecast of different agricultural crops
CO-5	Evaluate the performance of machine learning models

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report
AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in atmosphere; Interaction with matter.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 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 geoinformatics.	Mid-term Exams and End-Term Exam Assignments
	Unit-3 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; Impact of Block chain and it's concepts	End-Term Exam Assignments
	Unit-4 Probability and Statistics: Bayes Theorem, correlation and Covariance, Continuous Random variables and probability distribution function, various forms of distributions, central limit theorem	End-Term Exam Assignments

	Unit-5 Basics of Machine Learning: Random forest, SVM, ensemble methods; Basics of Deep learning: various model architectures and it's training aspects; Hyperspectral and Thermal Remote Sensing; Proximal Soil and Crop Sensors.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Familiarization with different remote sensing equipments and data products, 2. Interpretation of aerial photographs and satellite data 3. Preparation of Land Use/Land cover map 4. Conduct soil surveys using GPS and traditional method. 5. Demonstrate basic tools of GIS software 6. Digitize watershed boundaries and stream networks using GIS tools. 7. Extract and delineate specific study areas from spatial datasets using GIS techniques. 8. Georeferencing of toposheets, 9. Design and produce soil maps 10. Basics of multivariate data analytics, 11. Applications of Regression analysis in Data Analytics. 12. To study clustering methods 13. To study geostatistics are essential in agricultural studies. 14. Applications of Decision Tree and SVM in Data Analytics.	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Explain Remote sensing and its component in detail. b) Elaborate importance of Expert system in detail. c) Discuss machine learning. Write any two methods in detail.

Suggested reading	1. Agarwal, R.L. 1995. Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India. 2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd 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, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publ 5. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall.
Suggested resources (Websites/eBooks)	• https://annamalaiuniversity.ac.in/studport/download/engg/civil/resources/Remote%20Sensing%20and%20GIS.pdf • https://onlinecourses.nptel.ac.in/noc25_ce108/preview • https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/MACHINE%20LEARNING(R17A0534).pdf

Course Code: ELCT-AGRON-413		**Course Name:** Principles and Practices of Organic Farming and Conservation Agriculture		**Semester:** VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	03	01	05	B.Sc. (Hons.) Agriculture
Curriculum level	• Information-based		**Student-specific course outcome**	• Higher education

Course Objectives:

1. To study the principles of crop production under organic and conservation agriculture Situation
2. To impart practical knowledge of organic and conservation agriculture practices

Course outcomes: After completion of the course, the student will be able to:

CO-1	Remember the definition, concept, principles, and scope of organic farming and conservation agriculture, and assess their relevance in the Indian agricultural context.
CO-2	Understand the suitable crops and varieties for organic systems and apply organic nutrient management and eco-friendly pest, disease, and weed control measures.
CO-3	Apply the core practices of organic farming and conservation agriculture minimum soil disturbance, crop residue retention, and crop diversification and compare the application and impact of organic manures versus inorganic fertilizers for major crops.
CO-4	Analyze the processing, labelling, marketing, and export potential of organic products along with the economic viability of organic farming systems.
CO-5	Evaluate the operational structure of the National Programme for Organic Production (NPOP), including certification procedures and crop standards.

Teaching Pedagogy	
T1	1. Interactive Lectures 2. Video Lectures 3. Power point presentation 4. Field Visits/Lab experiments 5. Flipped classes

Assessment tools	
AT-1	Mid-term Exams

AT-2	End-Term Exam
AT-3	Quiz/Assignments/herbarium file
AT-4	Practical Exam
AT-5	Viva-Voce examination

Prerequisites	Unit-wise Course Contents	Assessment tools
Course Contents	**Unit-1** Introduction to Organic Farming- Concept of organic farming. Principles of organic farming. Scope of organic farming in India. Choice of crops and varieties in organic farming.	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Nutrient management in organic farming and their sources. Organic manures – recommended doses and application in comparison to inorganic fertilizers for major crops. Fundamentals of insect, pest, disease, and weed management under organic mode of production.	Mid-term Exams and End-Term Exam Quiz/Assignments
	Unit-3 Organic Standards and Certification- Operational structure of NPOP (National Programme for Organic Production). Certification process and crop standards of organic farming.	End-Term Exam Assignments
	Unit-4 Processing and labelling of organic products. Economic considerations and viability of organic farming. Marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs, and other organizations for promotion of organic agriculture.	End-Term Exam Quiz/Assignments

