JHARKHAND Rai University
RANCHI

Bachelor of Science (Hons.)

Agriculture

SYLLABUS

ACADEMIC YEAR
2025-2026

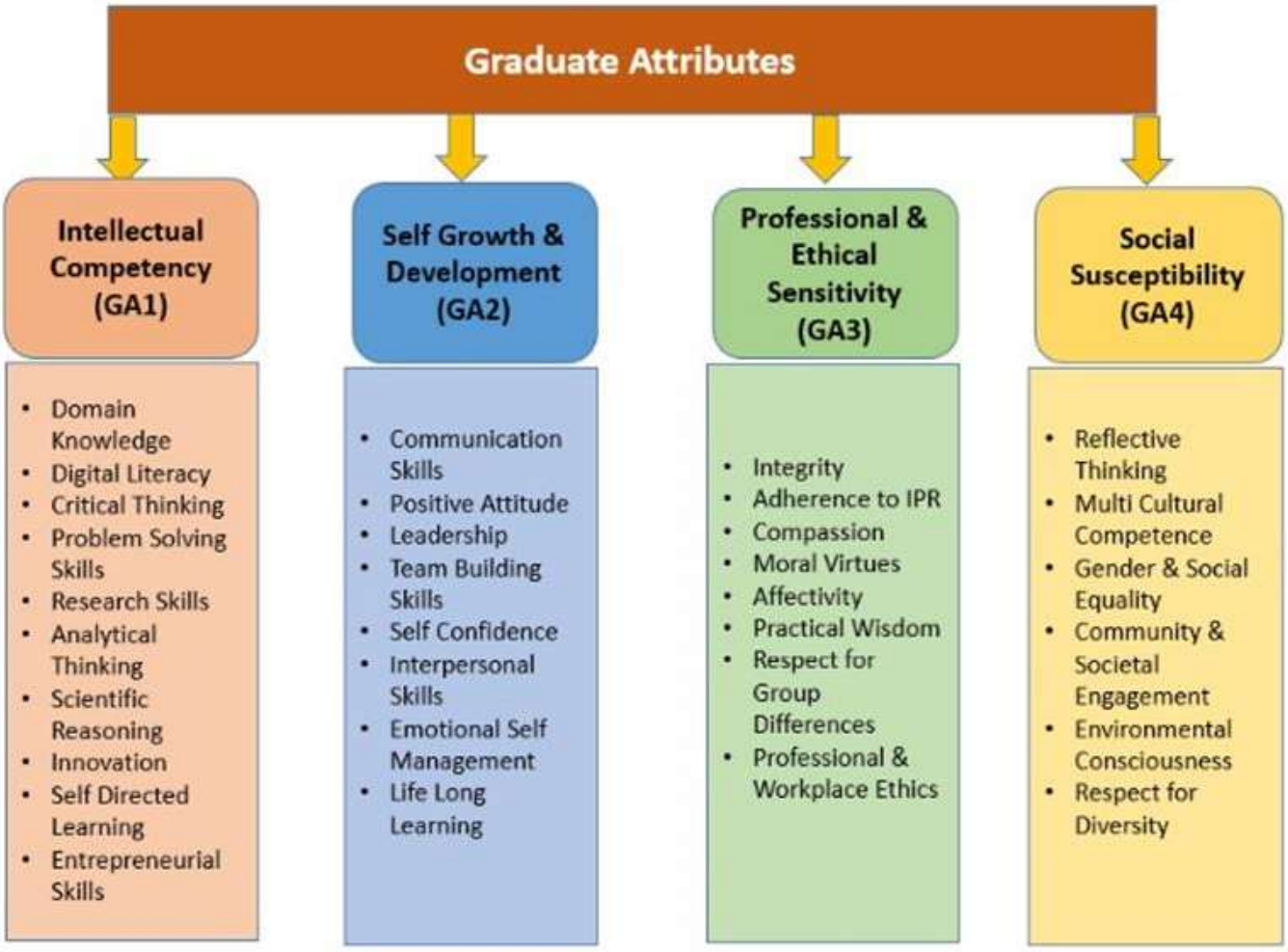
Vision of the Department

The Department of Agriculture envisions quality agricultural education, need-based research and innovative extension educational activities to produce quality agriculture graduates/post graduates in order to bring qualitative changes in both rural and urban life.

Mission of the Department

- To create the best possible learning environment through practice-oriented training & efficient mentorship in agriculture and allied fields.
- To produce quality human resources who understands and solve problems of the farming community for sustainable growth ensuing enhanced food & nutritional security, income generation and environmental safety.

Graduate Attributes



Program Educational Objectives (PEO)

PEO 1: Graduates will be able to develop the conceptual and practical knowledge, skills and competency related to the various aspects of agriculture and allied sciences

PEO 2: Graduates will be agricultural professionals or experts who will help to solve technological as well as production problems in the agriculture and allied fields.

PEO 3: Graduates will be able to develop entrepreneurial skills, creativity and innovation in the field of agricultural science and related sectors.

PEO 4: Graduates will be able to develop professional skills with ethical and moral responsibilities in the workplace/society and contribute to the country's economic growth & development.

PEO 5: Graduates will have the opportunity to pursue higher education in agriculture or allied sectors.

PEO 6: Graduates will be engaged in independent and life-long learning in the ever-changing agricultural production system or enterprise.

Program Outcome (PO)

On successfully completing the agriculture program the student will be able to:

PO 1: Understand in-depth knowledge of agriculture and its allied fields.

PO 2: Apply the professional agricultural solutions and demonstrate the knowledge and need for sustainable development.

PO 3: Deliver relevant extension services effectively by providing quality services and assistance to agriculture sectors.

PO 4: Identify various business opportunities and demonstrate scientific knowledge and skills of a prospective entrepreneur.

PO 5: Demonstrate legal & ethical practices impacting agriculture enterprises and exhibit an understanding of the ethical implications of decisions.

PO 6: Engage in critical thinking by analyzing the situations and communicate & work effectively in a team

PO 7: Develop the decision-making ability for selection of higher studies in agriculture or allied fields.

PO 8: Practice lifelong learning using various skills to analyse, interpret and present relevant data and reports in the field of agriculture.

Mapping of PEO and PO

POs	PEOs					
	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5	PEO 6
PO 1	H	M	M		H	
PO 2	M	M				
PO 3	M	M			M	
PO 4	H	M	L			
PO 5	L	M		L		
PO 6	M	M	M	L		M
PO 7	M	L		L	M	
PO 8	M	M	M	M		L

H- High, M- Medium, L- Low

Course Component of Agriculture program having 167+10 Credits			
Category of Course	**PEOs**	**Curriculum Content (Total no. of credits of the Program)**	**Curriculum Content (% of total number of credits of the program**
Core Courses (Major & Minor subjects)	**PEO1, PEO2, PEO4**	**112**	**67.1%**
Common Courses (MDC + VAC + AEC)	**PEO1, PEO4, PEO6**	**23**	**13.8%**
Skill Enhancement Courses (SEC)	**PEO2, PEO3, PEO5**	**12**	**7.2%**
Internship / Student READY (RAWE + Experiential Learning)	**PEO2, PEO3, PEO4, PEO6**	**20**	**12.0%**
MOOCs / SWAYAM ***(Non-gradial)***	**PEO5, PEO6**	**10**	**-**
Total credit		**167+10***	**100%**

B.Sc. (Hons.) Agriculture (2025 onwards)

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
First year								
I Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
1.	Deeksharambh (Induction cum Foundation course)	1 week (NG) Non-gradial	-	-	-	-	-	-
2.	Skill Enhancement course-I*	2(0+2)	10	-	30	10	50	-
3.	Skill Enhancement course-II*	2(0+2)	10	-	30	10	50	-
4.	Communication Skills	2(1+1)	10	20	-	10	20	40
5.	Farming based livelihood systems	3(2+1)	10	20	-	10	20	40
6.	Rural Sociology and Educational Psychology	2 (2+0)	10	30	-	10	-	50
7.	Fundamentals of Agronomy	3(2+1)	10	20	-	10	20	40
8.	Fundamentals of Soil Science	3(2+1)	10	20	-	10	20	40
9.	Fundamentals of Horticulture	3(2+1)	10	20	-	10	20	40
10.	National Service Scheme (NSS-I)/ National Cadet Corps (NCC-I)	1(0+1)	10	-	30	10	50	-
11.	Introductory mathematics (need based)	1(1+0) Non gradial	10	30	-	10	-	50
	Total credit hours	**21(11+10)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
First year								
II Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
12.	Skill Enhancement course-III*	2(0+2)	10	-	30	10	50	-
13.	Skill Enhancement course-IV*	2(0+2)	10	-	30	10	50	-
14.	Personality Development	2(1+1)	10	20	-	10	20	40
15.	Environmental Studies and Disaster Management	3(2+1)	10	20	-	10	20	40
16.	Soil Fertility Management	3 (2+1)	10	20	-	10	20	40
17.	Fundamentals of Entomology	3(2+1)	10	20	-	10	20	40
18.	Livestock and Poultry Management	2(1+1)	10	20	-	10	20	40
19.	Fundamentals of Plant Pathology	3(2+1)	10	20	-	10	20	40
20.	NCC-II/NSS-II 1(0+1)	1(0+1)	10	-	30	10	50	-
21.	**Total credit hours**	**21(11+10)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
Second year								
III Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
22.	Skill Enhancement course-V*	2(0+2)	10	-	30	10	50	-
23.	Entrepreneurship Development and Business Communication	3(2+1)	10	20	-	10	20	40
24.	Physical Education, First Aid, Yoga Practices and Meditation	2(0+2)	10	-	30	10	50	-
25.	Principles of Genetics	3(2+1)	10	20	-	10	20	40
26.	Crop Production Technology-I (Kharif crops)	3(1+2)	10	20	-	10	20	40
27.	Production Technology of Fruit and Plantation Crops	2(1+1)	10	20	-	10	20	40
28.	Fundamentals of Extension Education	2(1+1)	10	20	-	10	20	40
29.	Fundamentals of Nematology	2(1+1)	10	20	-	10	20	40
30.	Principles and Practices of Natural Farming	2(1+1)	10	20	-	10	20	40
	Total credit hours	**21(9+12)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
Second year								
IV Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
31.	Skill Enhancement course-VI*	2(0+2)	10	-	30	10	50	-
32.	Agricultural Informatics and Artificial Intelligence	3(2+1)	10	20		10	20	40
33.	Production Technology of Vegetables and Spices	2(1+1)	10	20	-	10	20	40
34.	Principles of Agricultural Economics and Farm Management	2(2+0)	10	30	-	10	-	50
35.	Crop Production Technology-II (Rabi Crops)	3(1+2)	10	20	-	10	20	40
36.	Farm Machinery and Power	2(1+1)	10	20	-	10	20	40
37.	Water Management	2(1+1)	10	20	-	10	20	40
38.	Problematic Soils and their management	2(1+1)	10	20	-	10	20	40
39.	Basics of Plant Breeding	3(2+1)	10	20	-	10	20	40
	Total credit hours	**21(11+10)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
Third year								
V Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
40.	Agricultural Marketing and Trade	3(2+1)	10	20	-	10	20	40
41.	Introduction to Agro-meteorology	2(1+1)	10	20	-	10	20	40
42.	Fundamentals of Crop Physiology	3(2+1)	10	20	-	10	20	40
43.	Pest management in Crops and Stored Grains	3(2+1)	10	20	-	10	20	40
44.	Diseases of Field & Horticultural Crops & their Management	3(2+1)	10	20	-	10	20	40
45.	Crop Improvement (kharif crops) - I	2(1+1)	10	20	-	10	20	40
46.	Weed Management	2(1+1)	10	20	-	10	20	40
47.	Ornamental Crops, MAPs and Landscaping	2(1+1)	10	20	-	10	20	40
48.	Introductory Agro forestry	2(1+1)	10	20	-	10	20	40
	Total credit hours	**22(13+9)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
Third year								
VI Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
49.	Fundamentals of Agri Biotechnology	3(2+1)	10	20	-	10	20	40
50.	Basic and Applied Agril Statistics	3(2+1)	10	20	-	10	20	40
51.	Crop Improvement (Rabi crops) - II	2(1+1)	10	20	-	10	20	40
52.	Renewable energy in Agriculture and Allied Sector	2(1+1)	10	20	-	10	20	40
53.	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)	10	20	-	10	20	40
54.	Agricultural Microbiology and Phyto -remediation	2(1+1)	10	20	-	10	20	40
55.	Agricultural Finance & Cooperation	2(1+1)	10	20	-	10	20	40
56.	Essentials of Plant Biochemistry	3 (2+1)	10	20	-	10	20	40
57.	Fundamentals of Seed Science & Technology	2(1+1)	10	20	-	10	20	40
	Total credit hours	**21(11+10)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
Fourth year								
VII Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment Mid -Term (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
58.	5 Elective Courses (Major or minor) each of 4 (3+1) credits for B.Sc. (Hons.) Agriculture degree		10	20	-	10	20	40
	Total credit hours	**20(15+5)**						

S. No	Course Title	Credit Hours	EVALUATION SCHEME					
Fourth year								
VIII Semester			**Quiz/Assessment**	**Mid - Term**	**Internal Assessment (Pr.)**	**Class Participation & EC/CC**	**Practical**	**ESE**
59.	For B.Sc. (Hons.) Agriculture Degree Student READY: RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship							
	Total credit hours	**20 Credits**						

ASSESSMENT SCHEME

Courses with only Theory + Practical

CIA-Continuous Internal Assessment (60Marks)				
Assessment Parameters	**Assessment Tool**	**Marks**	**Bloom's Taxonomy Category**	**Bloom's Taxonomy Level (LOT/HOT)**
Assessment 1	Quiz/Assignment	10 M	Remember, Understand, Apply	LOT/HOT
Mid-Term Examination		20 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
Teacher Assessment/ Class Participation				
Class Participation/	Quiz, Presentations, Lab work, Project	5 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
EC&CC Activities	Extracurricular & Co-Curricular activities or any other activity	5 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
Practical's		20 M		

Courses with only Theory

CIA-Continuous Internal Assessment (50Marks)				
Assessment Parameters	**Assessment Tool**	**Marks**	**Bloom's Taxonomy Category**	**Bloom's Taxonomy Level (LOT/HOT)**
Assessment 1	Quiz/Assignment	10 M	Remember, Understand, Apply	LOT/HOT
Mid-Term Examination		30 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
Teacher Assessment/ Class Participation				
Class Participation/	Quiz, Presentations, Project	5 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
EC&CC Activities	Extracurricular & Co-Curricular activities or any other activity	5 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT

Courses with only Practical's

CIA-Continuous Internal Assessment (50Marks)				
Assessment Parameters	**Assessment Tool**	**Marks**	**Bloom's Taxonomy Category**	**Bloom's Taxonomy Level (LOT/HOT)**
Assessment 1	Mid Term	30 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
Practical's		50 M	Remember, Understand, Apply, Analyze, Evaluate and create	LOT/HOT
Teacher Assessment/ Class Participation				
Class Participation/ EC&CC Activities	Project Extracurricular & Co-Curricular activities or any other activity	20	Remember, Understand	LOT/HOT

Semester I

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Rural Sociology and Educational Psychology
Course Code: EXT-101

L	T	P	C
2	0	0	2

Course Objective:

1. Understand the basic concepts of Extension Education and Agricultural Extension, the role of sociology and rural sociology in agricultural development.
2. Analyze the social structure of Indian rural society including social groups, their dynamics, and their implications for agricultural extension work and know about social structures, cultural concepts, and social processes relevant to rural society and their application in agricultural extension.
3. Comprehend the concepts of educational psychology and apply them effectively in agricultural extension.
4. Impart concepts of intelligence, personality, and the teaching-learning process, and apply them effectively in agricultural extension.

Course Outcomes (CO):
After the completion of this course, the student will be able to –

CO1 Learn the basic concepts of Extension Education and Agricultural Extension, the role of sociology, and rural sociology in agricultural development.

CO2 Acquire the social structure of Indian rural society, including social groups, their dynamics, and their implications for agricultural extension work, and know about social structures, cultural concepts, and social processes relevant to rural society and their application in agricultural extension.

CO3 Identify and classify social control and leaders, evaluate methods of leader selection and training.

CO4 Explain psychological principles to enhance agricultural extension practices, types and factors of intelligence and personality, evaluate their role in extension, and apply principles of learning to improve teaching and communication in agricultural extension.

	Content	CO Mapping	Hours
UNIT 1	**Foundations of Extension Education and Rural Sociology in Agricultural Extension**: 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, motivation in group formation and role of social groups in Agricultural Extension. Social Stratification: Meaning, definition, functions, basis for stratification, forms of social	CO1	8

	stratification, characteristics and differences between class and caste system.		
UNIT 2	**Sociocultural Dynamics in Agricultural Extension Cultural concepts**: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension. Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension. Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension. Social Organizations: Meaning, definition, types of organizations and role of social organizations in agricultural Extension. Social Control: Meaning, definition, need of social control and means of social control. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change.	CO2	8
UNIT 3	**Leadership** Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension.	CO3	7
UNIT 4	**Psychological Foundations 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.	CO4	7

Suggested readings

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

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Communication Skills
Course Code: AEC-101

L	T	P	C
1	0	1	2

Course Objective:

1. Develop competence in oral, written, and non-verbal communication by understanding the communication process, types, models, and barriers to effective communication.
2. Enhance basic communication skills such as listening, speaking, reading, and writing through practical exercises like précis writing, abstracting, summarizing, and resume writing.
3. Demonstrate effective interpersonal and group communication by applying strategies to build self-esteem, overcome communication fears, and utilize both verbal and non-verbal techniques.
4. Apply principles of structural and functional grammar to construct clear, grammatically correct, and technically sound written communication using correct sentence structures and grammatical rules.

Course Outcomes (CO):

After the completion of this course, the student will be able to –

CO1: Acquire a clear understanding of the communication process, its types, models, and barriers, and apply this knowledge in oral, written, and non-verbal communication.

CO2: Demonstrate use basic communication skills such as listening, speaking, reading, and writing in academic and professional contexts through various structured tasks.

CO3: Display confidence and professionalism in interpersonal and group communication by overcoming communication-related fears and using appropriate verbal and non-verbal strategies.

CO4: Construct and practice well-formed, grammatically accurate sentences and technical documents by applying principles of structural and functional grammar.

	Content	CO Mapping	Hours
UNIT 1	Communication Process The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication	CO1	4
UNIT 2	Basic Communication Skills Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/ Summarizing; Style of technical communication Curriculum vitae/ resume writing; Innovative methods to enhance vocabulary, analogy questions.	CO2	3
UNIT 3	Structural and Functional Grammar Sentence structure, modifiers, connecting words and verbal's; phrases and clauses; Case: subjective case, possessive case; objective case.	CO3	4

UNIT 4	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	CO4	4

Practical:

S. No.	Practical's	Hours
1.	The magic of effective communication.	1
2.	2. Building self-esteem and overcoming fears.	1
3.	3. Concept, nature and significance of communication process; Meaning, types and models of communication.	1
4.	4. Verbal and non-verbal communication.	1
5.	5. Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.	1
6.	6. Listening, Speaking, Reading and Writing Skills.	1
7.	7. Precis writing/ Abstracting/ Summarizing; Style of technical communication Curriculum vitae/resume writing.	1
8.	8. Innovative methods to enhance vocabulary, analogy questions.	1
9.	9. Sentence structure, modifiers, connecting words and verbal's; phrases and clauses.	2
10.	10. Case: subjective case, possessive case; objective case.	2
11.	11. Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles	2
12.	Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.	2

Suggested readings

1. *Thomson and Martinet (1995) "A Practical English Grammar" OUP Publication 2.*
2. *Thomson and Martinet (1997) "A Practical English Grammar, Exercise Books Vol. I & II" OUP Publication*
3. *Michal Swan(1995) "A Practical English Grammar" OUP Publication*
4. *David Green (1990) "Contemporary English Grammar Structure Composition" McMillan.*
5. *A.S. Hornby (1997) "Advance Learner's Dictionary" OUP Publication*
6. *S. Allen (1997) "Living English Structure" Orient Longman*
7. *Daniel Jones (1997) "Drills and Tests in English Sounds" ELBS*
8. *Krishnamohan "Speaking English Effectively" McMillan*

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Fundamentals of Agronomy
Course Code: AGRON-101

L	T	P	C
2	0	1	3

Course Objective:

1. Impart knowledge about scope and significance of agronomy, principles of tillage, seed and sowing techniques, nutrient management using manures and fertilizers and nutrient use efficiency.
2. Acquaint knowledge about soil-water-plant relationships, water resources, crop water requirements, water use efficiency, and irrigation methods and scheduling.
3. Make the learners understand the biology and ecology of weeds, weed-crop competition, and principles and practices of weed management including the use of herbicides.
4. Comprehend the mechanism of growth and development of crops, plant ideotypes, crop rotation, and crop management technologies including harvesting and threshing.

Course Outcomes (CO):

After the completion of this course, the student will be able to –

CO1: Understand the scope of agronomy and apply principles of tillage, seed sowing, crop density, and plant nutrient management using manures and fertilizers and nutrient use efficiency.