	Unit-5 Conservation agriculture: definition, origin, principles, advantages, and challenges. Primary practices: minimum soil disturbance, crop residue retention, and crop diversification. Complementary practices in conservation agriculture. Conservation agriculture vis-à-vis Climate Smart Agriculture.	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Visit to Organic Farms 2. Preparation of Enriched Compost 3. Preparation of Vermicompost 4. Quality Analysis of Organic Manures 5. Method of Application of Bio-fertilizers 6. Green Manuring (In-situ) 7. Green Leaf Manuring Techniques 8. Study of Indigenous Technical Knowledge (ITK) for Nutrient Management 9. Study of ITK for Insect-Pest Management 10. Study of ITK for Disease Management 11. Study and Preparation of Botanical Extracts 12. Weed Management in Organic Farming 13. Cost Analysis of Organic Farming Systems 14. Introduction to Conservation Agriculture 15. Integrated Practice of Conservation Agriculture 16. Cost Analysis of Conservation Agriculture Practices	Practical Exam Viva-Voce Examination

Assignment	**As part of their continuous evaluation system, students are required to submit one assignment** a) Weed Management practices under Organic Production b) Nutrient and Pest Management under Organic Production c) Certification, Processing, and Market Potential d) Conservation Agriculture and Climate Smart Practices

Suggested reading	1. Dahama. A.K. Organic Farming for Sustainable Agriculture. Agrobios (India), Jodhpur. 2. Sharma, A.K. Handbook of Organic Farming. Agrobios (India), Jodhpur. 3. Palaniappan, S.P. and Annadurai, K. Organic Farming – Theory and Practice. Scientific Publishers. Jodhpur. 4. Thapa, U. and Tripathy, P.. Organic Farming in India- Problems and Prospects. Agrotech publishing agency, Udaipur.
Suggested resources (Websites/eBooks)	1. https://nconf.dac.gov.in/booksmanuals 2. https://apeda.gov.in/Madhya_Pradesh 3. https://npop.apeda.gov.in/ 4. https://www.researchgate.net/publication/358280728_A_TEXT_BOOK_OF_MODERN_ORGANIC_FARMING

Course Code: ELCT-FSN-411		Course Name: Food Science and Nutrition		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• Research • Higher education

Course Objectives:

1. To impart knowledge on the biochemical aspects of various nutrients and their interactions in foods during processing, storage and deterioration.

Course outcomes: After completion of the course, the student will be able to:

CO-1	Understand the principles of human nutrition,
CO-2	Illustrate the role of nutrients in human body.
CO-3	Describe the nutritional assessment methods
CO-4	Discuss balanced diet and its different components
CO-5	Apply nutritional knowledge while processing

Teaching Pedagogy	
T1	1. Classroom Teaching 2. Lab Experiments 3. Chalkboard 4. Power Point Presentations
T2	1. ABL activities 2. Assignments 3. Flip Class/Seminars 4. Quiz

Assessment tools	
AT-1	Mid-term Exams and End-Term Exam
AT-2	Seminar Presentation and Report

AT-3	Quiz
AT-4	Poster
AT-5	Activity-Based Learning
AT-6	Practical Exam
AT-7	Viva-Voce examination
AT-8	Report Writing
AT-9	Field Visit Report
AT-10	Assignments