CO2: Explain soil-plant-water relationships and apply efficient irrigation management practices, including water quality assessment and scheduling methods.

CO3: Identify and classify weeds, analyze weed-crop competition, and implement integrated weed management strategies including the use of herbicides.

CO4: Analyze crop growth and development stages, understand plant ideotypes, and apply principles of crop rotation, adaptation, and field-level agronomic practices.

	Content	CO Mapping	Hours
UNIT 1	Agronomy and its scope: Definition, meaning and scope of Agronomy; art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, fields crops and classification, importance, ecology and ecosystem. Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc. Tillage and 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.	CO1	**8**
UNIT 2	Crop nutrition: 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 of nutrients, forms of plant nutrients absorbed by plants, Combined /uncombined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures	CO2	**6**

	in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.		
UNIT 3	Water management: Water resources of the world, India and the state; Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.	CO2	**4**
UNIT 4	Weeds: Definition, Importance and basics of classification of weeds and their control.	CO3	**4**
	Agroclimatic zones of India and the state, cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation pollution and pollutants, Allelopathy: Meaning and importance in crop production, Growth and development of crops: Definition, Meaning and factors affecting growth and development.	CO4	**8**

Practical:

S. No.	Practical's	Hours
1.	A visit to Instructional Crop farm and study on field crops	4
2.	Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state	4
3.	Study of some preparatory tillage implements, Study of inter tillage implements	2
4.	Practice of ploughing/puddling	2
5.	Study and practice of inter cultivation in field crops	4
6.	Numerical exercises on calculation of seed, plant population and fertilizer requirement,	2
7.	Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops,	4
8.	Seed germination and viability test of seed	4
9.	Practice on time and method of application of manures and fertilizers.	4

Suggested readings

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.

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Farming Based Livelihood System
Course Code: MDC-101

L	T	P	C
2	0	1	3

Course Objective:

1. To make the students aware about farming-based livelihood systems in agriculture

2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood

Course Outcomes (CO):

After the completion of this course, the student will be able to –

CO1 Understand and evaluate the status of agriculture and livelihood patterns in India

CO2 Evaluate components of farming-based livelihood systems and analyse factors influencing the integration of various enterprises

CO3 Assess feasibility of farming systems across agro-climatic zones and evaluate farming-based livelihood models

CO4 Analyse the risks and success factors of farming-based livelihood systems

	Content	CO Mapping	Hours
UNIT 1	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, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems.	CO1	8
UNIT 2	Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., 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	CO2	8
UNIT 3	Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with farming.	CO3	7
UNIT 4	Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.	CO4	7

Practical:

S. No.	Practical's	Hours
1.	Survey of farming systems and agricultural based livelihood enterprises,	4
2.	Study of components of important farming-based livelihood models/ systems in different agro-climatic zones	4
3.	Study of production and profitability of crop based, livestock based, processing based and integrated farming-based livelihood models	4
4.	Field visit of innovative farming system models.	4
5.	Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors	4
6.	Study of agri-enterprises involved in industry and service sectors (Value Chain Models)	2
7.	Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis	4
8.	Case study of Start-Ups in agri-sectors.	4

Suggested readings

1. *Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7. [Google Scholar]*

2. *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*

3. *Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy*

4. *Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA*

5. *Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy*

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

7. *Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.*

8. *Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.*

9. *Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.*

10. *Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.*

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Fundamentals of Soil Science
Course Code: SS-101

L	T	P	C
2	0	1	3

Course Objective:

1. To introduce the concept of soil as a natural body and its role in the ecosystem.
2. To understand the processes of soil formation and classification.
3. To study the physical, chemical, and biological properties of soil.
4. To impart knowledge on soil fertility, nutrient management, and conservation.

Course Outcomes (CO):

After the completion of this course, the student will be able to –

CO1 Explain the origin, development, and classification of soils.

CO2 Analyze soil properties relevant to plant growth and agricultural productivity.

CO3 Identify essential nutrients and understand their behavior in soils.

CO4 Recommend basic soil management and conservation techniques for sustainable agriculture.

	Content	CO Mapping	Hours
UNIT 1	Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering, Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity)	CO1	8
UNIT 2	Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils,	CO1	8
UNIT 3	Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water.	CO3	7
UNIT 4	Soil reaction and buffering capacity, Soil taxonomy, keys to soil orders. Soils of India	CO4	7

Practical:

S. No.	Practical's	Hours
1.	Study of general properties of minerals, study of minerals-silicate and non-silicate minerals	4
2.	Study of rocks-igneous, sedimentary and metamorphic rocks	3
3.	Study of a soil profile, collection and processing of soil for analysis	4
4.	Study of soil texture-feel method, mechanical analysis, determination particle density and soil porosity	4
5.	Determination of soil colour,	3
6.	Study of soil structure and aggregate analysis	4
7.	Determination of soil moisture, determination of soil moisture constants field capacity; water holding capacity.	4
8.	Study of infiltration rate of soil, determination of pH and Electrical conductivity of soil.	4

Suggested readings

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.

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Fundamentals of Horticulture
Course Code: HORT- 101

L	T	P	C
2	0	1	3

Course Objective:

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 (CO): After the completion of this course, the student will be able to –

CO1: Differentiate and describe the major branches of horticulture (pomology, olericulture, floriculture, landscaping, spices, and medicinal plants).

CO2: Apply knowledge of orchard management, propagation techniques, cultural operations, and nutrient management practices to horticultural crops.

CO3: Analyze the physiological processes influencing growth, development, and productivity of horticultural crops.

	Content	CO Mapping	Hours
UNIT 1	Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops.	CO1	8
UNIT 2	Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.	CO2	8
UNIT 3	Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation,	CO2	7
UNIT 4	Unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization and parthenocarpy, importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.	CO3	7

Practical:

S. No.	Practical's	Hours
1.	Identification and nomenclature of fruit,	2
2.	Layout of an orchard, pit making and system of planting.	2
3.	Nursery raising techniques of fruit crops,	4
4.	Understanding of plant propagation structures	2
5.	Propagation through seeds and plant parts,	4
6.	Propagation techniques for horticultural crops,	2
7.	Container, potting mixture, potting and repotting,	2
8.	Training and pruning methods on fruit crops,	2
9.	Preparation of fertilizer mixture and application,	2
10.	Preparation and application of PGR	2
11.	Layout of different irrigation systems,	2
12.	Maturity studies, harvesting, grading, packaging and storage.	4

Suggested readings

1. Basics of Horticulture by Jitendra Singh

2. Introduction to Horticulture by N. Kumar

3. Handbook of Horticulture by ICAR

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: National Service Scheme (NSS-1)
Course Code: NSS-101

L	T	P	C
0	0	1	1

Course Objective:

1. To create a generation of well-informed, responsible citizens who are committed to contributing to the betterment of society through active engagement, volunteerism, and social mobilization

Course Outcomes (CO):

After the completion of this course, the student will be able to –

CO1 Understand about NSS, its organizational structure and the significance of its symbols and badges.

CO2 Analyze and guide financial patterns of NSS schemes and effectively maintain activity diaries.

CO3 Understand the various definitions, profiles, and challenges faced by youth, recognizing their potential as agents of social change and exploring opportunities available through youth programs.

CO4 Develop skills in mapping community stakeholders, crafting culturally relevant messages, and utilizing effective methods for youth-adult partnership in mobilization efforts.

CO5 Instill a sense of national identity by exploring the role of youth in nation-building, along with strategies for conflict resolution and peace-building within diverse communities.

CO6 Explore the significance of volunteerism and shramdan in Indian tradition.

CO7 Gain knowledge about the Constitution of India, including fundamental rights and duties, human rights, and consumer awareness, enhancing their sense of citizenship.

CO8 Analyze the concept of family, community structures like Panchayati Raj Institutions (PRIs), and their roles in societal development.

	Content	CO Mapping	Hours
UNIT 1	**Introduction and organizational Structure of NSS**: Introduction and basic components of NSS: Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS. Organizational structure of NSS, code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health.	CO1	**5**
UNIT 2	**NSS programmes and activities:** Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analysing guiding financial patterns of scheme, youth programme/ schemes of GOI, coordination with different agencies and maintenance of diary.	CO2	**5**
UNIT 3	**Citizenship, constitution and human rights:** Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights to information.	CO3	**3**
UNIT 4	**Community mobilization:** Mapping of community stakeholders, designing the message as per problems and their culture; identifying	CO4	**3**

	methods of mobilisation involving youth-adult partnership; Social harmony and national integration.		
UNIT 5	**Social Harmony and National Integration:** Indian history and culture, role of youth in nation building, conflict resolution and peace-building.	CO5	**3**
UNIT 6	**Volunteerism and shramdan:** Indian tradition of volunteerism, its need, importance, motivation and constraints; shramdan as part of volunteerism.	CO6	**5**
UNIT 7	**Citizenship, constitution and human rights:** Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights to information.	CO7	**3**
UNIT 8	**Family and society:** Concept of family, community (PRIs and other community based organizations) and society.	CO8	**3**

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Introductory Mathematics (Non-gradial)
Course Code: MATH-101

L	T	P	C
1	0	0	1

Course Objective:

1. Equipping students with essential mathematical skills and a preliminary understanding of mathematics.

Course Outcomes (CO):

After the completion of this course, the student will be able to –

CO1 Grasp the definitions and characteristics of arithmetic, geometric, and harmonic progressions. Develop critical thinking and analytical skills to solve problems related to progressions in various contexts.

CO2 Understanding fundamental of Matrices, their types, and basic operations. Familiarize with key properties of determinants to enhance their understanding of matrix theory.

CO3 Equip with various techniques for finding derivatives. Explore practical applications of derivatives in real- world contexts, such as optimization problems (maximizing and minimizing). Introduce the concept of partial derivatives and their significance in functions of multiple variables. Develop a robust understanding of how differentiation applies to growth rates, costs, and revenues.

CO4 Gain a comprehensive understanding of integral calculus and its applications to find the area of curve.

CO5 Develop a comprehensive understanding of agricultural systems and the use of mathematical models, enabling them to apply these concepts effectively in research and practical applications in agriculture. Develop a solid understanding of how to fit linear, quadratic, and exponential models to experimental data.

	Content	CO Mapping	Hours
UNIT 1	**Algebra:** Progressions- Arithmetic, Geometric and Harmonic Progressions.	CO1	4
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.	CO2	
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 $y = f(x1, x2)$.	CO3	5
UNIT 4	**Integral Calculus:** Integration -Definite and Indefinite Integrals- Methods- Integration by substitution, Integration by parts. Area under simple well-known curves.	CO4	3

UNIT 5	**Mathematical Models:** Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.	CO5	3

Suggested readings

1. Gokhroo, D. C. and Jain, Krishi Ganita, Alka Publication, Ajmer.
2. Gokhroo, D.C. Differential calculus.
3. Gokhroo, D.C. Integral calculus.
4. Pandey R.K. Basic Mathematics

Semester II

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: Personality Development
Course Code: AEC-121

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

1. To introduce the students about personality development by realizing their potential, strengths, cultivate their inter-personal skills and improve employability.

Course Outcomes:
At the end of the course, the student will be able to:
CO1 Understand personality and analyze personality shaping factors

CO2 Understand behaviors and evaluate their impact on organizational behavior.

CO3 Explore learning and intelligence and their role in individual and group performance.

CO4 Apply motivation to enhance teamwork, group dynamics, and conflict management.

	Content	CO Mapping	Hours
UNIT 1	Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance	CO1	4
UNIT 2	Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution.	CO2	4
UNIT 3	Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and value, Intelligence-types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence.	CO3	4
UNIT 4	Motivation- theories and principles, Teamwork and group dynamics.	CO4	3

Practical:

S. No.	Practicals	Hours
1.	MBTI personality analysis	2
2.	Learning Styles and Strategies	3
3.	Motivational needs	3
4.	Firo-B	3
5.	Interpersonal Communication	3
6.	Teamwork and team building	3
7.	Group Dynamics	3
8.	Win-win game	2
9.	Conflict Management	3
10.	Leadership styles	2
11.	Case studies on Personality and Organizational Behavior	3

Suggested readings

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

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: Environmental Studies and Disaster Management
Course Code: VAC 121

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

1. Develop an understanding of the natural environment, its components, and processes.
2. Foster awareness about current environmental issues such as pollution, climate change, biodiversity loss, deforestation, and resource depletion. Encourage responsible behavior and sustainable practices to mitigate environmental problems.
3. Familiarize students with national and international policies, treaties, and legal frameworks related to environmental protection and disaster management. Highlight the role of government, non-governmental organizations (NGOs), and international agencies in these domains Train students to analyze complex environmental and disaster-related challenges
4. Instil a sense of ethical responsibility towards the environment and society.
5. Encourage participation in community-based initiatives for environmental conservation and disaster risk reduction.

Course Outcomes:

At the end of the course, the student will be able to:

CO1 Introduction to basic concepts of Environment.

CO2 Basics of Ecosystem and environmental pollution along with various laws of environment protection.

CO3 Understanding the disaster, its types and management.

	Content	CO Mapping	Hours
UNIT 1	**Introduction**: 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. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources.	**CO1**	**10**
UNIT 2	**Ecosystems:** Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical	**CO2**	**10**

	classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity. Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.		
UNIT 3	**Disaster management:** Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.	**CO3**	**10**

Practical:

S. No.	Practicals	Hours
1.	Visit to a local area to document environmental assets river/forest/grassland/hill/mountain	3
2.	Energy: Biogas production from organic wastes. Environmental sampling and preservation	2
3.	Visit to wind mill / hydro power / solar power generation units	2
4.	Biodiversity assessment in farming system	2
5.	Floral and faunal diversity assessment in polluted and un polluted system	2
6.	Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds	3
7.	Water quality analysis: pH, EC and TDS	2
8.	Estimation of Acidity, Alkalinity. Estimation of water hardness	2
9.	Estimation of DO and BOD in water samples	2
10.	Estimation of COD in water samples	2
11.	Enumeration of E. coli in water sample	2
12.	Assessment of Suspended Particulate Matter (SPM)	2
13.	Study of simple ecosystem – Visit to pond/river/hills.	2
14.	Visit to areas affected by natural disaster.	2

Suggested readings

1. *De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp*
2. *Dhar Chakrabarti, P.G. 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.*
3. *Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi*
4. *Parthiban, K.T. Vennila, Prasanthrajan, S., Umesh, M. and Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India. (In Press).*
5. *Prasanthrajan M. and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur - 313 002. First Edition: 2008*
6. *Prasanthrajan M. 2018. Objective environmental studies and disaster management. ISBN 9789387893825. Scientific publishers, Jodhpur, India. Pp. 146.*
7. *Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerut, India*
8. *Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA*

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: Soil Fertility Management
Course Code: SS 121

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

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

Course Outcomes:
At the end of the course, the student will be able to:

CO1 Develop knowledge of soil fertility, plant nutrition, nutrient transport, and the chemistry of nutrients. Identify the roles, deficiencies, and toxicities of essential nutrients.

CO2 Gain expertise in evaluating soil fertility, soil testing, plant analysis, and rapid tissue tests. Understand critical nutrient levels and forms in soil.

CO3 Learn about manures, fertilizers, and nutrient management approaches. Study fertilizer classification, composition, properties, and methods to improve nutrient use efficiency.

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Soil Fertility and Plant Nutrition:** History of soil fertility plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of macro and micronutrients.	CO1	10
UNIT 2	**Soil fertility evaluation**: Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants.		
UNIT 3	**Manures, fertilizers and soil amendments:** ntroduction and importance of manures and fertilizers. Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes .Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customised fertilisers, water soluble fertilizers nano fertilizers. Soil amendments, Fertilizer Storage, Fertilizer Control Order.	CO2	10
UNIT 4	Fertilizer recommendation, Carbon sequestration and Carbon Trading Fertilizer recommendation approaches.Integrated nutrient management. Methods of fertilizer recommendations to crops. Factor influencing nutrient useefficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading.	CO3	10

Practical:

S. No.	Practicals	Hours
1.	Introduction of analytical instruments and their principles, calibration and applications of Coloremetry and flame photometry	2
2.	Estimation of alkaline hydrolysable N in soils	2
3.	Estimation of soil extractable P in soils	2
4.	Estimation of exchangeable K in soils	2
5.	Estimation of exchangeable Ca and Mg in soils	2
6.	Estimation of soil extractable S in soils	2
7.	Estimation of DTPA extractable Zn in soils	2
8.	Estimation of N in plants	4
9.	Estimation of P in plants	4
10.	Estimation of K in plants	4
11.	Estimation of S in plants	4

Suggested readings

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.*

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: Fundamentals of Entomology
Course Code: ENTO-101

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:
1. To know the history of entomology, classification of insects and their relationship with other arthropods

2. To study the various morphological characters of class insect and their importance for classification of insects

3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects

4. To study the characteristics of commonly observed insect orders and their economically important families

Course Outcomes:
At the end of the course, the student will be able to:
CO1 Learn about phylum arthropoda.

CO2 Understand morphology and anatomy of insect.

CO3 Comprehend effect and functions of various biotic and abiotic factors.

CO4 Identify agriculturally important insect's orders and families.

	Content	CO Mapping	Hours
UNIT 1	**Introduction:** 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.	**CO1**	**6**
UNIT 2	**Insect Morphology and Anatomy** Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. 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	**CO2**	**8**
UNIT 3	**Insect Ecology:** Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests.	**CO3**	**6**

UNIT 4	**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; Isoptera: Termitidae; Thysanoptera: Thripidae 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; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.	**CO4**	**10**

Practical:

S. No.	Practicals	Hours
1.	Methods of collection and preservation of insects including immature stages	4
2.	External features of Grasshopper/Blister beetle	2
3.	Types of insect antennae, mouthparts and legs	2
4.	Wing venation, types of wings and wing coupling apparatus	2
5.	Types of insect larvae and pupae	2
6.	Dissection of digestive system in insects (Grasshopper)	2
7.	Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance	10
8.	Insecticides and their formulations	2
9.	Pesticide appliances and their maintenance	2
10.	Sampling techniques for estimation of insect population and damage.	2

Suggested readings

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*

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: Livestock and Poultry Management
Course Code: LPM 121

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

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:
At the end of the course, the student will be able to:
CO1 Understand the importance of livestock and poultry management.

CO2 Learn about breeds and breeding management of animals and poultry.

CO3 Apply nutritional practices of animals and poultry.

CO4 Recommend health management practices of animals and poultry.

	Content	CO Mapping	Hours
UNIT 1	**Outline of Animal husbandry**: Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry.	**CO1**	**4**
UNIT 2	**Breed and Breeding Management**: Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding of chicks. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry.	**CO2**	**5**
UNIT 3	**Animal Nutrition Management:** 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.	**CO3**	**3**
UNIT 4	**Animal Health Management:** Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.	**CO4**	**3**

Practical:

S. No.	Practicals	Hours
1.	External body parts of cattle, buffalo, sheep, goat, swine and poultry.	2
2.	Handling and restraining of livestock.	2
3.	Identification methods of farm animals and poultry.	2
4.	Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.	4
5.	Judging of cattle, buffalo and poultry.	2
6.	Culling of livestock and poultry.	2
7.	Planning and layout of housing for different types of livestock.	2
8.	Computation of rations for livestock.	2
9.	Formulation of concentrate mixtures.	2
10.	Clean milk production, milking methods.	2
11.	Hatchery operations, incubation and hatching equipment.	2
12.	Management of chicks, growers and layers.	2
13.	Debeaking, dusting and vaccination.	2
14.	Economics of cattle, buffalo, sheep, goat, swine and poultry production	2

Suggested readings

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

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: Fundamentals of Plant Pathology
Course Code: PP 121

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

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:
At the end of the course, the student will be able to:

CO1 Gain a clear understanding of the concept of disease in plants and the terminology commonly used in plant pathology.

CO2: Acquaint with the role of different microorganisms in the development of plant disease.

CO3: Understand the principles and practices of plant disease management including chemical, cultural, biological, and host resistance methods.

	Content	CO Mapping	Hours
UNIT 1	**Introduction-** Introduction to Plant Pathology: Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India	**CO1**	**5**
UNIT 2	**Causes and Disease Development-** Causes of plant disease: Inanimate and animate causes, Classification of plant disease; Parasitism and pathogenesis; Development of disease in plants: Disease Triangle, Disease cycle	**CO2**	**8**
UNIT 3	**Overview of Plant Pathogens-** Fungi and their morphology, reproduction and classification of fungi; Bacteria: Morphology, reproduction classification of phytopathogenic bacteria; Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants;Viruses and viroids, virus transmission		**9**
UNIT 4	**Plant Disease Management-** Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).	**CO3**	**8**

Practical:

S. No.	Practicals	Hours
1.	Study of the microscope	2
2.	Acquaintance with laboratory material and equipment	2
3.	Study of different plant disease symptoms	3
4.	Microscopic examination of general structure of fungi	3
5.	Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria	4
6.	Microscopic examination of fungal diseased specimen	2
7.	Microscopic examination of bacterial diseased specimen	2
8.	Preparation of culture media	3
9.	Isolation of plant pathogens: Fungi, bacteria and viruses	3
10.	Purification of plant pathogens	2
11.	Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and calculation on fungicides.	4

Suggested readings

1. *Agrios, G.N. 2010. Plant Pathology. Acad. Press.*
2. *Alexopoulos, Mims and Blackwel. Introductory Mycology.*
3. *Dhingra, O.D. and Sinclair, J.B. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.*
4. *Gibbs, A. and Harrison, B. 1976. Plant Virology - The Principles. Edward Arnold, London*
5. *Goto, M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.*
6. *Hull R. 2002. Mathew's Plant Virology. 4 edn. Academic Press, New York.*
7. *Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur.*
8. *Mehrotra, R.S. and Aggarwal, A. 2007. Plant Pathology. 7 edn. Tata Mc Graw Hill Publ. Co. Ltd.*
9. *Nene, Y.L. and Thapliyal, P.N. 1993. Fungicides in Plant Disease Control. 3rd Ed. Oxford & IBH, New Delhi.*
10. *Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur*
11. *Rajeev, K. and Mukherjee, R.C. 1996. Role of Plant Quarantine in IPM. Aditya Books.*
12. *Rhower, G.G. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd edn. Vol. II. (Ed. David Pimental). CRC Press.*
13. *Singh R.S. 2008. Plant Diseases. 8 th Ed. Oxford & IBH. Pub. Co.*
14. *Singh R.S. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.*
15. *Verma, J.P. 1998. The Bacteria. Malhotra Publ. House, New Delhi.*
16. *Vyas SC. 1993. Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.*

Program: B.Sc. (Hons.) Agriculture
Semester: Second
Course: National Service Scheme - II
Course Code: NSS 121

L	T	P	C
0	0	1	1

Course Objective:
The course objective will be to make the students to:

1. Leadership skills that promote social and community development.

2. Practical life competencies such as communication, problem-solving, and decision-making that are essential for personal success and social cohesion.

3. Health awareness and practices to support personal well-being and community health, including the promotion of hygiene, nutrition, sanitation, and preventive healthcare.

4. A deeper understanding of yoga as a tool for maintaining a balanced and healthy life.

Course Outcomes:
At the end of the course, the student will be able to:

CO1 Identify leadership qualities in themselves and others, understand leadership roles in various contexts (community, political, organizational), and explore how youth can contribute to positive societal changes.

CO2 Gain practical skills for addressing everyday challenges, enhance their communication abilities, and build confidence in making informed decisions. These competencies will aid in both personal and professional growth.

CO3 Learn about national and regional initiatives aimed at empowering youth, the role of youth in development programs, and how to actively participate in or establish youth-led organizations.

CO4 Identify the key factors affecting public health, understand the importance of proper sanitation, and recognize the role of personal hygiene in preventing diseases.

CO5 Lead a healthy lifestyle, understand the social and medical implications of HIV/AIDS and substance abuse, and acquire basic first aid skills.

CO6 Gain an understanding of yoga's health benefits, learn various practices, and appreciate how yoga can be integrated into daily routines for overall health improvement

	Content	CO Mapping	Hours
UNIT 1	**Importance and role of youth leadership** Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership.	**CO1**	**5**

UNIT 2	**Life competencies** Definition and importance of life competencies, problem-solving and decision- making, inter personal communication.	**CO2**	**5**
UNIT 3	**Youth development programmes** Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organisations.	**CO3**	**5**
UNIT 4	**Health, hygiene and sanitation** Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.	**CO4**	**5**
UNIT 5	**Youth health, lifestyle, HIV AIDS and first aid** Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid.	**CO5**	**5**
UNIT 6	**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.	**CO6**	**5**

Semester III

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Entrepreneurship Development and Business Communication
Course Code: AECON-201

Course Objective:
The course objective will be to make the students to:

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

Course Outcomes:
At the end of the course, the student will be able to:

CO1: The basic concepts of entrepreneurship Development.
CO2: Role of entrepreneurs in business development activities
CO3: Basic concept about financial statement and project cycle and cost accounting.

	Topics	**CO Mapping**	**Hours**
Unit-I	**Introduction to Entrepreneurship**: Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial Attributes / competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development.	CO1	8
Unit-II	**Entrepreneurial Finance and Financial Institutes:** 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. 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.	CO2	8
Unit-III	**Project Cycle and Inventory Management**: 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, and Material management. Production management: raw material costing, inventory control. Personal management: manpower planning, labour turn over, wages / salaries.	CO3	6

Unit-IV	**Financial Management and Cost Accounting**: 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, and taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.	CO3	8

Practical:

S. No.	Practicals	Hours
1.	Visit to small scale industries/agro-industries.	6
2.	Interaction with successful entrepreneurs/ agri centre entrepreneurs	4
3.	Visit to financial institutions and support agencies.	4
4.	Preparation of project proposal for funding by different agencies	4
5.	Project Appraisal Techniques	4
6.	Cost accounting methods.	4
7.	Financial Statement.	4

Suggested readings:

1. *Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises.*
2. *Pearson Publications, New Delhi.*
3. *Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.*
4. *Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.*
5. *Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.*
6. *Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.*
7. *Mehra, P. 2016, Business Communication for Managers. Pearson India, New Delhi.*
8. *Pandey, M. and Tewari, D. 2010, The Agribusiness Book. IBDC Publishers, Lucknow.*
9. *Singh, D. 1995. Effective Managerial Leadership. Deep & Deep Publ.*
10. *Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books.*
11. *Tripathi, P.C. and Reddy, P.N. 1991. Principles of Management. Tata McGraw Hill.*
12. *Vasant Desai, 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House.*

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Physical Education, First Aid, Yoga Practices and Meditation
Course Code: PHE-201

L	T	P	C
0	0	4	2

Course Objective:

The course objective will be to make the students to:

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 wellbeing through yoga.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Get the different types of physical trainings.

CO2: Understand the concept of balanced diet and nutrition.

CO3: Acquaint with the knowledge about the effect of physical activities & yoga on our body metabolism and personality development.

	Topics	CO Mapping	Hours
Unit-I	**Physical Training and Coaching** : Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and anaerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems;	CO1	10
Unit-II	**Balanced Diet and Nutrition** : 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.	CO2	15
Unit-III	**Yoga** : 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,	CO3	15

	Uddanmudra. Role of yoga in sports. Teaching of Asanas – demonstration, practice, correction and practice.		
Unit-IV	**Sports and Games** : 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.	CO3	10
Unit-V	**First Aid** : 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.	CO3	10

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Principles of Genetics
Course Code: GPB-201

L	T	P	C
2	0	2	3

Course Objective:
The course objective will be to make the students to:

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

Course Outcomes:
At the end of the course, the student will be able to:
CO1: The basic concepts of genetics.
CO2: Role of genes in genetic manifestation of various characters.
CO3: Basic concepts of molecular genetics.

	Topics	CO Mapping	Hours
Unit-I	**Mendelian concepts and cell division** : Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Study of model organisms (Drosophila, Arabidopsis, Garden pea, E. coli, and mice), Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell divisionmitosis and meiosis. Probability and Chi-square. Types of DNA and RNA.	CO1	7
Unit-II	**Gene interaction & cytogenetics**: Dominance relationships, Epistatic interactions with example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation. Multiple alleles, pleiotropism and pseudo alleles and blood group genetics.	CO1	6
Unit-III	**determination, Linkage and crossing over** : Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanism, chromosome mapping.	CO2	5
Unit-IV	**Structural and numerical variations in chromosome and their implications** : Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics, Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance,	CO2	7
Unit-V	**Nature, structure and replication of genetic material**: Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.	CO3	5

Practical

S. No.	Topic Name of	Hours
1	Study of microscope: parts and types.	2
2	Study of cell structure	2
3	Mitosis and meiosis cell division.	2
4	Experiments on monohybrid, test cross and back cross.	2
5	Experiments on dihybrid, test cross and back cross.	2
6	Experiments on trihybrid, test cross and back cross.	2
7	Experiments on epistatic interactions including test cross and back cross.	2
8	Practice on mitotic cell division.	2
9	Practice on meiotic cell division.	2
10	Experiments on probability.	2
11	Experiments on Chi-square test.	2
12	Determination of linkage and cross-over analysis (through two-point test cross and three-point test cross data).	4
13	Study on sex linked inheritance in Drosophila.	2
14	Study of models on DNA and RNA structures.	2

Suggested Readings

1. *Gardner, J., Simmons, M. J. and Snustad, D. P. 2009. Principles of Genetics (8th Ed.). Wiley India Pvt. Ltd., New Delhi.*
2. *Gupta, P. K. 2016. Cytology, Genetics and Evolution. Rastogi Publications, Meerut. (Hindi Edition).*
3. *Klug, W. W. and Cummings, M. R. 2005. Concepts of Genetics. Pearson Education (Singapore) Pvt. Ltd., Indian Branch, Pratapganj, New Delhi.*
4. *Principles of Genetics: Sinnott, Dunn and Dobzhansky*
5. *Ramchandra, R. K. 2015. Princilpes of Genetics. Jaya Publishing House, Delhi.*
6. *Singh, B. D. 2001. Fundamentals of Genetics. Kalyani Publishers, Ludhiana.*
7. *Singh, B. D. 2015. Genetics. Kalyani Publishers, New Delhi.*
8. *Strickberger, M. W. 2004. Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.*

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Crop Production Technology-I (Kharif crops)
Course Code:

L	T	P	C
1	0	4	3

Course Objective:
The course objective will be to make the students to:

1. Impart knowledge on various cultivation practices of different Kharif crops.

Course Outcomes:
At the end of the course, the student will be able to:

CO1: To know the suitable crop production technology of Kharif cereals including origin, geographical distribution and economic importance.
CO2: To know the suitable crop production technology of Kharif pulses and oilseeds including origin, geographical distribution and economic importance.
CO3: To know the suitable crop production technology of Kharif fibre and forage including origin, geographical distribution and economic importance.

	Topics	CO Mapping	Hours
Unit-I	**Cereals**: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rice, Maize, Sorghum, Pearlmillet, finger millet and other millets	CO1	3
Unit-II	**Pulses** : Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Pigeon pea, Mungbean, Urdbean and Mothbean	CO2	3
Unit-III	**Oilseeds** : Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Groundnut, Soybean, Sesame and Castor	CO2	3
Unit-IV	**Fibre crops** : Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Cotton and jute	CO3	3
Unit-V	**Forage crops** :Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Sorghum, Cowpea, Clusterbean, maize, guinea and Napier.	CO3	3

Practical

S. No.	Name of Topic	Hours
1	Introduction of the course, crop planning and allotment of field.	2
2	Field preparation.	2
3	Selection of crop and varieties, Seed treatment.	2
4	Sowing of crops.	2
5	Observations on germination.	2
6	Thinning and gap filling.	2
7	Intercultural operations-hoeing and weeding.	2
8	Water management- application of irrigation water and demonstrating methods of irrigation.	2
9	Top dressing of fertilizer (urea).	2
10	Insect-pest and disease management.	2
11	Harvesting.	2
12	Threshing, winnowing and storage.	2
13	Marketing of produce.	2
14	The emphasis will be given to seed production, mechanization.	2
15	Preparation of balance sheet including estimating cost of cultivation and net return per student as well as per team of a group of student.	2

Suggested Readings:

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.

Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production. South Asian Publishers, New Delhi.

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Production Technology of Fruit and Plantation Crops
Course Code: HORT-201

L	P	T	C
1	2	0	2

Course Objective:
The course objective will be to make the students :

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:
At the end of the course, the student will be able to:
CO1: Importance and scope of fruit and plantation crops and their classification.
CO2: Production technology of fruit crops.
CO3: Production technology of palms and plantation crops.

	Topics	CO Mapping	Hours
Unit-I	**Introduction**: Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit crops; area, production, productivity and export potential of fruit and plantation crops.	CO1	4
Unit-II	**Production technology of fruit crops** : Crop production techniques in tropical, sub-tropical and temperate fruit crops: Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care– training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices, harvesting and yield, pests and diseases, value addition: Fruit crops: mango, banana, papaya, guava, sapota, citrus, grape, litchi, pineapple, pomegranate, apple, pear, peach, strawberry, nut crops (walnut and almond), jackfruit, and minor fruits (date, ber, kair, lasora, aonla and bael).	CO2	6
Unit-III	**Production technology of palms and plantation crops:** Crop production techniques in palms and plantation crops: 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, multitier cropping system, mulching, special horticultural practices, maturity indices, harvesting and yield, pests and diseases, processing-value addition: Palms: Coconut, Arecanut, Oil palm and Palmyrah. Plantation crops: Tea, Coffee, Cocoa, Cashewnut and Rubber.	CO3	5

Practical:

S. No.	Name of Topic	Hours
1	Identification and brief description of propagation techniques in fruit crops.	2
2	Selection of planting material in fruit crops.	2
3	Identification and description of fruit crop varieties.	2
4	Important cultural practices for mango, banana, papaya, sapota, guava, grapes, citrus (mandarin and acid lime), pomegranate, jackfruit.	2
5	Preparation and application of PGRs for propagation.	2
6	Fertilizer applications in fruit crops.	2
7	Nutritional disorders in fruit crops.	2
8	Micropropagation protocol for mass multiplication and hardening of fruit crops.	2
9	Identification and description of plantation crop varieties.	2
10	Mother palm and seed nut selection in palms.	2
11	Nursery practices in plantation crops.	2
12	Seedling selection in palms.	2
13	Fertilizer application in plantation crops.	2
14	Pests and diseases of Coconut, Arecanut, Cocoa, Tea, Coffee, Rubbe and Cashew.	2
15	Visit to commercial orchard and plantation industries.	2

Suggested Readings:

1. Bal, J.S. 2013. Fruit Growing. Kalyani Publishers.

2. Banday, F.A. and M.K. Sharma. 2010 Advances in temperate fruit production. Kalyani Publishers.

3. Bose, T.K., S.K. Mitra and D. Sanyal. 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.

4. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR.

5. Chadha, T.R. 2001. Textbook of Temperate Fruits. ICAR.

6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers.

7. Chudawat, B.S.1990. Arid fruit culture. Oxford &IBH.

8. Das, B.C. and S.N. Das. 2003. Cultivation of Minor Fruits. Kalyani Publishers.

9. David Jackson and N.E. Laone. 1999. Subtropical and Temperate Fruit Production. CABI.

10. Dhillon, W.S. 2013. Fruit Production in India. Narendra Publishing House.

11. Kavino, M.V., R.M. Jegadeeswari, Vijayakumar and S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops. Narendra Publishing House.

12. Ponnuswami, V., M. Kumar, S.R. Kumar and C. Krishnamoorthy. 2015. Fruit and Plantation Crops. Narendra Publishing House.

13. Radha, T. and L. Mathew. 2007. Fruit Crops. NIPA.

14. Sadhu, M.K. and P.K. Chattopadhyay. 2001. Introductory Fruit Crops. Naya Prokash.

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Fundamentals of Extension Education
Course Code: EXT-201

L	T	P	C
1	0	2	2

Course Objective:

The course objective will be to make the students:

1. Orient with the concept of extension education and its importance in Agriculture development and also to expose the students with various Rural development programmes aimed at poverty alleviation and to increase employment opportunities and their analysis.
2. Learn about the new innovations being brought into the Agricultural Extension in India.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Understand key concepts, objectives, and principles of education and extension education, including program planning and development.

CO2: Analyze the evolution of agricultural extension systems and explore various Rural development programmes.

CO3: Understand key concepts of rural development, leadership, and extension administration.

CO4: Implement monitoring, evaluation, and technology transfer techniques, using ICT and communication strategies for extension outreach.

CO5: Understand Communication Strategies and ICT in Technology Transfer.

	Topics	CO Mapping	Hours
Unit-I	**Foundations of Education and Extension Education** : Education: Meaning, definition and 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.	CO1	3
Unit-II	**Evolution and Emerging Trends in Agricultural Extension Systems in India** : 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.). Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM. Women Development Programme: RMK, MSY etc. New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Attributes of Innovation, DWCRA, Commodity Interest Groups (CIGs)., Farmers Producer Group (FPG).	CO2	4

Unit-III	**Rural Development and Leadership in Agricultural Extension**: Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader. Extension administration: meaning and concept, principles and functions.	CO3	3
Unit-IV	**Monitoring, Evaluation, and Technology Transfer in Extension**: Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs; Transfer of technology: concept and models, capacity building of extension personnel Extension teaching methods: meaning, classification, individual, group and mass contact methods.	CO4	3
Unit-V	**Communication Strategies and ICT in Technology Transfer** ICT Applications in TOT (New and Social Media), media mix strategies; Communication: 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.	CO5	2

Practical

S. No.	**Name of Topic**	**Hours**
1	To get acquainted with university extension system.	4
2	Group discussion- exercise.	2
3	Identification of rural leaders in village situation	2
4	Preparation and use of AV aids, preparation of extension literature (leaflet, booklet, folder, pamphlet news stories and success stories).	4
5	Presentation skills exercise; micro teaching exercise.	2
6	A visit to village to understand the problems being encountered by the villagers/ farmers.	6
7	To study organization and functioning of DRDA/PRI and other development departments at district level.	2
8	Visit to NGO/FO/FPO and learning from their experience in rural development.	2
9	Understanding PRA techniques and their application in village development planning.	2
10	Exposure to mass media: visit to community radio and television studio for understanding the process of programme production.	2
11	Script writing, writing for print and electronic media, developing script for radio and television.	2

Suggested Readings:

1. *Adivi Reddy, A. Extension Education*
2. *Dahama, O. P. and Bhatnagar, O.P. Education and Communication for Development*
3. *Jalihal, K. A. and Veerabhadraiah, V. Fundamentals of Extension Education and Management in Extension,*
4. *Muthaiah Manoraharan, P. and Arunachalam, R., Agricultural Extension*
5. *Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship and Communication Skills*
6. *Rathore, O. S. et al. Handbook of Extension Education*
7. *Dudhani, C.M., Hirevenkatgoudar, L.V., Manjunath, L. Hanchinal, S.N. and Patil, S.L. Extension Teaching Methods and Communication Technology*
8. *Sandhu, A.S. Text book on Agricultural Communication: Process and Methods*
9. *Singh, A.K., Lakhan Singh, R. and Roy Burman. Dimensions of Agricultural Extension.*

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Fundamentals of Nematology
Course Code: NEM-201

L	T	P	C
1	0	2	2

Course Objective:

The course objective will be to make the students to:

1. To impart knowledge on the history, and economic importance of plant parasitic nematodes, morphology, biology, and 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:

At the end of the course, the student will be able to:

CO1: Basic knowledge and importance of nematodes in Agriculture.
CO2: Study about morphology, biology, and taxonomy of nematodes.
CO3: Interaction and synergetic impact of nematodes.
CO4: Role of plant parasitic nematodes in crop protection.
CO5: Improve knowledge about management practices against plant parasitic nematodes.

	Topics	CO Mapping	Hours
Unit-I	**Introduction** History of phytonematodes. Habitat and diversity of nematodes. Economic importance of nematodes. General characteristics of plant parasitic nematodes	CO1	3
Unit-II	**General morphology and Biology** General morphology (Inner-outer body tubes and systems). General biology (Embryogenesis and life cycle).	CO2	2
Unit-III	**Taxonomy**: Classification of nematodes. Economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit	CO2	2
Unit-IV	**Symptomatology and Interaction** Symptoms caused by plant parasitic nematodes. Role of nematodes in disease development. Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses	CO3	2
Unit-V	**Nematode pests of crops** Rice, wheat & barley, and vegetables. Pulses, oilseed and fiber crops. Orchards and plantation crops. Protected cultivation	CO4	3
Unit-VI	**Nematode management** Cultural and physical methods. Biological methods. Chemical methods. Plant Quarantine and Plant resistance. Integrated Nematode Management (Principles, elements and components)	CO5	3

Practical

S. No.	Name of Topic	Hours
1	Collection of soil and root samples for nematode detection and diagnosis.	2
2	Extraction of nematodes from soil samples.	2
3	Extraction of nematodes from plant material.	2
4	Counting, picking, killing, fixing, clearing and mounting of nematodes.	2
5	Study about Life cycle of Plant Parasitic Nematode.	2
6	Nature of damage and Symptoms of nematodes infection in field.	2
7	Histo-pathological changes caused by plant parasitic nematodes on their host.	2
8	Identification and description of root-knot nematode.	2
9	Identification and description cyst nematodes.	2
10	Identification and description reniform nematode.	2
11	Identification and description citrus nematode.	2
12	Identification and description root lesion nematode.	2
13	Identification and description ectoparasitic nematodes.	2
14	Identification and description of foliar nematodes.	2
15	Methods of application of nematicides and organic amendments in the field.	2

Suggested Readings:

1. *Economic Nematology-Edited by J.M. Webster.*
2. *Plant Parasitic Nematodes (Vol-1) by Zukerman, Mai, Rohde.*
3. *Plant Parasitic Nematodes of India: Problems and Progress by - Gopal Swarup, D. R. Dasgupta, P. K. Koshy.*
4. *Textbook on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj.*
5. *Introductory Plant Nematology- P. Parvatha Reddy.*
6. *Plant Nematology- N. G. Ravichandra.*

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: Principles and Practices of Natural Farming
Course Code: AGRON-202

L	T	P	C
1	0	2	2

Course Objective:

The course objective will be to make the students to:

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 perspective.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Know the basic knowledge on natural farming.