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
Course Contents	**UNIT I:** Introduction on fundamentals of foods and human nutrition; Basic food groups; Concept of balanced diets; Recommended Daily Allowances (RDA) for various age groups;	Mid-term Exams and End-Term Exam Assignments
	UNIT II: Biochemical composition, energy and food value of various food grains, fruits and vegetables; Carbohydrates, proteins, fats as nutrients and their interactions;	Mid-term Exams and End-Term Exam Assignments
	UNIT III: Physio-chemical, functional and nutritional characteristics of essential nutrients- sources and functions,	Mid-term Exams and End-Term Exam Assignments
	UNIT IV: Nutritional requirements, malnutrition, inborn errors of metabolism, deficiency diseases; Digestion, absorption, transport and metabolism of nutrients in human system;	End-Term Exam Assignments
	UNIT V: Protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinational factors and biochemistry of postharvest storage, losses during processing.	End-Term Exam Assignments
	UNIT VI: Effect of cooking, processing and preservation on nutrients of different food products, biochemical aspects of food spoilage; Food fads, food safety and quality standards.	End-Term Exam Assignments
	UNIT VII: Enzymes in food industry, food additives, nutritional quality of plant, animal, dairy, marine and fermented products	End-Term Exam Assignments
List of Practical (Field/Lab Exercises)		**Assessment tools**

1. Estimation of Moisture analysis of foods; 2. Estimation of Fat 3. Estimation of Protein 4. Estimation of Fiber 5. Estimation of ash 6. Estimation of calorific value of foods; 7. Estimation of vitamins, 8. Estimation of phenols and flavonoids, 9. Estimation of carotenoids, 10. Estimation of antinutrients like Phytate/ Oxallate, 11. Estimation of Trypsin inhibitor activities 12. Estimation of Chymotrypsin inhibitor activities, 13. Estimation of limiting amino acids in pulses 14. Estimation of limiting amino acids in Cereals	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

Assignment	As part of their continuous evaluation system, students are required to submit one assignment a) Identification of nutritional deficiency by using signs and symptoms b) Assessment of nutritional status in community through dietary assessment methods c) Assessment of nutritional status in community through anthropometric measurements d) Planning of balanced diet
Suggested reading	1. Damodaran, S. and Parkin, K.L. (Ed.). 2017. Fennema's Food Chemistry. CRC Press 2. Gibney, M.J., Lanham-New, S.A., Cassidy, A. and Voster, H.H. (Ed.). 2009. Introduction to Human Nutrition. Wiley-Blackwell. 3. Trueman, P. 2007. Nutritional Biochemistry. MJP Publishers. 4. Rekhi, Tejmeet and Yadav, Heena. 2014. Fundamentals of Food and Nutrition. Elite Publishing House. 257p. 5. Dharmesh Kumar. Food Science and Nutrition. Random
Suggested resources (Websites/eBooks)	• https://drive.google.com/file/d/1GtjbaUlQ8HOPLfQjnfuXjwNZOt2hWFho/view • https://nin.res.in/downloads/What_India_Eats%20Report_13th_April_23.pdf • https://nin.res.in/downloads/My_Plate_for_the_day_J24.pdf

	• https://drive.google.com/file/d/1HC1Gh4HfDfiMMDrdc1oeM-kw0Rt5-mGM/view • https://nin.res.in/downloads/ATTAPADI%20FINAL%20REPORT-MARCH%202023.pdf

Course Code: ELCT-PHT-411		Course Name: Post Harvest Technology and Value Addition		Semester: VII
Credits	**Theory**	**Practical**	**Contact Hours (per week)**	**Programme**
04	**03**	**01**	**05**	**B.Sc. (Hons.) Agriculture**
Curriculum level	• Information-based • Research-based		**Student-specific course outcome**	• **Higher Education** • **Placement** • **Research** • **Entrepreneurship**

Course Objectives:

1. **To educate about the different pre-harvest, harvest and post-harvest factors affecting the post-harvest life of fruits and vegetables**
2. **To educate about preparation techniques of value-added products**
3. **To educate about the different dehydration techniques of horticultural crops**

After completion of the course, the student will be able to:

CO-1	Understand the importance of post-harvest processing and identify the causes and extent of post-harvest losses in fruits and vegetables.
CO-2	Analyze the influence of pre-harvest factors, maturity stages, and ripening processes on post-harvest quality of fruits and vegetables.
CO-3	Demonstrate knowledge of harvesting techniques, field handling, and various storage methods for extending shelf life and maintaining quality.
CO-4	Demonstrate knowledge of harvesting techniques, field handling, and various storage methods for extending shelf life and maintaining quality.
CO-5	Evaluate processing methods and quality standards of tomato products, dried/dehydrated products, and canned goods including packaging practices.