CO2: Acquire comprehensive knowledge on different management options available under natural farming.

CO3: Familiar with the mechanization, processing, certification and marketing aspects, in natural farming.

CO4: Acquaint with initiatives taken by public and private sector for promotion of natural farming.

	Topics	CO Mapping	Hours
Unit-I	**Introduction and History** Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in view of climate change, soil health, water use carbon sequestration, biodiversity conservation, food security and nutritional security, and sustainable development goals (SDGs).	CO1	3
Unit-II	**Concept, Priniciples, Scope and Pillars** Concept of natural farming; Definition of natural farming; 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.	CO1	3
Unit-III	**Management of natural ecosystem** 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.	CO2	3
Unit-IV	**Cultivation, mechanization, processing, certification and marketing** Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming;	CO3	3

	Mechanization in natural farming, Processing, labelling, economic 3considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products.		
Unit-V	**Initiatives taken by public and private sector for promotion** 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.	CO4	3

Practical

S. No.	Name of Topic	Hours
1	Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm.	2
2	Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management.	2
3	On-farm inputs preparation methods and protocols.	4
4	Studies in green manuring in-situ and green leaf manuring.	2
5	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.	2
6	Weed management practices in natural farming.	4
7	Techniques of Indigenous seed production.	2
8	Techniques of Indigenous storage and marketing.	2
9	Partial and complete nutrients in natural farming.	2
10	Financial budgeting in natural farming.	2
11	Evaluation of ecosystem services in natural farming (Crop, Field and System).	2

Suggested Readings:

1. *Ayachit, S.M. 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, 199pp*
3. *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.*
4. *Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.*
5. *Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace.*
6. *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.*
7. *Fukuoka, M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. pp 181.*

8. *Fukuoka, M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.*
9. *Hill S.B and Ott. P. (Eeds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.*
10. *Hill, S.B. and Ott, P. (Eeds.). 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. pp 38.*
13. *Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.*
14. *Malhotra R. and S.D. Babaji. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.*
15. *Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telengana), India. pp 94.*
16. *Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. Pp 104.*
17. *Nalini, S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. pp 64.*

Program: B.Sc. (Hons.) Agriculture
Semester: Third
Course: National Service Scheme-III
Course Code: NSS- 201

L	P	T	C
0	2	0	1

Course Objective:
The course objective will be to make the students to:

1. Equip NSS volunteers with practical vocational skills, environmental awareness, disaster management capabilities, and entrepreneurial knowledge.

Course Outcomes:
At the end of the course, the student will be able to:

CO1: To gain expertise in two vocational skills from a selected list to enhance employability or support small business ventures.

CO2: To learn the importance of environmental conservation (e.g., forestation, water and soil conservation), energy conservation, waste management, and sustainable resource practices.

CO3: To understand disaster types (natural and man-made), the importance of disaster management, and the role of NSS volunteers in relief and recovery, including rehabilitation, safety, and coordination efforts.

CO4: To understand key entrepreneurial qualities (e.g., leadership, innovation), learn the steps to start a business (idea development, market research, planning), and explore financial support options (capital, loans, mentorship).

CO5: To learn project formulation from planning to execution, develop management skills, and assess the social, economic, and environmental impact on local communities.

CO6: To learn to collect and analyze project data (e.g., surveys, observations, statistics), document activities through reports and presentations, and effectively communicate results to stakeholders, communities, and government agencies to drive positive change.

	Topics	CO Mapping	Hours
Unit-I	**Vocational skill development** To enhance the employment potential and to set up small business enterprises skills of volunteers, a list of 12 to 15 vocational skills will be drawn up based on the local conditions and opportunities; Each volunteer will have the option to select two skill-areas out of this list.	CO1	5
Unit-II	**Issues related environment** Environmental conservation, enrichment and sustainability, climatic change, natural resource management (rain water harvesting, energy conservation, forestation, waste land development and soil conservations) and waste management.	CO2	5
Unit-III	**Disaster management** Introduction and classification of disaster, rehabilitation and management after disaster; role of NSS volunteers in disaster management.	CO3	5
Unit-IV	**Entrepreneurship development** Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution.	CO4	5

Unit-V	**Formulation of production oriented project** Planning, implementation, management and impact assessment of project; Documentation and data reporting: Collection and analysis of data, documentation and dissemination of project reports.	CO5	5
Unit-VI	**Documentation and data reporting** Collection and analysis of data, documentation and dissemination of project reports.	CO6	5

Semester IV

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Agricultural Informatics and Artificial Intelligence

Course Code: AIAI-221

L	T	P	C
2	0	1	3

Course Objective:

The course objective will be to make the students to:

1. To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
2. To provide basic knowledge of computer with applications in agriculture
3. To make the students familiar with agricultural-informatics, its components and applications in agriculture and Artificial intelligence

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: The basic concepts of Computers knowledge and its programming.
CO-2: The basic concepts of Computers application in Agricultural Sciences.
CO-3: The knowledge of Agriculture Informatics and its application in Agriculture and Artificial intelligence.

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Computers and its operating system:** Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions.	CO-1	**5**
UNIT 2	**Data base management and programming:** Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations	CO-1	**5**
UNIT 3	**e-Agriculture:** e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputsoutputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation.	CO-2	**6**
UNIT 4	**Information Technology in Agriculture**: IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for	CO-2	**7**

	generating valuable agri-information, Decision support systems: 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.		
UNIT 5	**Artificial intelligence in Agricultural Sciences:** Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; 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.	CO3	**7**

Practical:

S. No.	Practical's	Hours
1.	Study of computer components, accessories, practice of important DoS Commands	2
2.	Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management.	2
3.	Use of MS-WoRD and MS Power-point for creating, editing and presenting a scientific documents.	2
4.	MS-EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros	2
5.	MS-ACCESS: Creating Database, preparing queries and reports	2
6.	Demonstration of Agri- information system.	2
7.	Introduction to World Wide Web (WWW) and its components.	2
8.	Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++	2
9.	Hands on practice on Crop Simulation Models (CSM), DSSAT/CropInfo/Crop Syst/ Wofost	2
10.	Preparation of inputs file for CSM and study of model outputs	2
11.	Computation of water and nutrient requirements of crop using CSM and IT tools.	2
12.	Use of smart phones and other devices in agro-advisory and dissemination of market information.	2
13.	Introduction of Geospatial Technology.	2
14.	Hands on practice on preparation of Decision Support System.	2
15.	Preparation of contingent crop planning.	1
16.	India Digital Ecosystem of Agriculture (IDEA)	1

Suggested readings

1. Fundamentals of Computer by V. Rajaroman.

2. Introduction to Information Technology by Pearson.

3. Introduction to Database Management System by C. J. Date.

4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.

5. Introductory Agri Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.

6. Russell, Stuart. Artificial Intelligence: A Modern Approach, Pearson Edition 2013.

7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa. 8. Allport, G. W. Personality: A Psychological Interpretation.

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Production Technology of Vegetables and Spices

Course Code: HORT-221

L	T	P	C
1	0	1	2

Course Objective:

The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: Importance of vegetables and spices in human nutrition and national economy.

CO-2: Production technology of vegetables.

CO-3: Production technology of spices.

	Content	CO Mapping	Hours
UNIT 1	**Introduction:** Importance of vegetables and spices in human nutrition and national economy, Kitchen gardening.	CO-1	3
UNIT 2	**Production technology of vegetables:** Brief description about origin, area, climate, soil, improved varieties and cultivation practices such as time and method of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important vegetables. Vegetable crops: Tomato, Okra, Brinjal, Chilli, Capsicum, Cucumber, Bitter gourd, Bottle gourd, Sweet potato, Cassava, Moringa, Pumpkin, French bean, Peas, Cole crops such as Cabbage, Cauliflower, Knol-khol, Bulb crops such as Onion and Garlic, Root crops such as Carrot, Radish and Beetroot, Tuber crop such as Potato; Leafy vegetables such as Amaranth, Palak; and Perennial vegetable- Pointed gourd.	CO-2	7
UNIT 3	**Production technology of spices**: Brief description about origin, area, climate, soil, improved varieties and cultivation practices such as time and method of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important spices Spice crops: Ginger, Turmeric, Black pepper, Cardamom, Cumin, Coriander, Fennel, Fenugreek, Clove, Nutmeg, Cinnamon, Curry leaf, Tamarind and Herbal spices	CO-3	5

Practical:

S. No.	Practical's	Hours
1	Identification of vegetables and spice crops and their seeds.	2
2	Study of morphological characters of vegetables.	2
3	Study of morphological characters of spices.	2
4	Description of varieties of vegetables.	2
5	Description of varieties of spices.	2
6	Propagation methods of vegetables and spices.	2
7	Rapid multiplication techniques of vegetables and spices.	2
8	Seed collection and extraction of vegetables.	2
9	Seed collection and extraction of spices.	2
10	Nursery raising of vegetables and spices.	2
11	Direct seed sowing and transplanting in vegetables and spices.	2
12	Fertilizer applications in vegetables and spices.	2
13	Harvesting and post-harvest practices in spices and vegetables.	2
14	Economics of vegetables and spices cultivation.	2
15	Visit to spice gardens.	2

Suggested readings

1. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR, New Delhi.

2. Dashora, L. K., A. Dashora, S. S. Lakhawat, and L.L. Somani. 2013. Production Technology of Plantation Crops, Spices, Aromatic & Medicinal Plants. Agrotech.

3. Fagaria, M.S., B.R. Choudhury and R.S. Dhaka. 2016. Vegetable Crops Production Technology Text Book (Vol.-II). Kalyani Publishers.

4. Kumar, N. 2017. Introduction to Spices, Plantation Crops, Medicinal & Aromatic Plants (3rd Edn.). MedTech.

5. Singh, K.P. and Anant Bahadur. Olericulture: Fundamentals of Vegetable Production (Vol.1). Kalyani Publishers.

6. Som, M.G., T.K. Bose, J. Kabir. 2021. Vegetable Crops (Vol.3, 4th Rev. Edn.). Astral Publishing

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Principles of Agricultural Economics and Farm Management

Course Code: AECON-221

L	T	P	C
2	0	0	2

Course Objective:

The course objective will be to make the students to:

1. To aware the students about broad areas covered under agricultural Economics and farm Management
2. To impart knowledge on judicious use of resources for optimum production

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: The basic concepts of Fundamental economics

CO-2: Role of Farm manager in business development activities

CO-3: Basic concept about Farm management tools and International Trade.

CO-4: To understand different type of insurance scheme.

	Content	CO Mapping	Hours
UNIT 1	**Basics Concepts of Economics** Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro- and macro-economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle.	CO-1	**5**
UNIT 2	**Consumers Theory** 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	CO-2	**5**
UNIT 3	**Farm Production Economics Production:** Process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale. Cost: Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production	CO-3	**5**
UNIT 4	**Rent, Wages, Interest and Theory of Profit:**	CO-3	5

	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 socioeconomic determinants, current policies and programs on population control		
UNIT 5	**Economic Systems 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 Indian economy	CO-4	5

Suggested readings

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.

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Crop Production Technology-II (Rabi Crops)

Course Code: AGRON-221

L	T	P	C
1	0	2	3

Course Objective:

The course objective will be to make the students to:

This course intends to impart knowledge on various cultivation practices of different Rabi crops.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: To know the suitable crop production technology of Rabi cereals including origin, geographical distribution and economic importance.

CO-2: To know the suitable crop production technology of Rabi pulses and oilseeds including origin, geographical distribution and economic importance.

CO-3: To know the suitable crop production technology of Rabi sugar crops including origin, geographical distribution and economic importance.

CO-4: To know the suitable crop production technology of Rabi medicinal, aromatic, forage and cash crops including origin, geographical distribution and economic importance.

	Content	CO Mapping	Hours
UNIT 1	**Cereals:** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Wheat and Barley.	CO-1	**2**
UNIT 2	**Pulses:** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Chickpea, Lentil, Peas, Rabi Redgram and Rajmash.	CO-2	**3**
UNIT 3	**Oilseeds:** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rapeseed, Mustard, Sunflower and Safflower.	CO-2	**2**
UNIT 4	**Sugar crops:** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Sugarcane and Sugarbeat.	CO-3	**2**
UNIT 5	Medicinal and aromatic crops: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Mentha, Lemon grass, Citronella and isabgoal.	CO-4	**2**

UNIT 6	Forage crops: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Barseem, Lucerne and Oat.	CO-4	**2**
UNIT 7	Cash crops: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of potato, quinoa, tobacco.	CO-4	**2**

Practical:

S. No.	Practicals	Hours
1.	Identification of seeds, crops and other inputs of rabi season.	2
2.	Sowing methods of wheat.	2
3.	Sowing methods of sugarcane.	2
4.	Identification of weeds in rabi season crops.	2
5.	Study of morphological characteristics of rabi crops.	2
6.	Study of yield contributing characters of rabi season crops.	2
7.	Yield and juice quality analysis of sugarcane.	2
8.	Study of important agronomic experiments of rabi crops at experimental farms	4
9.	Study of rabi forage experiments.	2
10.	Oil extraction of medicinal crops.	4
11.	Visit to research stations of related crops.	6

Suggested readings

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. Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.

5. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.

6. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.

7. Rajendra Prasad. 2002. Text Book of Field Crops Production, ICAR, New Delhi.

8. Reddy, S.R. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.

9. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.

10. UAS, Bangalore. 2011. Package of Practice. UAS, Bengaluru.

***Practical Crop Production- One (1) credit from practical of the course is allotted for Practical Crop Production of selected Rabi crops covered under this course.**

Practical schedule: Practical Crop Production

S. No.	Practical's	Hours
1.	Introduction of the course, crop planning and allotment of field.	2
2.	Field preparation.	2
3.	Selection of crop and varieties, Seed treatment.	2
4.	Sowing of crops.	2
5.	Observations on germination.	2
6.	Thinning and gap filling.	2
7.	Intercultural operations-hoeing and weeding.	2
8.	Water management- application of irrigation water and demonstrating methods of irrigation.	2
9.	Top dressing of fertilizer (urea).	2
10.	Insect-pest and disease management.	2
11.	Harvesting	2
12.	Threshing, winnowing and storage.	2
13.	Marketing of produce.	2
14.	The emphasis will be given to seed production, mechanization.	2
15.	Preparation of balance sheet including estimating cost of cultivation and net return per student as well as per team of a group of students.	2

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Farm Machinery and Power

Course Code: AENGG-221

L	T	P	C
1	0	1	2

Course Objective:

The course objective will be to make the students to:

To enable the students to understand the need of farm power, basic principles and parts of IC engine, different tillage, sowing, intercultural, plant protection equipment, working principles of threshers, harvesting of field and horticultural crops.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Status of Farm Power in India and Familiarization with different systems of I.C. engines and maintenance of tractor.

CO-2: Familiarization with Primary and Secondary Tillage implement ans use in Agriculture.

	Content	CO Mapping	**Hours**
UNIT 1	**Status of Farm Power in India and Familiarization with different systems of I.C. engines and maintenance of tractor:** Status of Farm Power in India; Sources of Farm Power, I.C. engines, working principles of I.C. engines; comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems; Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor; Familiarization with Power transmission system : clutch; gear box, differential and final drive of a tractor; Tractor types; Cost analysis of tractor power and attached implement; Criteria for selection of tractor and machine implements.	CO-1	8
UNIT 2	**Familiarization with Primary and Secondary:** Tillage implement and its use in Agriculture Familiarization with Primary and Secondary Tillage implement; Implement for hill agriculture; implement for intercultural operations; Familiarization with sowing and planting equipment; calibration of a seed drill and solved examples; Familiarization with Plant Protection equipment; Familiarization with harvesting and threshing equipment.	CO-2	7

Practical:

S. No.	Practical's	Hours
1.	Study of different components of I. C. engine.	2
2.	To study air cleaning and cooling system of engine.	2
3.	Study of transmission system.	2
4.	Study of transmission system-clutch, gear box, differential, final drive and PTO	2
5.	Familiarization with brake, steering, hydraulic control system of engine.	2
6.	Tractor driving.	2
7.	Daily and periodic maintenance of tractor	2
8.	Study of power tiller and garden tractor	2
9.	Study of primary and secondary tillage implements: mould board plough, disc plough	4
10.	Study of secondary tillage implements- cultivators, harrows and hoes	4
11.	Study of seed metering mechanism and calibration of seed drill and numerical.	2
12.	Study of different types of sprayers and dusters	2
13.	Study of harvesting machinery - reaper and thresher	2

Suggested readings

1. Jagdiswar Sahay – Elements of Agricultural Engineering Jain, S.C. and C.R. Rai-Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak. Delhi- 110006.

2. Ojha, T.P. and A.M. Michael, A.M. Principles of Agricultural Engineering. Vol.-I. Jain brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005.

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

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Water Management

Course Code: AGRON-222

L	T	P	C
1	0	1	2

Course Objective:

The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: to know basic knowledge on water resources.

CO-2: to acquaint with soil plant water relationship.

CO-3: to familiarisation with the irrigation methods.

CO-4: to analyse the irrigation efficiency and quality of irrigation water.

CO-5: to construct ideologies pertaining to water management for different soils and crops.

	Content	CO Mapping	Hours
UNIT 1	**Water resources, utilization and irrigation development Irrigation:** definition and objectives; Importance: Function of water for plant growth, Water resources and irrigation development for different crops in India	CO-1	2
UNIT 2	**Soil-plant-water relationships and Irrigation Scheduling** Soil plant water relationships; Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation.	CO-2	3
UNIT 3	**Methods of Irrigation and fertigation** 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	CO-3	3
UNIT 4	**Irrigation efficiency, water quality management**	CO-4	3

	Irrigation efficiency and water use efficiency, Conjunctive use of water, irrigation water quality and its management.		
UNIT 5	**Water management information** Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); irrigation management practices for different soils and crops, drip, sprinkler. Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.	CO-5	4

Practical:

S. No.	Practical's	Hours
1.	Determination of bulk density by field method.	2
2.	Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter.	2
3.	Determination of field capacity by field method.	2
4.	Determination of permanent wilting point.	2
5.	Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices.	2
6.	Calculation of irrigation water requirement (Problems).	2
7.	Determination of infiltration rate.	2
8.	Demonstration of furrow method of irrigation.	2
9.	Demonstration of check basin and basin method of irrigation.	2
10.	Visit to farmers' field and cost estimation of drip irrigation system.	4
11.	Demonstration of filter cleaning, fertigation, injection and flushing of laterals.	2
12.	layout for different methods of irrigation, Erection and operation of sprinkler irrigation system.	2
13.	Measurement of emitter discharge rate and wetted diameter.	2
14.	Calculation of emitter discharge variability.	2
15.	Visit to irrigation research centre/ station and visit to command area.	

Suggested readings

1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Academy, Udaipur.

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.

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Problematic Soils and Their Management

Course Code: SS-221

L	T	P	C
1	0	1	2

Course Objective:

The course objective will be to make the students to:

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

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: about various types of problematic soils.

CO-2: about the management processes and reclamation techniques for these soils.

CO-3: about irrigation water, remote sensing, GIS for diagnosis and management, and bioremediation of problem soils.

	Content	CO Mapping	Hours
UNIT 1	**Soil health and Problem Soils** Soil quality and health. Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties.	CO-1	**2**
UNIT 2	**Reclamation and Management of Problematic Soils** Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, Waterlogged soils.	CO-2	**4**
UNIT 3	**Quality of irrigation water** Irrigation water – quality and standards, utilization of saline water in agriculture	CO-3	**2**
UNIT 4	**Remote sensing and GIS in Agriculture** Use of Remote sensing and GIS in diagnosis and management of problem soils.	CO-3	**3**
UNIT 5	**Bio-remediation and land classification system** Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.	CO-3	**4**

Practical:

S. No.	Practicals	Hours
1.	Determination of pHs and EC of saturation extract of problematic soil.	2
2.	Determination of redox potential in soil.	2
3.	Determination of Ca++ and Mg++ in saturation extract of soil.	2
4.	Determination Na+ in saturation extract of soil.	2
5.	Determination K+ in saturation extract of soil.	2
6.	Computation of SAR and ESP.	2
7.	Determination of Gypsum requirement of alkali/ sodic soil.	2
8.	Determination of lime requirement of acidic soil.	2
9.	Determination of pH and EC in irrigation water.	2
10.	Determination of Ca++ and Mg++ in irrigation water.	2
11.	Determination of Na+ and Cl in irrigation water.	2
12.	Determination of CO3 and HCO3 in irrigation water.	2
13.	Computation of SAR and RSC in irrigation water.	2
14.	Determination of nitrate (NO3-) from irrigation water.	2
15.	Determination of dissolved oxygen in water samples.	2
16.	Determination of free carbon dioxide levels in water samples.	2

Suggested readings

1. Brady, N. C. and Well, R. R. 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.

2. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).

3. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).

4. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.

5. Mehra, R. K. 2004. Text Book of Soil Science, ICAR, New Delhi.

6. Rakshit, A., Raha, P. and Bhadoria, P. B. S. 2015. Principles of Soil Science. Kalyani Publishers, Ludhiana.

7. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR,

8. Cirsan J. Paul., 1985,. Principles of Remote Sensing. Longman, New York

9. Osman, Khan Towhid., 2018., Management of Soil Problems. Springer publication.

10. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi.

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: Basics of Plant Breeding

Course Code: GPB-221

L	T	P	C
2	0	1	3

Course Objective:

The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: History, nature and role of Plant breeding.

CO-2: Breeding methods for self-pollinated, cross-pollinated and clonally propagated crops.

CO-3: Special breeding techniques viz., Wide hybridization, Mutation Breeding, Pre-Breeding, polyploidy etc. and metod of variety release

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Plant Breeding** Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male-sterility- genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/ diversity, Components of Genetic variation. Heritability and genetic advance.	CO-1	8
UNIT 2	**Breeding methods for self- and cross-pollinated crops** Pre-breeding and Universal Plant Breeder's equation. Genetic basis and breeding methods in self-pollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept, Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross-pollinated crops, modes of selection. Population movement schemes- Ear to Row method, Modified Ear to Row, recurrent selection schemes. Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties.	CO-2	6
UNIT 3	**Breeding methods for clonally propagated crops** Breeding methods in asexually propagated crops, clonal selection and hybridization.	CO-2	5

UNIT 4	**Distant Hybridization and Breeding for Stress** Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding- methods and uses. Breeding for important biotic and abiotic stresses.	CO-3	6
UNIT 5	**Variety Release and Intellectual property rights** Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.	CO-3	5

Practical:

S. No.	Practical's	Hours
1.	Plant Breeder's kit.	2
2.	Study of germplasm of various crops.	2
3.	Study of floral structure of self-pollinated crops.	2
4.	Study of floral structure of cross-pollinated crops.	2
5.	Emasculation and hybridization techniques in self-pollinated crops I.	2
6.	Emasculation and hybridization techniques in self-pollinated crops II.	2
7.	Emasculation and hybridization techniques in cross-pollinated crops I.	2
8.	Emasculation and hybridization techniques in cross-pollinated crops II.	2
9.	Consequences of inbreeding on genetic structure of resulting populations.	2
10.	Study of male sterility system.	2
11.	Handling of segregating populations.	2
12.	Methods of calculating mean, range, variance, standard deviation, heritability.	2
13.	Statistical Designs used in Plant Breeding experiments; Analysis of Randomized Block Design.	2
14.	To work out the mode of pollination in a given crop and extent of natural out crossing.	2
15.	Prediction of performance of double cross hybrids and maintenance of breeding records and data collection.	2
16.	Screening tests for biotic and abiotic stresses.	2

Suggested readings

1. *Allard, R. W. 2000. Principles of Plant Breeding. John Willey & Sons, New York.*
2. *Chahel, G.S. and Ghosal, S.S. 2002. Principles and Procedures of Plant Breeding, Biotechnological and Conventional Approaches. Narosa Publishing House, New Delhi.*
3. *Chopra, V. L. 2012. Plant breeding: Theory and Practice. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.*
4. *Jain, H. K. and Kharsckwal, M. C. 2004. Plant Breeding- Mendelian to Molecular Approach. Narosa Publishing House, New Delhi.*
5. *Ramchandra, R. K. 2015. Princilpes of Plant Breeding. Jaya Publishing House, Delhi.*
6. *Sharma, J. R. 1994. Principles and Practices of Plant Breeding. Tata McGraw Publishing Company Ltd., New Delhi.*
7. *Singh, B. D. 2006. Plant Breeding. Kalyani Publishing House, New Delhi.*
8. *Principles of Plant Genetics and Breeding by George Acquaah.*

Program: B.Sc. (Hons.) Agriculture

Semester: Fourth

Course: National Service Scheme –IV

Course Code: NSS-221

L	T	P	C
0	0	1	1

Course Objective:

The course objective will be to make the students to:

To empower youth by developing their ability to prevent and address crime, defend themselves, mobilize resources, and improve their personal and professional lives.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: To understand the root causes of youth crime and the impact on individuals and communities. Promote awareness of peer mentoring as a strategy to prevent crime and educate youth about the juvenile justice system and legal rights.

CO-2: To equip with the knowledge and practical skills required for self-defence and emergency preparedness in various situations, including understanding civil defence services and their role in national safety.

CO-3: To enable youth to mobilize resources, write effective proposals, and establish sustainable self-funding ventures, promoting entrepreneurial thinking and community development.

CO-4: To build a positive mindset, develop strong personal leadership, improve self-esteem, and learn how to set and achieve life goals while managing stress and maintaining work-life balance.

	Content	CO Mapping	**Hours**
UNIT 1	**Youth and crime** Sociological and psychological factors influencing youth crime, cyber-crime, pear mentoring in preventing crime and awareness for juvenile justice.	CO-1	**9**
UNIT 2	**Civil/self defence** Civil defence services, aims and objectives of civil defence; needs and training of self-defence.	CO-2	**8**
UNIT 3	**Resource mobilization** Writing a project proposal of self-fund units (SFUs) and its establishment.	CO-3	**6**
UNIT 4	**Additional life skills** Positive thinking, self-confidence and esteem, setting life goals and working to achieve them, management of stress including time management.	CO-4	**7**

Semester V

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Agricultural Marketing and Trade
Course Code: AECON-301

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

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 the completion of this course, the student will be able to-

CO-1: Aware about exposure on market concepts, marketing of agricultural commodities, intermediaries involved, domestic and export trade, risk in agricultural marketing.

CO-2: Understand Marketing process functions and marketing channels.

CO-3: Understand role of government agencies and international trade.

	Content	CO Mapping	Hours
UNIT 1	**Agricultural Marketing** Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets.	CO1	**3**
UNIT 2	**Supply, Demand and Producers Surplus** Demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities.	CO1	4
UNIT 3	**Pricing and promotional strategies** 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.	CO2	4
UNIT 4	**Marketing process and functions**	CO2	5

	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); 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.		
Unit 5	**Market Intigration,Marketing Margin and Price Spread** Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.	CO3	**4**
Unit 6	**Role of Govt. Agencies in agricultural marketing,** Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India; 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	CO3	5
Unit 7	**Trade** 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.	CO3	4

Practical:

S. No.	Practicals	Hours
1.	Plotting and study of demand and supply curves and calculation of elasticities	2
2.	Study of relationship between market arrivals and prices of some selected commodities.	2
3.	Computation of marketable and marketed surplus of important commodities	2
4.	Construction of index numbers	2
5.	Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels	4

	for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class	
6.	Visit to market institutions –NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning	4
7.	Application of principles of comparative advantage of international trade.	2

Suggested readings

1. *Acharya, S.S. and Agarwal, N.L. 2006. Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.*
2. *Chinna, S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.*
3. *Dominic Salvatore, Micro Economic Theory*
4. *Kohls Richard, L. and Uhl Josheph, N. 2002. Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.*
5. *Kotler and Armstrong, 2005. Principles of Marketing, Pearson Prentice-Hall.*
6. *Lekhi, R. K. and Joginder Singh. 2006. Agricultural Economics. Kalyani Publishers, Delhi.*
7. *Memoria, C.B., Joshi, R.L. and Mulla, N.I. 2003. Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.*
8. *Pandey Mukesh and Tewari, Deepali. 2004. Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.*
9. *Sharma, R. 2005. Export Management, Laxmi Narain Agarwal, Agra.*

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Introduction to Agro-meteorology
Course Code: AGMET-301

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

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 the completion of this course, the student will be able to learn about-

CO-1: Learn basic concepts of Agricultural Meteorology and weather parameters**.**

CO-2: Weather hazards in relation to Agriculture .

CO-3: Weather forecasting and modification of crop microclimate.

CO 4: Understand the basics of climate change and its regional impact on agriculture.

	Content	CO Mapping	Hours
UNIT 1	Meaning and scope of agricultural meteorology; Earth atmosphere: its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze;	**CO1**	**3**
UNIT 2	Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, 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;	**CO2**	**4**
UNIT 3	Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of	**CO3**	**4**

	precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking.		
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. 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	**CO4**	**4**

Practical:

S. No.	Practicals	Hours
1.	Visit of Agrometeorological Observatory.	2
2.	Selection of observatory, exposure of instruments and weather data recording	2
3.	Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law	2
4.	Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS.	3
5.	Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis.	2
6.	Measurement of soil temperature and computation of soil heat flux	2
7.	Determination of vapor pressure and relative humidity.	3
8.	Determination of dew point temperature.	2
9.	Measurement of atmospheric pressure and analysis of atmospheric conditions.	2
10.	Measurement of wind speed and wind direction, preparation of wind rose.	2
11.	Measurement, tabulation and analysis of rain.	2
12.	Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET.	2
13.	Use of synoptic charts, weather reports, weather forecasting-types and methods.	2
14.	Crop weather calendar.	2

Suggested Readings

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*

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Fundamentals of Crop Physiology
Course Code: PPHY-301

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

To explain about the basic physiological process of plant viz. plant cell and water relations, mineral nutrition, carbon metabolism, reproductive physiology and plant growth and development

Course Outcomes:

After the completion of this course, the student will be able to learn about –

CO-1: The basic concepts of Plant Physiology, water and nutrient mechanism in plants.

CO-2: Role of photosynthesis and respiration in plant growth and development.

CO-3: Use of plant growth regulators in agriculture.

CO-4: Understand the Photoperiodic induction site of photo-inductive perception and learn , Agricultural uses of PGRs.

	Content	CO Mapping	Hours
UNIT 1	Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science; Diffusion and osmosis; Physiological roles of water to crop plants; Definition of water potential and components of water potential; Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation; Water use efficiency; Essential and beneficial elements; Passive and active transport of mineral element; Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms.	CO1	8
UNIT 2	Foliar nutrition and root feeding – significance; Aeroponics Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap – theories and mechanism; Soil-plant-atmospheric continuum. Significance of transpiration. Stomatal opening and closing mechanisms. Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand	CO2	7

	culture. Overview of plant cell - organelle and their functions. Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.), Difference between chlorophyll a and chlorophyll b, Structure of chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II.		
UNIT 3	Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of O2 during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to C3 , C4 and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle; Significance of these pathways (concept of photorespiration, absence of photorespiration in C4 plant: Productivity of C4 plant, CAM: an adaptive mechanism); Factors affecting photosynthesis (light, temperature, CO2 , O2 etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Kreb Cycle and ETC, Factors affecting respiration (O2 , temperature, CO2 etc.). Terminologies / Definitions: Growth, Development and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimension, area etc.).	CO3	8
UNIT 4	Introduction to CGR, RGR, NAR etc. Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc. Introduction to Photoperiodic induction site of photo-inductive perception, Role of Phytochrome Introduction to Vernalization (What is vernalization, devernalization etc.), Meaning, classification (seasonal, sequential etc), relation with abscission. Physiological and biochemical changes during senescence, Abscission and its significance, Concept of stay green, Hormonal regulation of senescence. Terminologies / Definitions: Plant hormone, Plant growth regulators (PGR), Plant growth inhibitor. Recognized classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2, 4 –D, GAs, Kinetin etc).	CO4	7

Practical:

S. No.	Practicals	Hours
1.	Study on structure and distribution of stomata	3
2.	Demonstration of imbibition, osmosis, plasmolysis, estimation of water potential, relative water content.	4
3.	Tissue test for mineral nutrients, identification of nutrient deficiency and toxicity symptoms in plant.	4
4.	Identification of nutrients by hydroponics	4
5.	Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration	4
6.	Plant growth analysis	4
7.	Study on senescence and abscission, hormonal regulation of senescence	4
8.	Demonstration of the effects of different PGRs on plants, Leaf anatomy of C3 and C4 plants.	3

Suggested readings

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*

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Pest management in crops and stored grains
Course Code: ENTO-301

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

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

Course Outcomes:

CO-1: Identify the various insect-pests their Life cycle, symptoms of damage and their management practices.

CO-2: Understand various pest infesting during storage and their management.

CO-3: Apply integrated pest management techniques for pest management.

CO-4: Understand the classification of insecticides, toxicity of insecticides and formulations of insecticides and learn use of drones and AI in pest management.

	Content	CO Mapping	Hours
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 crops, vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments.	CO1	8
UNIT 2	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.	CO2	8
UNIT 3	Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non insect pest of mites, snails and slugs, Concept of IPM, Practices, scope and limitations of IPM.	CO3	7
UNIT 4	Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management.	CO4	7

Practical:

S. No.	Practicals	Hours
1.	Field visit, identification of major insect pests and their damage symptoms.	5
2.	Collection and preservation of major insect pests	5
3.	Collection of damage samples, their identification and herbarium preparation.	4
4.	Methods of monitoring of pest incidence in situ.	3
5.	Management strategies of insect pests of different crops.	3
6.	Study on structural entomology and household pests.	3
7.	Storage structures and methods of grain storage.	3
8.	Vertebrate pest management, Mass multiplication of NPV and entomopathogenic nematodes	4

Suggested readings

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*
6. *Pest Management: Methods, Applications and Challenges, Tarique Hassan Askary, Agriculture, Agriculture Issues and policies, Books, Nova, Pest Control, Science and Technology,2022.*

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Diseases of Field and Horticultural Crops and their Management
Course Code: PP-301

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students :

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

Course Outcomes:

After the completion of this course, the student will be able to –

CO-1: Acquaint with symptoms, etiology, disease cycle, and management of cereal, pulse oilseed, and Sugar and Cash crops diseases.

CO-2: Acquaint with symptoms, etiology, disease cycle, and management of fruit and vegetable crop diseases.

CO-3: Acquaint with symptoms, etiology, disease cycle, and management of ornamental and plantation crops diseases.

	Content	CO Mapping	Hours
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); Groundnut (early and late leaf spots, rust, wilt); Soybean (rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic);	CO1	8
UNIT 2	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)	CO1	8

	and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, black arm).		
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); 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)	CO2	7
UNIT 4	Brinjal (phomopsis blight and fruit rot, sclerotinia blight) and Chilli (anthracnose and fruit rot, wilt, leaf curl); Cucurbits (powdery and downy mildew, wilts) and Cruciferous vegetables (Alternaria leaf spot, black rot, cauliflower mosaic); Beans (anthracnose, bacterial blight) and Okra (yellow vein mosaic); Ginger (soft rot), Turmeric (leaf Spot) and Coriander (stem gall); Rose (dieback, powdery mildew, black leaf spot) and Marigold (botrytis blight, leaf spots).	CO3	7

Practical:

S. No.	Practicals	Hours
1.	To study the symptoms of different diseases of field and horticultural crops: Blast and brown spot of rice, sheath blight and bacterial leaf blight of rice,	5
2.	Downy mildew and powdery of cucurbits, rhizoctonia and Cercospora leaf spot of green gram / black gram,	5
3.	Alternaria blight and downy mildew of mustard, early blight of late blight of potato and tomato,	5
4.	Phomopsis blight of brinjal, powdery mildew and rust of pea, stem gall of coriander, anthracnose and fruit rot of chilli, taphrina leaf spot of turmeric, red rot of sugarcane, acquaintance with fungicides,	4
5.	Antibiotics and biopesticides and their use in management of diseases of horticultural crops.	4
6.	Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory	4
7.	Field visit for the diagnosis of field problems, Collection and preservation of plant diseased specimens for herbarium.	3

Suggested Readings

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*

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Crop Improvement (Kharif crops) – I
Course Code: GPB-301

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

1. To provide knowledge about Self-pollinated and cross pollinated Kharif crops

2. To learn about origin and distribution of Kharif crops

3.To design breeding objectives of major kharif crops

4.To impart information on different crop varieties for Kharif season

Course Outcomes:

After the completion of this course, the student will be able to learn-

CO-1: Origin and distribution of various Kharif crop species**.**

CO-2: Major breeding objectives and procedures in development of varieties and hybrids of various field and vegetable Kharif season crops.

CO-3: Conventional and modern breeding approaches for improving yield, adaptability, stability, abiotic and biotic stress tolerance and quality, hybrid seed production of crops.

	Content	CO Mapping	Hours
UNIT 1	Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops of kharif season	**CO-1**	**3**
UNIT 2	Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops.	**CO-1**	**4**
UNIT 3	Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional);	**CO-2**	**5**
UNIT 4	Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeopea etc. Ideotype concept, climate resilient crop varieties for future.	**CO-3**	**3**

Practical:

S. No.	Practical's	Hours
1.	Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. rice, jute, maize, sorghum, pearl millet, ragi, pigeopea, urdbean,	4
2.	Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. mungbean, soybean, groundnut, sesame, castor, cotton, cowpea, tabacco, brinjal, okra and cucurbitaceous crops.	4
3.	Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods	4
4.	Study of field techniques for seed production and hybrid seed production in kharif crops	4
5.	Layout of field experiments;	4
6.	Study of quality characters, donor parents for different characters	4
7.	Visit to seed production plots; Visit to AICRP breeding plots of different crops.	6

Suggested Readings

1. Breeding field crops -I by V.L. Chopra

2. Genetic improvement of field crops by C.B. Singh and D. Khare

3. Genetics and Breeding of Pulse crops by D.P. Singh

4. Vegetable breeding – Principles and Practices by Hari Har Ram

5. Breeding field crops by D.A. Sleper and J.M. Poehlman

6. Plant Breeding –theory and practice by S.K. Gupta

7. Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur

8. Practical manuals on Crop Improvement I (Kharif crops) by Rajendra Kumar Yadav

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Weed Management
Course Code: AGRON-301

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

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 the completion of this course, the student will be able to –

CO-1: Students trained in basic knowledge of weeds and their nature.

CO-2: Get acquainted about methods of weed management.

CO-3: Enhance skills in selection of herbicides with having broad knowledge about mode of action of herbicides**.**

CO-4: Know about herbicides compatibility with other agro-inputs.

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Weeds and Their Nature** Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Crop-weed competition, factors of competition. Factors affecting growth and development. Studies on weed seed bank, weed shifts.	**CO-1**	**3**
UNIT 2	**Methods of weed management** Concepts of weed management, principles and methods, physical, cultural, chemical and biological methods of weed management. Weed management in organic/ natural farming. Integrated weed management & implements for weed control, Robotic weed control & precision weed management.	**CO-2**	**3**
UNIT 3	**Herbicides** Herbicide classification and properties of important herbicides. Concept of adjuvants and surfactants. Herbicide formulation and their use. Mode of action of herbicides and selectivity phenomenon. Nano herbicides.	**CO-3**	**3**
UNIT 4	**Herbicides mixture and interaction with agro-chemicals** Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application**.**	**CO-4**	**3**

UNIT 5	**Herbicide resistance and weed management in crops** Herbicide resistance and its management. Weed management in different field and horticultural crops.Aquatic weed management. Weed management in cropping systems.	**CO-2**	**3**

Practical:3

S. No.	Practical's	Hours
1.	Techniques of weed preservation.	2
2.	Weed identification and and losses caused by weeds	2
3.	Biology of important weeds.	2
4.	Study of weeds in different situations.	2
5.	Study of herbicide formulations and mixture of herbicide.	2
6.	Study of methods of herbicide application.	2
7.	Study of Herbicide application equipmenttheir parts, use, maintenance and calibration	2
8.	Weed control implements.	2
9.	Calculation of herbicide doses and requirement, weed control efficiency and weed index, Phytotoxicity of herbicides	2
10.	Weed management in fallow lands.	2
11.	Management of problematic and parasitic weeds	2

Suggested Readings

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*.

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Ornamental Crops, MAPs and Landscaping
Course Code: HORT-301

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

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 the completion of this course the student will be able to learn-

CO-1: Importance of ornamental crops, MAPs and landscaping.

CO-2: Principles of landscaping, features of gardens, and landscape uses of plants.

CO-3: Production technology of ornamental crops and value addition.

CO-4: Production technology of medicinal & aromatic plants and value addition.

	Content	CO Mapping	Hours
UNIT 1	Production technology of ashwagandha, costus, isabgol and geranium; Production technology of mint, aloe and ocimum, Coleus, Glory lily, Periwinkle etc.; Production technology of plants like lemongrass, citronella, vetiver and palmarosa etc.	**CO1**	**3**
UNIT 2	Importance and scope of ornamental crops; Importance and scope of medicinal and aromatic plants and landscaping; Principles of landscaping; Landscape uses of trees, shrubs and climbers.	**CO2**	**2**
UNIT 3	Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and lilium; Production technology of chrysanthemum and carnation; Package of practices for loose f lowers like marigold and jasmine under open conditions.	**CO3**	**5**
UNIT 4	Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and lilium; Production technology of chrysanthemum and carnation; Package of practices for loose f lowers like marigold and jasmine under open conditions.	**CO4**	**5**

Practical:

S. No.	Practicals	Hours
1.	Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants).	3
2.	Propagation of MAP, Bed preparation and planting of MAP.	3
3.	Nursery bed preparation and sowing of seasonal flower seeds	3
4.	Propagation of ornamental plants by terminal/herbaceous cuttings	3
5.	Propagation of Anthurium and orchids	3
6.	Propagation of bougainvillea	3
7.	Planting of gerbera suckers; Gladiolus corms	2
8.	Establishment and maintenance of lawn	2
9.	Preparation of flower preservatives and their use in extending the vase life of cut flowers	2
10.	Training and pruning of ornamental plants and raising of hedge and edge.	2
11.	Planning and layout of garden.	4

Suggested readings

1. *Floriculture in India by G.S. Randhawa and Mukopadhyay*
2. *Introduction to spices, plantation crops, medicinal and aromatic plants by N. Kumar, Abdul Khadder, P. Rangaswamy, I. Irulappam*
3. *Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia*
4. *Commercial flowers (Vol 1 and 2) by T.K. Bose*.