Teaching Pedagogy	
T1	1. Classroom Lecture 2. Lab work 3. Chalkboard 4. Power Point Presentations

T2	1. ABL activities 2. Assignments 3. Seminars 4. Quiz

Assessment tools	
AT-1	Assignment
AT-2	Quiz
AT-3	Mid Term Exams
AT-4	End Term Exam
AT-5	Report Writing
AT-6	Activity Based Learning
AT-7	Viva Voce Examination

Prerequisites	**Unit-wise Course Contents**	**Assessment tools**
	Unit-1 Importance of post-harvest processing of fruits and vegetables-Extent and possible causes of post-harvest losses-Pre-harvest factors affecting post-harvest quality-Maturity, ripening and changes occurring during ripening-Respiration and factors affecting respiration rate	Mid-term Exams and End-Term Exam Assignments
	Unit-2 Harvesting and field handling-Storage methods: Zero Energy Cool Chamber (ZECC), Cold storage, Controlled Atmosphere (CA), Modified Atmosphere (MA), Hypobaric storage	Mid-term Exams and End-Term Exam Assignments
	Unit-3 Value addition concept- Principles and methods of preservation	End-Term Exam Assignments

Course Contents	**Unit-4** Intermediate moisture foods (jam, jelly, marmalade, preserve, candy) – concepts and standards-Fermented and non-fermented beverages-Tomato products – concepts and standards	End-Term Exam Assignments
	Unit-5 Drying / Dehydration of fruits and vegetables – concept and methods, osmotic drying-Canning – concepts and standards-Packaging of products	End-Term Exam Assignments

List of Practical (Field/Lab Exercises)	**Assessment tools**
1. Study of Packaging Materials and Containers Used in Post-Harvest Handling 2. Application of Different Packaging Techniques for Shelf-Life Extension 3. Effect of Low and High Temperature on Shelf Life and Quality of Produce 4. Demonstration of Chilling Injury in Fruits and Vegetables 5. Demonstration of Freezing Injury in Fruits and Vegetables 6. Extraction of Fruit and Vegetable Pulps 7. Preservation Methods for Pulps and Juices 8. Preparation of Jam and Jelly 9. Preparation of RTS (Ready-to-Serve) Beverages and Nectar 10. Preparation of Squash and Osmotically Dried Products	Activity-Based Learning Practical Exam Viva-Voce Examination Field Visit Report Assignments

11. Preparation of Fruit Bars and Candies 12. Preparation of Tomato Products (Puree, Sauce, Ketchup) 13. Preparation of Canned Fruit and Vegetable Products 14. Quality Evaluation of Processed Products – Physico-Chemical Tests 15. Quality Evaluation of Processed Products – Sensory Analysis 16. Visit to a Commercial Fruit and Vegetable Processing Unit/Industry	
Assignment	**As part of their continuous evaluation system, students are required to submit one assignment** a) Value Addition and Preservation of Fruits and Vegetables: Principles, Methods, and Product Standards. b) Ripening Physiology and Respiration: Impacts on Post-Harvest Quality and Shelf Life
Suggested reading	1. Post-harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal. 2. Post-Harvest Technology by Suja Nabi Qureshi, Kounser Javeed and Abhay Kumar Sinha. Bioscientific Publishers. 3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira. New India Publishing Agency. 320p. 4.Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann. Daya Publishing House. 5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p

Suggested resources (Websites/eBooks)	1. https://rvsagri.ac.in/modules/academics/timetable/HOR%20311.pdf 2. https://icar.org.in/sites/default/files/inline-files/PHT-13-14.pdf 3. https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf 4. ICAR e-course