Program: B.Sc. (Hons.) Agriculture
Semester: Fifth
Course: Introductory Agro forestry
Course Code: AGRON-302

L	T	P	C
1	0	1	2

Course Objective:
The course objective will be to make the students to:

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 the completion of this course, the student will be able to,

CO-1- Understand basic concepts of agroforestry, Identification of Trees.

CO-2: Knowledge on Traditional agroforestry, basic knowledge for management of agroforestry.

CO-3: Management, socieo-economic aspect of agroforestry.

CO-4: Silviculture aspect of important agroforestry tree species and Important AF models.

	Content	CO Mapping	Hours
UNIT 1	Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India; MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of India, Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling.	**CO1**	**5**
UNIT 2	Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India. Management of Agro-forestry system; Role of agroforestry in soil and water conservation; windbreak; Shelterbelt definition, objectives.; Socio- economic aspects of Agroforestry system.	**CO2**	**4**
UNIT 3	Design and Diagnostic study of agroforetry system; Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, field handling of nursery stock.	**CO3**	**3**

UNIT 4	Management of tree species; Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc. Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI; Agroforestry models developed by Indian council of Forestry Research and Education.	**CO4**	**3**

Practical:

S. No.	Practicals	Hours
1.	Identification of tree species in agro-forestry	2
2.	Study of tree growth measurement	2
3.	Study of environmental parameters affecting AF System	2
4.	Plant propagation methods	2
5.	Pre-sowing seed treatment	2
6.	Preparation of nursery bed exercise	2
7.	Practising propagation techniques for trees	2
8.	Afforestation method, practical training, pruning, coppicing, pollarding etc	2
9.	Planting pattern and designs for plantation, natural and artificial regeneration, Design and diagnostic survey of agro forestry system.	3
10.	Evaluation of agro-forestry system in different agro climatic zones	3
11.	Exposure Visit to prevailing agroforestry systems of the state and related important institutions	4
12.	Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE	4

Suggested readings

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).*

Semester VI

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Fundamentals of Agricultural Biotechnology
Course Code: PBT- 321

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

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

Course Outcomes:

At the end of the course, the student will be able to:

After the completion of this course, the student will be able to learn about ;

CO 1: The basic concepts of plant tissue culture and its application.

CO2: Fundamentals of molecular biology with modern techniques.

CO3: R-DNA technology, transgenic and MAS for crop improvements

	Content	CO Mapping	Hours
UNIT 1	Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops.	CO1	8
UNIT 2	Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.	CO2	8
UNIT 3	Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation,	CO3	7
UNIT 4	Unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization and parthenocarpy, importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.	CO3	7

Practical:

1.	Introduction to Plant Tissue Culture Laboratory;	**2**
2.	Good Laboratory Practices;	**2**
3.	Media Preparation and sterilization;	**2**
4.	Glassware sterilization;	**2**
5.	Micropropagation;	**2**

6.	Callus induction and culture; Anther culture; Apical meristem culture;	**2**
7.	Preparation of synthetic seeds;	**2**
8.	Isolation of plasmid DNA;	**2**
9.	Quantification of DNA;	**2**
10.	Agarose Gel Electrophoresis and visualization of plasmid DNA;	**2**
11.	Restriction digestion of plasmid DNA and agarose gel electrophoresis;	**2**
12.	Isolation of Plant genomic DNA;	**2**
13.	PCR amplification of DNA;	**2**
14.	Gel electrophoresis of amplified DNA;	**2**
15.	Visit to tissue culture units /biotech labs.	**2**
16.	Introduction to Plant Tissue Culture Laboratory;	**2**

Suggested readings

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.

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Basic and Applied Agricultural Statistics
Course Code: STAT-321

L	T	P	C
2	0	1	3

Course Objective:
The course objective will be to make the students to:

1. Provide an idea on statistical concepts of both descriptive and inference Statistics which will be useful to do statistical analysis

Course outcomes

After the completion of this course, the student will be able to learn about

CO1: the fundamental of statistical concepts and their relevance in agricultural research

C02 use of statistical methods in in agricultural data and interpret results.

C03 basics of experiment design and sampling in agricultural research.

	Content	CO Mapping	Hours
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. 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. MedianDefinition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.	CO1	8
UNIT-2	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	CO1	6

	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.		
UNIT-3	Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability- Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability. 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 and Regression. Definition of Correlation. Scatter Diagram	CO2	8
UNIT-4	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. 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.	CO3	8

Practical

1	Diagrammatic and Graphical representation of data.	**5**
2	Calculation of A.M., Median and Mode (Ungrouped and Grouped data).	**5**
3	Calculation of S.D. and C.V. (Ungrouped and Grouped data).	**5**
4	Correlation and Regression analysis.	**5**
5	Application of t-test (one sample, two sample independent and dependent).	**5**
6	Analysis of variance one-way classification. CRD. Selection of random sample using simple random sampling	**5**

Suggested readings

1. *Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers.*

2. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.

3. Basic Statistics by B. L. Agarwal, New Age International Publishers.

4. Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House.

5. Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers.

6. Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Crop Improvement (Rabi crops)- II
Course Code: GPB-321

L	T	P	C
1	0	1	2

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 the completion of this course, the student will be able to learn about –

CO1: Origin and distribution of various Rabi crop species,

CO2: Major breeding objectives and procedures in development of varieties and hybrids of field and vegetable crops of Rabi season.

CO3: Conventional and modern breeding approaches for improving yield, adaptability, stability, abiotic and biotic stress tolerance and quality

	Content	CO Mapping	Hours
UNIT-1	Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops;	CO1	6
UNIT-2	Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops	CO1	3
UNIT-3	Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional);	CO2	3
UNIT-4	Hybrid seed production technology in wheat, oat, chickpea, rapeseed and mustard etc. Ideotype concept, climate resilient crop varieties for future.	CO3	3

Practical

1	Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. wheat, oat, rapeseed and mustard, pulses, potato, sugarcane, tomato, chilli, onion	**4**
2	Study of field techniques for seed production and hybrid seed production in rabi crops;	**6**
3	Estimation of heterosis, inbreeding depression and heritability;	**4**
4	Study of quality characters, donor parents for different characters;	**6**
5	Visit to seed production plots;	**6**
6	Visit to AICRP breeding plots of different crops.	**5**

Suggested readings

1. *Breeding Field Crops -I by V.L. Chopra*

2. *Genetic Improvement of Field Crops by C.B. Singh and D. Khare*

3. *Genetics and Breeding of Pulse crops by D.P. Singh*

4. *Vegetable Breeding – Principles and Practices by Hari Har Ram*

5. *Breeding Field Crops by D.A. Sleper and J.M. Poehlman*

6. *Plant Breeding –Theory and practice by S.K. Gupta*

7. *Breeding Asian field Crops by J.M. Poehlman and D.N. Barthakur*

8. *Practical Manuals on Crop Improvement I (Rabi crops) by Rajendra Kumar Yadav*

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Renewable energy in Agriculture and Allied Sector
Course Code: AENGG-321

L	T	P	C
1	0	1	2

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 the completion of this course, the student will be able to learn about

CO1 different types of materials used in Renewable Energy

C02: importance of Renewable Energy technology and its applications

C03 applications of solar thermal technology.

	Content	CO Mapping	Hours
UNIT-1	Classification of energy sources, contribution of these of sources in agricultural sector; Familiarization with biomass utilization for biofuel production and their application;	CO1	3
UNIT-2	Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource;	CO2	3
UNIT-3	introduction of solar energy, collection and their application; Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application;	CO3	3
UNIT-4	Introduction of wind energy and their application. Availability of bio mass and their application in different places.	CO3	6

Practical

1.	Familiarization with renewable energy gadgets.	2
2.	To study biogas plants,	3
3.	gasifier,	2
4.	production process of biodiesel,	3
5.	briquetting machine,	3
6.	production process of bio-fuels.	4
7.	Familiarization with different solar energy gadgets.	2
8.	To study solar photovoltaic system: solar light, solar pumping, solar fencing, solar cooker and solar drying system.	4
9.	To study solar distillation, solar pond and solar wind hybrid system	2
10.	Field visit to Solar –Wind farm.	2

Suggested readings

1. *C.S. Solanki. 2011. Solar Photovoltaic – Fundamentals, Technologies and Applications. PHI Learning Pvt. Ltd.*

2. S. Sukhatme and J. Nayak. 2008. Solar Energy: Principles of Thermal Collection and Storage. Third Edition (Tata McGraw-Hill

3.V.V.N. Kishore. 2008. Renewable Energy Engineering and Technology: Principles and Practice, Teri, India.

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Dryland agriculture/Rainfed agriculture and watershed management
Course Code: AGRON-321

L	T	P	C
1	0	1	2

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

Course outcomes

After the completion of this course, the student will be able

CO1: know the problems and prospects of Dryland/rainfed agriculture.

C02: learn the soil and water conservation approaches under rainfed condition.

C03: get acquainted with the nature of drought and water harvesting systems

C04: learn and evaluate the sustainable crop management practices for dryland/rainfed agriculture.

	Content	CO Mapping	Hours
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;	CO1	4
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; Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques	CO2	4
UNIT-3	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; Concept, history, objective, principles and components of watershed management, factors affecting watershed management.	CO3	4
UNIT-4	Log term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.	CO4	3

Practical

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

Suggested readings

1. *A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.*
2. *D. Lenka. 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.*
3. *G.S.L.H.V. Prasad Rao. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.*
4. *H.S. Mavi and Graeme J. Tupper. 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.*
5. *H.S. Mavi. 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.*
6. *H.V. Nanjappa and B.K. Ramachandrappa. 2007. Manual on Practical Agricultural Meteorology. Agrobios India. Jodhpur.*
7. *S.R. Reddy. 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.*
8. *T. Yellamanda Reddy and G.H. Sankara Reddi. 2010. Principles of Agronomy. Kalyani Publishers, New Delhi*

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Agricultural Microbiology and Phyto-remediation
Course Code: PP-321

L	T	P	C
1	0	1	2

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 the completion of this course, the student will be able to learn about

CO1: Introduction to microbiology with specific focus on its significance in agriculture science

C02 Bacterial structure and the function of the different bacterial components.

C03: Different fields of microbiology and Biological control and the role of biopesticides in plant disease management

C04: Bioremediation of polluted soils using microbial mediators and phytoremediation.

	Content	CO Mapping	Hours
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.	CO1	4
UNIT-2	Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, genetic engineering. Soil Microbiology: Nutrient mineralization and transformation, Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc.	CO2	4
UNIT-3	Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning. Water Microbiology: Types of water, water microorganisms, and microbial	CO3	4

	analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management		
UNIT-4	Concepts of rhizosphere microbiology- Rhizodeposits - biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere micro biomeresidents 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.	CO4	3

Practical

1.	Study of the microscope;	2
2.	Acquaintance with laboratory material and equipment;	2
3.	Microscopic observation of different groups of microorganisms: moulds (Fungi);	5
4.	Direct staining of bacteria by crystal violet; Negative or indirect staining of bacteria by nigrosin;	2
5.	Gram staining of bacteria;	2
6.	Study of phyllosphere and rhizosphere microflora;	2
7.	Measurement of microorganisms;	2
8.	Preparation of culture media; Isolation and purification of rhizospheric microbes;	2
9.	Isolation and purification of N-fixers; Isolation and purification of Nutrient solubilizers;	5
10.	Isolation and purification of Endophytes.	2
11.	Study of the microscope;	2

Suggested readings

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2002. Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.

2. Rangaswami, G. and Bagyaraj, D. J. 2005. Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.

3. Mukherjee, N. and Ghosh, T. 2004. Agricultural Microbiology. Kalyani Publishers, Calcutta

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Agricultural Finance and Cooperation
Course Code: AECON-321

L	T	P	C
1	0	1	2

Objectives

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

Course outcomes

After the completion of this course, the student will be able to learn –

CO1: introduction to Finance and financial test.

C02: to understand role of financial institution in agriculture field

C03: to understand different type of financial statements.

C04: to understand different type of insurance scheme

	Content	CO Mapping	Hours
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. Sources of agricultural finance: institutional and noninstitutional sources, commercial banks, social control and nationalization of commercial banks.	CO1	4
UNIT-2	Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. 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.	CO2	4
UNIT-3	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.	CO3	4
UNIT-4	Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing	CO4	3

	cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3R'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. Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.		

Practical

1	Optimum allocation of limited amount of capital among different enterprise.	**2**
2	Analysis of progress and performance of cooperatives using published data.	**2**
3	Analysis of progress and performance of commercial banks and RRBs using published data.	**2**
4	Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures.	**3**
5	Estimation of credit requirement of farm business – A case study.	**2**
6	Preparation and analysis of balance sheet – A case study.	**6**
7	Preparation and analysis of income statement – A case study.	**1**
8	Appraisal of a loan proposal – A case study.	**2**
9	Techno-economic parameters for preparation of projects.	**2**
10	Preparation of Bankable projects for various agricultural products and its value-added products.	**2**
11	Seminar on selected topics. Different types of repayment plans.	**8**

Suggested readings

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

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Essentials of Plant Biochemistry
Course Code: BIOCHEM-321

L	T	P	C
2	0	1	3

Objective

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

Course outcomes

After the completion of this course, the student will be able to –

CO-1: understand and describe biochemical concept

CO-2: analyze enzyme kinetics and mechanisms.

CO-3: apply metabolic pathways to understand energy generation and regulation

	Content	CO Mapping	Hours
UNIT-1	Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components. Bio-molecules – Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids. Vitamins – physiological and metabolic role.	CO1	6
UNIT-2	Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes.	CO2	4
UNIT-3	Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation.	CO3	3
UNIT-4	Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industrie	CO3	2

Practical

1	Preparation of standard solutions and reagents,	**2**
2	Determination of pH,	**2**
3	Qualitative tests of carbohydrates and amino acids,	**2**
4	Quantitative estimation of soluble sugars and starch,	**2**
5	Estimation of protein by Kjeldhal method and Lowry's method,	**2**

6	Preparation of mineral solution from ash,	**2**
7	Estimation of fat by Soxhlet method,	**2**
8	Determination of acid value,	**2**
9	saponification value and iodine number,	**6**
10	Estimation of ascorbic acid,	**6**
11	Qualitative/quantitative tests of secondary metabolites.	**8**

Suggested reading

1. Nelson and Cox. 2008. Lehninger Principles of Biochemistry. Fourth/Fifth edition. Freeman (Can be downloaded)

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 (Can be downloaded)

4. Heldt. 2005. Plant Biochemistry. Elsevier (Can be downloaded)

5. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.

Program: B.Sc. (Hons.) Agriculture
Semester: Sixth
Course: Fundamentals of Seed Science and Technology
Course Code: GPB-321

L	T	P	C
1	0	1	2

Objectives

1. To impart basic and fundamental knowledge on principles and practices seed science and technology

2. To impart practical skills on scientific seed production and post-harvest quality management

Course outcomes

After the completion of this course, the student will be able to learn about

CO-1: History, nature and goals of Seed technology.

CO-2: Foundation and certified seed production of important crops.

CO-3: Seed drying, Processing, Storage, and Marketing.

CO-4: Seed certification, Seed Act and Seed Act enforcement.

	Content	CO Mapping	Hours
UNIT-1	Introduction to seed technology, definition and importance; Seed quality -definition, characters of good quality seed; Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed	CO1	4
UNIT-2	Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures; Post-harvest seed quality management; seed processing procedures, s	CO2	4
UNIT-3	seed drying; Seed treatment, its importance, method of application and seed packing; seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage..	CO3	4
UNIT-4	Seed Certification and legislation; Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques.	CO4	3

Practical

1	Seed Structure, Seed sampling, Physical purity,	**2**
2	Moisture determination, Germination test, Seed and seedling vigour test,	**3**
3	Seed Viability,	**3**
4	Genetic purity test: Grow out test	**3**
5	Field inspection, Seed health testing using blotter and agar plate method.	**3**
6	Visit to seed production farms, seed testing laboratories and seed processing plant.	**6**
7	Seed Structure, Seed sampling, Physical purity,	**6**

Suggested Readings

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.

Semester VII

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Agri-Business Management
Course Code: AECON-401

L	T	P	C
3	0	1	4

Course Objective:
The course objective will be to make the students to:

To impart knowledge on concepts, processes, significance and role of Management and organizational behavior.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: The meaning and concept of Agribusiness Management.

CO-2: Agro-industries aspects of the rural economy as they affect the agricultural sector.

CO-3: The Financial and Capital Management techniques.

CO-4: The organizational behavior and management concepts of Agri-Business.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction**: Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems; Importance of agribusiness in the Indian economy and New Agricultural Policy and distinctive features of Agribusiness Management.	**CO-1**	10
UNIT 2	**Importance and needs of agro-based industries**: Classification of industries and types of agro based industries; Institutional arrangement, procedures to set up agro based industries; Constraints in establishing agro-based industries; Agri-value chain: Understanding primary and support activities and their linkages.	**CO-2**	12
UNIT 3	**Business environment and Management functions**: PEST & SWOT analysis; Management functions: Roles & activities, Organization culture; Planning, meaning, definition, types of plans; Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget; Components of a business plan, Steps in planning and implementation; Organization, staffing, directing and motivation. Ordering, leading, supervision, communications, control.	**CO-3**	15
UNIT 4	**Capital Management and Financial management of Agribusiness**: Financial statements and their importance; Sales & Distribution Management; Pricing policy, various pricing methods; Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation; Project Appraisal and evaluation techniques.	**CO-4**	8

Practical:

S.No.	Practicals	Hours
1.	Study of agri-input markets: Seed, fertilizers, pesticides.	3
2.	Study of output markets: grains, fruits, vegetables, flowers.	3
3.	Study of product markets, retails trade commodity trading and value added products.	3
4.	Study of financing institutions- Cooperative, commercial banks.	3
5.	Study of financing institution- RRBs.	3
6.	Study of financing institution- Agribusiness Finance Limited.	3
7.	Preparations of projects and Feasibility reports for agribusiness entrepreneur.	3
8.	Case study of agro-based industries.	3
9.	Trend and growth rate of prices of agricultural commodities.	3
10.	Appraisal/evaluation techniques of identifying viable project- discounted and non-discounting techniques.	3

Suggested readings

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.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Management of Natural Resources
Course Code: AGRON-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: Develop understanding of natural resource bases and their management.

CO-2: Understand the status and problems of land, water and energy resources and their management.

CO-3: Get acquainted with the paradigms and approaches in resource management

CO-4: Learn soil loss estimation methods, soil erosion, its control measures and water harvesting techniques.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Natural Resource Bases:** 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.	**CO-1**	8
UNIT 2	**Land, water and energy resources:** 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. Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.	**CO-2**	15
UNIT 3	**Resource Management Paradigms:** Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches;	**CO-3**	7

	integrated resource management strategies.		
UNIT 4	**Soil erosion and their conservation measures:** 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	**CO-4**	15

Practical:

S.No.	Practicals	Hours
1.	Identifying natural resources and their utility.	2
2.	Practicing survey - Principles and educating to use pacing technique for measurement.	2
3.	Area calculations through chain survey.	2
4.	GPS demo for tracking and area measurement.	2
5.	Estimation of soil loss and calculation of erosion index.	2
6.	Leveling concepts and practical utility in agriculture.	2
7.	Preparation of contour maps.	2
8.	Concept of vegetative water ways and design of grassed water ways.	2
9.	Wind erosion and estimation process.	2
10.	Different irrigation pumps and their constructional differences.	2
11.	Farm pond construction and its design aspects.	2
12.	Visit to nearby farm pond.	4
13.	Visit to an erosion site.	2
14.	Exposure to strip cropping/contour bunding.	2

Suggested readings

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.

4. Management of Resources for Sustainable Development: Sushma Goel. The Orient Blackswan 284p.

5. Natural Resources: Their Conservation and Management by Arvindrai Upadhyay. Aspiration Academy, 320p.

6. Natural Resource Management for Growth Development and Sustainability by Vasudeva Srishti Pal.Today & Tomorrows Printers and Publishers, 336p.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Agrochemicals
Course Code: ENTO-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

To impart knowledge on different classes of agrochemicals.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Acquaint with the various agrochemicals and types of herbicides, fungicides and insecticides.

CO-2: Gain knowledge of the types, importance, and manufacturing processes of nitrogenous, phosphatic, and potassic fertilizers, including slow-release options.

CO-3: Learn skills in preparing mixed and complex fertilizers and understanding their compatibility and application.

CO-4: Gain knowledge of the Fertilizer Control Order and provide insights into fertilizer logistics, marketing, and regulatory practices.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Agrochemicals and Herbicides:** 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.	**CO-1**	8
UNIT 2	**Introduction to Fungicides and Insecticides:** Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxychloride. Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification and insecticides: inorganic and organic insecticides 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.	**CO-2**	20
UNIT 3	**Introduction to Fertilizers and Primary Fertilizers:** Fertilizers and their importance. Nitrogenous fertilizers:	**CO-3**	7

	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.		
UNIT 4	**Mixed and complex fertilizers:** ixed 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 control order. Fertilizer logistic and marketing.	**CO-4**	10

Practical:

S.No.	Practicals	Hours
1.	Sampling of pesticides.	2
2.	Sampling of fertilizers.	2
3.	Pesticides application technology to study about various pesticides appliances.	2
4.	Quick tests for identification of common fertilizers.	2
5.	Identification of anion and cation in fertilizer.	2
6.	Calculation of doses of insecticides to be used.	2
7.	To study and identify various formulations of insecticide available in market.	2
8.	Estimation of nitrogen in Urea.	4
9.	Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate.	4
10.	Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer.	4
11.	Determination of copper content in copper oxychloride.	2
12.	Determination of sulphur content in sulphur fungicide.	2

Suggested readings

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

2. Panda H. 2022.The Complete Technology Book on Pesticides, Insecticides, Fungicides and

3. Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details. 2nd Revised Edition. NPCS

4. Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency

5. Singh, A., 2022 Basics of Agrochemical Formulations, Brillion Publishing, 176p.

6. Larramendy, M.L 2017. Toxicity and Hazard of Agrochemicals, INTECH, 170p.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Agricultural Journalism
Course Code: EXT-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

To impart knowledge and skill in agricultural journalism

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Define and differentiate the agricultural journalism from other journalism, its types, principles, objectives and the role of agricultural journalists in promoting agricultural development.

CO-2: Identify and apply various types of agricultural stories, effectively gathering information from diverse sources and structuring narratives using established writing techniques, including the inverted pyramid structure.

CO-3: Assess readability measures and implement strategies to enhance the readability of articles and stories, while incorporating visual elements, like photographs and artwork to enrich agricultural journalism.

CO-4: Demonstrate the proficiency in editorial processes, including proofreading, copy reading, headline writing, and layout design, to produce high-quality agricultural publications.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Agricultural Journalism and its Role in Communication 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. 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.	**CO-1**	15
UNIT 2	**Writing and Structuring Agricultural Stories:** The agricultural stories: 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. Writing a news story difference between news and feature story, the principle of	**CO-2**	13

	writing a news story, Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body.		
UNIT 3	**Readability, Visual Elements in Agricultural Journalism:** Readability measure readability ease score, automated readability index, gunning fog index. How to improve readability of articles and stories. Use of photograph in agricultural journalism- Basic principles of photography - composition, exposure, lens, light. Use of artwork (Graphs, charts maps, etc.). Writing the captions.	**CO-3**	10
UNIT 4	**Editorial Processes in Agricultural Journalism 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	**CO-4**	7

Practical:

S.No.	Practicals	Hours
1.	Practice in writing an agricultural news story.	2
2.	Practice in writing an agricultural feature story.	2
3.	Covering agricultural events for the information collection.	2
4.	Practice in interviewing for the information collection.	2
5.	Abstracting stories from research and scientific materials and wire services.	2
6.	Selecting pictures and artwork for the agricultural story.	2
7.	Practice in editing, copy reading. Practice in headline and title writing.	2
8.	Practicing proof reading.	4
9.	Practice in lay outing of newspaper.	4
10.	Testing copy with a readability formula.	4
11.	Visit a publishing office.	4

Suggested readings

1. Carole Fleming, Emma Hemmingway, and Gillian Moore. Introduction to Journalism.
2. Rangaswami Parthasarathy. Basic Journalism.
3. K. M. Shrivastava. News Reporting and Editing.
4. M.V. Kamath. Professional Journalism.
5. M.V. Kamath. The Journalist's Handbook Book.
6. Bhaskaran et al. Farm Journalism and Media Management.
7. A K Singh. Agricultural Extension and farm Journalism.
8. Jana and Mitra. Farm Journalism.
9. Rathore, O. S. et al. Handbook of Extension Education.
10. Dudhani, C.M., Hirevenkatgoudar, L.V., Manjunath, L. Hanchinal, S.N. and Patil, S.L. Extension Teaching Methods and Communication Technology.
11. Sandhu, A.S. Text book on Agricultural Communication: Process and Methods.
12. Singh, A.K., Lakhan Singh, R. and Roy Burman. Dimensions of Agricultural Extension.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Landscaping
Course Code: HORT-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

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 landscape designs

3. To enable students to design landscapes in softwares like AutoCAD, ArchiCAD etc.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Principles of landscaping, different styles and types of gardens.

CO-2: Selection and utilization of different ornamental plants in landscaping.

CO-3: Bio aesthetic planning

CO-4: Landscaping of various places and use of softwares like AutoCAD, ArchiCAD

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction and principles of landscaping garden styles and types**: Importance and scope of landscaping, history of gardening and famous garden of India. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. Gardens for special purposes.	**CO-1**	13
UNIT 2	**Selection and utilization of ornamental plants in landscaping Trees:** selection, propagation, planting schemes, canopy management. Shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting. Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management.	**CO-2**	15
UNIT 3	**Bioaesthetic planning:** Bio aesthetic planning, definition, need, planning.	**CO-3**	7
UNIT 4	**Landscaping of different places:** Landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions, Bonsai principles and management. Lawn: establishment and maintenance. CAD application.	**CO-4**	10

Practical:

S.No.	Practicals	Hours
1.	Identification of ornamental trees, shrubs, annuals, pot plants.	2
2.	Identification of tools and implements used in landscape designing.	2
3.	Propagation of trees and shrubs.	2
4.	Propagation of annuals.	2
5.	Care and maintenance of plants.	2
6.	Potting and repotting.	2
7.	Training and pruning of plants for special effects.	2
8.	Lawn establishment and maintenance.	2
9.	Symbols for landscape designing.	2
10.	Layout of formal gardens.	1
11.	Layout of informal gardens.	1
12.	Special type of gardens (sunken garden, terrace garden, rock garden).	2
13.	Designing of conservatory and lathe house.	2
14.	Use of computer software.	2
15.	Visit to important gardens/parks/institutes.	4

Suggested readings

1. Arora, J. S. 2010. Introductory Ornamental Horticulture. Kalyani Publisher.

2. Bose, T. K., Malti, R. G., Dhua, R. S. and Das, P. 2012. Floriculture and Landscaping (Vol.-1 & -2, 2nd Rev. Edn.). Nayaprakash.

3. Chandrasekhar, S. Y. and Hemla N.B. 2020. Principles of Landscape Gardening. ICAR.

4. Mishra, P. and B. Naik. 2022. Principles of Landscape Architecture. NIPA.

5. Pradhan, S. 2018. Landscape Gardening. Biotech Books.

6. Randhawa, G. S. and A. Mukhopadhyay. 2004. Floriculture in India. Allied Publishers.

7. Singh, A.K. and Anjana Sisodia. 2017. Textbook of Floriculture and Landscaping. NIPA.

8. Singh, R. and B.K. Singh. 2020. Introductory Ornamental Horticulture and Landscape Gardening. Bio-Green Books.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Commercial Plant Breeding
Course Code: GPB-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. To learn about the 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 line and cultivar development.

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

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: The types of crops and modes of plant reproduction.

CO-2: Various methods of hybrid seed production.

CO-3: Special breding methods and plant variety protection laws.

CO-4: Principles of seed production techniques.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Line Development and Maintenance breeding:** Types of crops and modes of plant reproduction. Line development and maintenance breeding in self- and cross- pollinated crops (A/B/R and two-line system) for development of hybrids and seed production. Genetic test of commercial hybrids.	**CO-1**	10
UNIT 2	**Advances in hybrid seed production of field crops:** Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc.	**CO-2**	10
UNIT 3	**Special Breeding Methods:** Speed Breeding, Breeding Management systems, High-throughput phenotyping and genotyping platforms, Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools. **IPR and PPV & FR Act, Variety testing, release and notification systems:** IPR issues in commercial plant breeding: DUS testing and registration of verities under PPV and FR Act. Variety testing, release and notification systems in India.	**CO-3**	20

UNIT 4	**Principles and techniques of seed production:** Principles and techniques of seed production, types of seeds, quality testing in self- and cross- pollinated crops.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Floral biology in self- and cross-pollinated species, selfing and crossing techniques.	2
2.	Techniques of seed production in self- and cross-pollinated crops using A/B/R and two-line system.	2
3.	Learning techniques in hybrid seed production using male-sterility in field crops.	2
4.	Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production.	2
5.	Concept of rouging in seed production plot.	2
6.	Concept of line its multiplication and purification in hybrid seed production.	2
7.	Role of pollinators in hybrid seed production.	2
8.	Hybrid seed production techniques in sorghum and pearl millet.	1
9.	Hybrid seed production techniques in maize and rice.	1
10.	Hybrid seed production techniques in rapeseed-mustard and sunflower.	1
11.	Hybrid seed production techniques in castor and pigeon pea.	1
12.	Hybrid seed production techniques in cotton and vegetable crops.	2
13.	Sampling and analytical procedures for purity testing and detection of spurious seed.	2
14.	Seed drying and storage structure in quality seed management.	2
15.	Screening techniques during seed processing viz., grading and packaging.	2
16.	Visit to public private seed production and processing plants.	4

Suggested readings

1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. Daya Publishing 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. Gene Tech Books.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Food Safety and Standards
Course Code: FSN-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

This course intends to provide knowledge about the basic concepts & implementation of food safety for development of safe products

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: To develop skill to convert raw materials into safe, attractive food products.

CO-2: Management of the production of food products.

CO-3: To know food safety management tools and regulation.

CO-4: to have the know-how of recent concerns to food safety.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Food Safety**: Food safety –Definition, Importance, Scope and Factors affecting Food Safety. Hazards and Risks, Type of Hazards - Biological, Chemical, Physical hazards. Management of hazards – Need, Control of Parameters.	**CO-1**	10
UNIT 2	**Factors affecting Food Safety**: Temperature Control, Food Storage, Production Design, Hygiene and Sanitation in Food Service Establishments-Introduction, Sources of contamination and their control. Water Analysis, Surface Sanitation, Personal Hygiene.	**CO-2**	10
UNIT 3	**Food Safety Management**: Food Safety Management Tool- Basic concepts. Food safety Measures, PRPs, GHPs, GMPs, SSOPs etc. HACCP, ISO series. TQM- concept and need for quality, components of TQM, Kaizen. Risk Analysis, Accreditation and Auditing Waste Disposal, Pest and Rodent Control, Personnel Hygiene. **Food Regulations**: Food laws and Standards Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food. Indian and International Standards for food products.	**CO-3**	20
UNIT 4	**Recent Trends in Food Safety:** Recent concerns -New and Emerging Pathogens. Packaging, Product labelling and Nutritional labelling. Genetically modified food/transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Water quality analysis.	3
2.	Physico – chemical analysis	3
3.	Microbiological. Preparation of different types of media.	3
4.	Microbiological examination of different food samples.	3
5.	Assessment of surface sanitation by swab/rinse method.	3
6.	Assessment of personal hygiene.	3
7.	Biochemical tests for identification of bacteria.	3
8.	Scheme for the detection of food borne pathogens.	3
9.	Preparation of plants for Implementation of FSMS-HACCP	3
10.	ISO:22000.	3

Suggested readings

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.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Bioformulation and Nano Formulation
Course Code: PP-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: Understand the history, principles, and significance of biological control in managing pests and plant diseases.

CO-2: Analyze various microbial biopesticides, their role in organic agriculture, and the global and Indian market scenarios.

CO-3: Identify and evaluate different biocontrol agents and biofertilizers, their modes of action, production processes, and application methods.

CO-4: Explore nanotechnology and its applications in pest and nutrient management, including nano biopesticides and fertilizers.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction and histrory of biological control:** Introduction and history of biological control of pests and diseases; **Microbial bio-pesticides:** the global and Indian market scenario; biopesticides for organic agriculture	**CO-1**	7
UNIT 2	**Biocontrol agents:** Different phytopathogenic biocontrol agents: Mode of action; Different entomopathogenic biocontrol agents: Mode of action; Microbial inoculants as biofertilizer candidates, Production, quality assessment and methods of application of biopesticides and biofertilizers;	**CO-2**	10
UNIT 3	**Biopesticides:** Regulatory system of biopesticides in India; Formulations of plant essential oils, botanicals, pheromone, and parapheromone and their	**CO-3**	13

	application in insect pest management; Use of predators and parasitoids for insect pest management;		
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, 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	**CO-4**	15

Practical:

S.No.	Practicals	Hours
1.	Introduction and acquaintance with biopesticide laboratory	2
2.	Preparation of culture media	2
3.	Isolation and purification of bioagent from soil and infected insects	2
4.	Microscopic study of different microbial bioagents	2
5.	In vitro assay of microbial bioagents against plant pathogens	2
6.	In vitro compatibility study among different microbial bioagents	2
7.	Mass multiplication of biopesticides	2
8.	Population enumeration of biocontrol agents in different biopesticides.	2
9.	Preparation of plant extracts and their efficacy test against insect pests	2
10.	Use of pheromone parapheromone for monitoring and management of insect pests	2
11.	Bioassay of Entomopathogenic biocontrol agents on insect pests	2
12.	Preparation of microbial inoculants of biofertilizer microbes	2
13.	Compatibility of biofertilizer microbes	2
14.	Preparation of solid and liquid consortia of biofertilizer microbes	4

Suggested readings

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.

4. Kuykendall Marel Dekker, INC. 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.

7. Kuykendall Marel Dekker, INC. 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.

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

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Biopesticides and Biofertilizers
Course Code: SS-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases.

2. To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Different types of biopesticides and their mass production techniques.

CO-2: The types, structure and characteristics of bacterial, cyanobacterial, and fungal biofertilizers.

CO-3: The mechanisms of nitrogen fixation, phosphate solubilization, and biofertilizer production technology.

CO-4: The application, storage, shelf life and marketing strategies for biofertilizers.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction and histrory of bio-pesticides:** History and concept of bio pesticides. Importance, scope and potential of bio pesticides. Definitions, concepts and classification of bio pesticides viz. Pathogen, botanical pesticides, and bio rationales. Botanicals and their uses. **Mass production and application of bio-pesticides:** Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of bio pesticides. Methods of quality control and Techniques of bio pesticides. Impediments and limitation in production and use of bio pesticides.	**CO-1**	15
UNIT 2	**Introduction, structure and characteristics of biofertilizers:** Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers– Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cynobacterial bio fertilizers- Anabaena, nostoc, Hapalosiphon and fungal biofertilizers– AM mycorrhiza and ectomycorhiza.	**CO-2**	10
UNIT 3	**Mechanism of nitrogen fixation, phosphate solubilisation and Production Technology of biofertilizers:** Nitrogen fixation– Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K-solubilization. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier	**CO-3**	15

	based and liquid biofertilizers. FCO specifications and quality control of biofertilizers.		
UNIT 4	**Application, Storage and marketing**: Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Isolation and purification of important biopestisides: Trichoderma Pseudomonas, Bacillus, Metarhyzium etc. and its production.	3
2.	Identification of important botanicals	3
3.	Visit to biopesticide laboratory in nearby area.	3
4.	Field visit to explore naturally infected cadavers.	3
5.	Identification of entomopathogenic entities in field condition.	3
6.	Quality control of biopesticides.	3
7.	Isolation and purification of Azospirillum, Azotobactor, Rhizobium, P solubilizers and Cyanobacteria.	3
8.	Mass multiplication and inoculums production of biofertilizers.	3
9.	Isolation of AM fungi- Wet sieving method & sucrose gradient method.	3
10.	Mass production of AM inoculants.	3

Suggested readings

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. Kalyani Publishers. 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 using Antagonistic Organisms in India. Precision Fototype Services, Bengaluru.

11. Singh, Awani Kr. Handbook of Microbial Biofertilizers. Agrotech Press, Jaipur, India.

12. Singh, A.K. Organic Farming. New India Publishing Agency, New Delhi.

13. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services, Bengaluru.

14. Trivedi, P.C. Fungal Biopesticides and VAM applications. Pointer Publishers, Jaipur, India.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: System Simulation and Agro advisory
Course Code: AGMET-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. To impart the knowledge of Systems approach and crop models.

2. To get acquainted with different weather forecasting techniques and their usability analysis

3. To study about the preparation and dissemination of agro advisory bulletin

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Get the basic knowledge on system approaches of SPAC.

CO-2: Know about various crop models and crop responses to weather elements.

CO-3: Enhance skills in crop production under potential and resource limited condition.

CO-4: Familiarisation with the weather forecasting system and agroadvisory by using weather forecasting and simulation models.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction:** System approach for representing soil-plant-atmospheric continuum, system boundaries.	**CO-1**	5
UNIT 2	**Crop models, their simulation and validation:** Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams. Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis.	**CO-2**	15
UNIT 3	**Crop production under potential and resource limited condition:** 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.	**CO-3**	15
UNIT 4	**Weather forecasting:** Weather forecasting, types methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity; Crop- Weather Calendars. **Agroadvisory**: Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro- advisory and its effective dissemination.	**CO-4**	10

Practical:

S.No.	Practicals	Hours
1.	Preparation of crop weather calendars	3
2.	Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts.	3
3.	Working with statistical and simulation models for crop growth.	3
4.	Potential and achievable production; yield forecasting, insect and disease forecasting models.	3
5.	Simulation with limitations of water and nutrient management options.	3
6.	Sensitivity analysis of varying weather and crop management practices.	3
7.	Use of statistical approaches in data analysis.	3
8.	Use of statistical approaches in preparation of historical, past and present meteorological data for medium range weather forecast.	3
9.	Feedback from farmers about the agro-advisory.	6

Suggested readings

1. Introduction to Agrometeorology by H. S. Mavi.

2. Modelling physiology of crop development, growth and yield by Soltani A and Sinclair, T. R. CAB International, U. K.

3. Agricultural Meteorology by G.S.L.H.V. Prasado Rao.

4. Advances in Plant Atmospheric Interactions (Eds. Rao, V.U.M., Rao, A.V.M.S., Rao, G.G.S.N., Ramana Rao, B.V., Vijaya Kumar, P. and Venkateswarlu, B), Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad.

5. Text Book of Agricultural Meteorology by M.C. Varshneya and P.B. Pillai. ICAR.

6. Principles of Agricultural Meteorology by O. P. Bishnoi.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Hi-tech Horticulture
Course Code:

L	T	P	C
3	0	1	4

Course Objective:
The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: About advanced technologies developed for protected cultivation/hi-tech production.

CO-2: Know the micropropagation process and its components.

CO-3: Know the micro-irrigation system

CO-4: know the application of precision farming elements in horticultural crops.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction:** Introduction & importance of Hi-tech horticulture, Nursery management, and use of recent technologies for farm mechanization.	**CO-1**	8
UNIT 2	**Modern techniques:** Micropropagation of horticultural crops; Modern field preparation and planting methods; Techniques used for protected cultivation: advantages, controlled conditions, application method	**CO-2**	15
UNIT 3	**Micro irrigation systems:** Micro irrigation systems and its components; EC, pH-based fertilizer scheduling; Canopy management and high-density orcharding	**CO-3**	7
UNIT 4	**Precision farming:** Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate Applicator (VRA); Application of precision farming in horticultural crops (fruits, vegetables, and ornamental crops); Mechanized harvesting of horticultural produce.	**CO-4**	15

Practical:

S.No.	Practicals	Hours
1.	Types of playhouses.	3
2.	Types of shade net houses.	3
3.	Intercultural operations.	3
4.	Tools and equipment identification.	3
5.	Tools and equipment application.	3
6.	Micropropagation	3
7.	Nursery-portrays.	3
8.	Micro-irrigation.	2
9.	EC, pH-based fertilizer scheduling.	3
10.	Visit to hi-tech orchard/hi-tech nursery.	4

Suggested readings

1. Hi-tech Horticulture by T.A. More.

2. Greenhouse Operation and Management by Paul V. Nelson.

3. Hi-Tech Horticulture (Pb) by S. Prasad, Dharam Singh and R.L. Bharadwaj, Agrobios

4. Instant Horticulture by S.N. Gupta. Jain Brothers. 488p.

5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide by Tom Garden, Webb Eleanor.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Protected Cultivation
Course Code: HORT-402

L	T	P	C
3	0	1	4

Course Objective:
The course objective will be to make the students to:

To educate students on the scientific and commercial cultivation of important value-added products in protected cultivation.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Importance of protected cultivation and different types of protected structures and cladding materials.

CO-2: Greenhouse design, environment control irrigation.

CO-3: Substrate management and fertigation

CO-4: Cultivation practices of economically important horticultural crops suitable for greenhouse.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction:** Protected cultivation- importance and scope, status of protected cultivation in India and the World, Types of protected structures based on site and climate. Cladding material involved in greenhouse/poly house.	**CO-1**	12
UNIT 2	**Greenhouse design and management:** Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management.	**CO-2**	8
UNIT 3	**Substrate management:** Types of benches and containers, Irrigation and fertigation management. Propagation and production of quality planting material for horticultural crops.	**CO-3**	10
UNIT 4	**Greenhouse cultivation of horticulture crops**: Greenhouse cultivation of important horticultural crops- rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants, turmeric, ginger etc. Cultivation of economically important medicinal and aromatic plants. Off-season production of flowers and vegetables. Insect pest and disease management.	**CO-4**	15

Practical:

S.No.	Practicals	Hours
1.	Raising of seedlings and saplings under protected conditions.	5
2.	Use of pro-trays in quality planting material production.	5
3.	Bed preparation and planting of crop for production.	5
4.	Inter cultural operations.	5
5.	Soil EC and pH measurement.	5
6.	Regulation of irrigation and fertilizers through drip, fogging and misting.	5

Suggested readings

1. Jha, M.K., S.S. Paikra and M.R. Sahu. 2019. Protected Cultivation of Horticultural Crops. Edu-creation Publishing.

2. Kumar, B.A., R. Eggadi and V. Sindhu. 2022. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops. Jain Brothers.

3. Nelson, P.V. 2002. Greenhouse Operation and Management. Pearson Education Limited.

4. Prabhakar, I., B.L. Manjunatha and B.S. Swetha. 2020. Protected Cultivation of Horticulture Crops. Satish Serial Publishing House.

5. Sagar, M., G.J. Dinkar and T. Shaknar. 2021. Protected Cultivation and Smart Agriculture. New Delhi Publishers.

6. Singh, B., B. Singh, N. Sabir and M. Hasan, 2015. Advances in Protected Cultivation. NIPA.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Climate Resilient Agriculture
Course Code: AGRON-402

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

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:

At the end of the course, the student will be able to:

CO-1: Develop an understanding of climate change and its impact on agriculture

CO-2: Know the climate resilient agriculture to improve the crop productivity

CO-3: Get acquainted with the Climate-Resilient Agricultural Practices

CO-4: Develop basic understanding of crop protection and improvement strategies under changing climatic scenario

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Overview of agriculture under climate change**: Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc. Basics of adaption and mitigation in the agricultural sectors; analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio-economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.	**CO-1**	10
UNIT 2	**Climate resilient agriculture (CRA):** 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.	**CO-2**	10
UNIT 3	**Climate resilient agronomic practices**: 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	**CO-3**	20

	microbial biodiversity, biomass recycling; use of renewable sources of energy.		
UNIT 4	**Crop protection and improvement strategies under changing climatic scenario:** Climate resilient pest-disease management strategies. Breeding strategies for development of climate change resilient crops and varieties. Development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Acquaintance with meteorological instruments including AWS.	3
2.	Statistical techniques to study trend of climatic parameters.	3
3.	Analysis of extreme weather events using non-parametric tests.	3
4.	Building climate change scenarios under different futuristic emission of GHGs.	3
5.	Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars.	3
6.	Climate resilient technologies and manipulation of cropping patterns.	3
7.	Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories.	3
8.	Analysing carbon sequestration potential of different agro ecosystems.	3
9.	Designing climate smart village model considering the availability of resources.	3
10.	Awareness programme on climate change and climate resilient agriculture among farming community.	3

Suggested readings

1. *Brown, T. A. 2006. Genomes (3rd edn). Garland Science Pub, New York.*
2. *Gene Cloning and DNA Analysis. 2010. Retrieved from http://biolab.szu.edu.cn/otherweb/lzc/genetic%20engineering/courseware/b1.pdf*
3. *Green, M. R. and Sambrook, J. 2012. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.*
4. *Kumar, Pranav and Mina, Usha. 2015. Biotechnology: A Problem Approach. Pathfinder Publication.*
5. *Old, R. W., Primrose, S. B. and Twyman, R. M. 2001. Principles of Gene Manipulation and Genomics 7th Edition: Oxford: Blackwell Scientific Publications.*
6. *Ram, HariHar. 2019. Crop Breeding and Biotechnology. Kalyani Publications.*
7. *Rastogi, S.C. 2020. Biotechnology: Principles and Applications. Narosa.*
8. *Sander, J.D. and Joung, J.K. 2014. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.*
9. *Singh, K.H., Kumar, Ajay and Parmar, Nehanjali. 2019. Agricultural Biotechnology at a Glance, science technology.*
10. *Slater. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford, 400p.*

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Biotechnology of Crop Improvement
Course Code: PBT-401

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. To provide knowledge about the biotechnological tools of crop improvement, direct and indirect methods of gene transfer, introduce about gene editing in plants and to provide knowledge about marker assisted breeding and genomic selection.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: The basic concepts of plant tissue culture and its application.

CO-2: Gene transformation and silencing techniques.

CO-3: Genome editing tool

CO-4: Marker assisted selection and its application in crop improvement

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Plant tissue culture techniques and its applications:** 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. 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.	**CO-1**	10
UNIT 2	**Gene transformation methods:** 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).	**CO-2**	10
UNIT 3	**Gene silencing techniques and Genome editing tool- CRISPR-Cas9:** 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. Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into	**CO-3**	20

	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.		
UNIT 4	**Marker assisted selection and its application:** 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.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Agrobacterium-mediated transformation in Tobacco- preparation of construct.	3
2.	Construct transfer to binary vector.	3
3.	Binary vector transform to Agrobacterium.	3
4.	Explant preparation and Inoculation and Co-cultivation.	3
5.	Selection of putative transformants based on antibiotic.	3
6.	Validation of transformants using PCR.	3
7.	Genome editing- preparation of CRISPR/CAS construct.	3
8.	Genome edited construct direct transfer to plant.	3
9.	Planning of a MABB programme– selection of parents, crossing strategies.	3
10.	Marker analysis.	3

Suggested readings

1. Brown, T. A. 2006. Genomes (3rd edn). Garland Science Pub, New York.

2. Gene Cloning and DNA Analysis. 2010. Retrieved from http://biolab.szu.edu.cn/otherweb/lzc/genetic%20engineering/courseware/b1.pdf

3. Green, M. R. and Sambrook, J. 2012. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

4. Kumar, Pranav and Mina, Usha. 2015. Biotechnology: A Problem Approach. Pathfinder Publication.

5. Old, R. W., Primrose, S. B. and Twyman, R. M. 2001. Principles of Gene Manipulation and Genomics 7th Edition: Oxford: Blackwell Scientific Publications.

6. Ram, HariHar. 2019. Crop Breeding and Biotechnology. Kalyani Publications.

7. Rastogi, S.C. 2020. Biotechnology: Principles and Applications. Narosa.

8. Sander, J.D. and Joung, J.K. 2014. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.

9. Singh, K.H., Kumar, Ajay and Parmar, Nehanjali. 2019. Agricultural Biotechnology at a Glance, science technology.

10.Slater. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford, 400p.

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Geoinformatics and Remote Sensing, Precision Farming
Course Code: AENGG-402

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. To acquaint the knowledge on basics of remote sensing technique for precision farming applications.
2. To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Get acquainted with the principles and application of remote sensing in soil survey, crop stress and yield forecasting.

CO-2: Know about data sharing and its applications.

CO-3: know about the basics of probability and statistics.

CO-4: familiar with the basics of machine and deep learning systems.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Remote sensing:** Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in atmosphere; Interaction with matter; Application of remote sensing techniques land use soil surveys; crop stress and yield forecasting; Advantages and disadvantages of remote sensing; Remote sensing institutes in India; Basic Concepts about geoinformatics.	**CO-1**	10
UNIT 2	**Data sharing:** 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.	**CO-2**	10
UNIT 3	**Probability and Statistics:** Probability and Statistics: Bayes Theorem, correlation and Covariance, Continuous Random variables and probability distribution function, various forms of distributions, central limit theorem.	**CO-3**	20
UNIT 4	**Basics of Machine and Deep Learning:** 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.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Familiarization with different remote sensing equipments and data products.	2
2.	Interpretation of aerial photographs and satellite data for mapping of land resources	2
3.	Global positioning system (GPS).	4
4.	Basics of Geographic Information System (GIS).	4
5.	Georeferencing of toposheets.	4
6.	Digital soil mapping with different variables.	4
7.	Basics of multivariate data analytics.	4
8.	Principal component analysis and regression applications.	4
9.	Clustering methods and geostatistics are essential in agricultural studies.	2

Suggested readings

1. *Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor (s): RabinarayanSatpathy, Tanupriya Choudhury, SuneetaSatpathy and SachiNandan.*
2. *Machine Learning Approaches to Bioinformatics by Zheng Rong Yang.*
3. *Text Book of Remote Sensing and Geographical Information Systems by M. Anji Reddy.*
4. *Precision Agriculture Technologies for Food Security and Sustainability ByA El-Kader, M Sherine, M El-Basioni and M Basma.*
5. *Principles and Theory of Geoinformatics by P.K. Garg. Khanna Publishers. 296p*
6. *Advances in Geoinformatics Remote Sensing and GIS by Bhunia, GouriSankar, Uday Chatterjee and Gopal Krishna Panda. BIO GREEN*
7. *Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes by John Adamssen. EfalonAcies.*
8. *Remote Sensing and Image Interpretation, 6th edn (WSE) Paperback – 1 January 2011, Willey Student Edition.*
9. *Remote Sensing and Geographic Information by A.M. Chandra and S.K. Ghosh. Narosa.*

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Micro-propagation Techniques
Course Code: GPB-402

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. This course intends to provide a basic knowledge about tissue culture techniques.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Micropropagation techniques

CO-2: Identification and handling of equipment in Tissue culture

CO-3: Organogenesis

CO-4: Cryopreservation

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction to Micro propagation:** Introduction, History, Advantages and limitations.	**CO-1**	8
UNIT 2	**Types of cultures and Various stages of Micropropagation:** Types of cultures (seed, embryo, organ, callus, cell); Stages of micro propagation; Axillary bud proliferation (Shoot tip and meristem culture, bud culture)	**CO-2**	12
UNIT 3	**Organogenesis:** Organogenesis (callus and direct organ formation); Somatic embryogenesis; Cell suspension cultures; production of secondary metabolites; Somaclonal variation	**CO-3**	20
UNIT 4	**Cryopreservation:** Cryopreservation techniques and methods.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Identification and use of equipments in tissue culture Laboratory.	2
2.	Nutrition media composition.	2
3.	Sterilization techniques for media.	2
4.	Sterilization techniques for containers and small instruments.	2
5.	Sterilization techniques for explants.	2
6.	Preparation of stocks and working solution.	4

7.	Preparation of working medium.	4
8.	Culturing of explants.	4
9.	Seeds, shoot tip and single node.	2
10.	Callus induction.	2
11.	Induction of somatic embryos regeneration of whole plants from different explants.	2
12.	Hardening procedures.	2

Suggested readings

1. *Bhojwani, S. S. 1983. Plant Tissue Culture. Theory and Practice, Elsevier.*
2. *Christou, P. and Klee, H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.*
3. *Dixon, R. A. 2003. Plant Cell Culture. IRL Press.*
4. *George, E. F., Hall, M. A. and De Klerk, G. J. 2008. Plant Propagation by Tissue Culture. Agritech Publishing.*
5. *Herman, E. B. 2005-08. Media and Techniques for Growth, Regeneration and Storage. Agritech Publishing.*
6. *Pierik, R. L. M. 1997. In vitro Culture of Higher Plants. Kluwer.*
7. *Singh, B. D. 2007. Biotechnology: Expanding Horiozon. Kalyani Publishers.*

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Commercial Seed Production
Course Code: GPB-403

L	T	P	C
3	0	1	4

Course Objective:
The course objective will be to make the students to:

1. To provide the knowledge of basic principles of planting material production at commercial scale and seed quality evaluation.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: General Principles of Seed Production seed processing.

CO-2: General Principles of Seed Testing and seed certification.

CO-3: Seed Industry and Seed Marketing.

CO-4: Role of Biotechnology in Seed Seed Production.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**General Principles of Seed Production and Processing:** Raising the seed crop, Introduction, Procurement of a class of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops, Concept of apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops, Farmers participatory seed production. Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling.	**CO-1**	15
UNIT 2	**General Principles of Seed Testing and Seed infection:** Seed testing-Introduction, Procedure of Seed testing, components of seed quality testing genetic, physical, physiological and seed health testing, Seed sampling, Types of seed sampling, Requirements of sampling, Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed, Principles of seed Germination, types of germination, biochemical and genetic basis.	**CO-2**	10

	History, concept and objectives of seed certification; seed certification agency/organization and staff requirement Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including GM varieties, field and seed standards.		
UNIT 3	**Seed Industry and Seed Marketing:** Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labelling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and/ packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand, Role of WTO in seed marketing.	**CO-3**	15
UNIT 4	Biotechnology in Seed Technology History of plant tissue culture, Laboratory organization, Composition of nutrient medium, Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation, Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds, Components of nutrient media for synthetic seed development, Storage of synthetic seeds, Advantages and limitations of synthetic seed production.	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Planning of Seed Production, requirements for different classes of seeds in field crops – unit area and rate Operation and handling of mechanical drying equipment.	1
2.	Effect of drying temperature and duration on seed germination and storability seed processing equipment; seed treating equipment.	1
3.	Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines.	2
4.	Synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage.	2
5.	Hand emasculation and pollination in tomato.	2
6.	Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application.	2
7.	Visits to seed production plots etc.	2
8.	Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurships visit to nearby areas.	2
9.	Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed-	2

	borne fungi, bacteria and viruses.	
10.	Identification of storage fungi, control of seedborne diseases, seed treatment methods.	3
11.	Maintenance of aseptic conditions and sterilization techniques.	3
12.	Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction.	3
13.	Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction.	2
14.	Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro-propagation.	1
15.	Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops.	1
16.	Synthetic seed preparation.	1

Suggested readings

1. *Agarwal, R.L. 1997. Seed Technology. 2nd edn. Oxford & IBH.*
2. *McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall*
3. *Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.*
4. *Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani.*
5. *Justice, O.L. and Bass, L.N. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.*
6. *Tunwar, N.S. and Singh S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.*
7. *Chawla, H.S. 2008. Introduction to Plant Biotechnology. 2nd edn. Oxford &IBH publishing Co. Ltd. 113-B ShahpurJat, New Delhi-110049.*

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Principles and Practices of Organic Farming/ Conservation Agriculture
Course Code: AGRON-403

L	T	P	C
3	0	1	4

Course Objective:
The course objective will be to make the students to:

1. To teach students the principles of crop production under organic and conservation agriculture situation.

2. To impart practical knowledge of organic and conservation agriculture practices.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Know about concepts, importance and management aspects of organic farming.

CO-2: Get acquainted with certification, processing and marketing system of organic farming.

CO-3: Know initiatives taken by public and private sector for promotion of organic farming.

CO-4: Familiar with the basics and practices using in conservation agriculture and calculate doses of organic manures for recommendation.

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction to organic crop management:** Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming. Nutrient management in organic farming and their sources; Fundamentals of insect, pest, disease and weed management under organic mode of production.	**CO-1**	10
UNIT 2	**Certification and marketing of organic products:** Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products.	**CO-2**	10
UNIT 3	**Initiatives taken by public and private sector:** Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.	**CO-3**	10
UNIT 4	**Conservation agriculture and organic manures:** Conservation agriculture: definition, origin, principles, advantages, challenges. Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture vis a vis Climate Smart Agriculture. Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.	**CO-4**	15

Practical:

S.No.	Practicals	Hours
1.	Visit of organic farms to study the various components and their utilization.	3
2.	Preparation of enrich compost.	3
3.	Preparation of enrich vermicompost.	3
4.	Quality analysis of compost and vermicompost.	3
5.	Method of application of bio-fertilizers.	3
6.	Indigenous technology knowledge (ITK) for nutrient, insect-pest, disease and weed management.	3
7.	Studies in green manuring in-situ and green leaf manuring.	3
8.	Studies on different type of botanicals for insect-pest management.	2
9.	Weed management in organic farming.	2
10.	Cost of organic production system.	2
11.	Practices of conservation agriculture.	3

Suggested readings

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

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Food Science and Nutrition
Course Code: FSN-402

L	T	P	C
3	0	1	4

Course Objective:
The course objective will be to make the students to:

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

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Composition of food and fundamentals of nutrition

CO-2: Characteristics of nutrients and their metabolism

CO-3: Principles of food processing and preservation

CO-4: Evaluate the role of enzymes

Syllabus:

	Content	CO Mapping	Hours
UNIT 1	**Introduction of foods and human nutrition:** Introduction on fundamentals of foods and human nutrition; Basic food groups; Concept of balanced diets; Recommended Daily Allowances (RDA) for various age groups; Biochemical composition, energy and food value of various food grains, fruits and vegetables; Carbohydrates, proteins, fats as nutrients and their interactions.	**CO-1**	10
UNIT 2	**Characteristics of essential nutrients- sources and functions:** Physio-chemical, functional and nutritional characteristics of essential nutrients- sources and functions, Nutritional requirements, malnutrition, inborn errors of metabolism, deficiency diseases; Digestion, absorption, transport and metabolism of nutrients in human system; Protein quality evaluation.	**CO-2**	10
UNIT 3	**Food safety and quality standards:** Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinational factors and biochemistry of postharvest storage, losses during processing. Effect of cooking, processing and preservation on nutrients of different food products, biochemical aspects of food spoilage; Food fads, food safety and quality standards.	**CO-3**	20
UNIT 4	**Role of Enzymes in food industry:** Enzymes in food industry, food additives, nutritional quality of plant, animal, dairy, marine and fermented products	**CO-4**	5

Practical:

S.No.	Practicals	Hours
1.	Proximate analysis of foods.	3
2.	Calorific value of foods.	3
3.	Estimation of vitamins.	4
4.	Estimation of phenols and flavonoids.	4
5.	Estimation of carotenoids.	4
6.	Estimation of Phytates/ Oxalates.	4
7.	Estimation of Trypsin and Chymotrypsin inhibitor activities.	4
8.	Limiting amino acids in food stuff.	4

Suggested readings

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.*

Program: B.Sc. (Hons.) Agriculture
Semester: Seventh
Course: Post-Harvest Technology and Value Addition
Course Code: HORT-404

L	T	P	C
3	0	2	4

Course Objective:
The course objective will be to make the students to:

1. To educate about pre-harvest, harvest and post-harvest factors which affecting the postharvest 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.

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Importance of post-harvest technology in fruits and vegetables.

CO-2: Analyze respiration behaviour in fruits and vegetables.

CO-3: Preparation techniques of value-added products.

CO-4: Dehydration techniques of horticultural crops.

Syllabus:

	Content	**CO Mapping**	**Hours**
UNIT 1	**Introduction:** 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	**CO-1**	10
UNIT 2	**Respiration:** Respiration and factors affecting respiration rate; Maturity, harvesting and field handling; Storage (ZECC, cold storage, CA, MA and hypobaric).	**CO-2**	8
UNIT 3	**Value-addition:** Value addition concept; Principles and methods of preservation; Intermediate moisture food (jam, jelly, marmalade, preserve, candy) - concepts and standards; Fermented and non-fermented beverages. Tomato products - concepts and standards.	**CO-3**	20
UNIT 4	**Dehydration and canning techniques:** Drying /Dehydration of fruits and vegetables – concept and methods, osmotic drying. Canning – concepts and standards, packaging of products.	**CO-4**	7

Practical:

S.No.	Practicals	Hours
1.	Applications of different types of packings and containers for shelf-life extension	2
2.	Effect of temperature on shelf life and quality of produce	2
3.	Demonstration of chilling and freezing injury in vegetables and fruits	2
4.	Extraction and preservation of pulps and juices	2
5.	Preparation of Jam	2
6.	Preparation of Jelly	2
7.	Preparation of RTS	2
8.	Preparation of Nectar	2
9.	Preparation of Squash	2
10.	Preparation of Osmotically dried products	2
11.	Preparation of fruit bar candy	2
12.	Preparation of Tomato product	2
13.	Preparation of Canned products	2
14.	Quality evaluation of products- Physico-chemical and sensory	2
15.	Visit to processing unit/industry	2

Suggested readings

1. *Goel, A.K., R. Kumar and S.S. Mann. 2007. Postharvest Management and Value Addition. Daya Publishing House.*
2. *R. L. Bhardwaj, Sharma Y.K. and Latika Vyas. 2021. Postharvest Handling of Horticultural Crops, Jaya Publishing House, New Delhi.*
3. *John, P.J. 2008. A Handbook on Post Harvest Management of Fruits and Vegetables. Daya Publishing House.*
4. *Kureel, M.K., D.S. Mandloi, K.V. Singh and R. Lekhi. 2007. Postharvest Management and Value Addition of Fruits and Vegetables. Biotech.*
5. *Mitra, S. K. 1997. Postharvest Physiology and Storage of Tropical Fruits. CABI.*
6. *Qureshi, S.N., K. Javeed and A.K. Sinha. 2018. Post-Harvest Technology. Bioscientific Publishers.*
7. *S.K. Sharma and M.C. Nautiyal.1999. Post-harvest Technology of Horticultural Crops. NIPA.*
8. *Srivastava, R. P. and Kumar, S. 2007. Fruits and Vegetable Preservation: Principles and Practice. IBDC.*
9. *Sudheer, K.P. and V. Indira. 2007. Postharvest Technology of Horticultural Crops. NIPA.*

Semester VII

READY-421	Student READY	20

Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE, AIA & ELP)			
S. No.	**Activities**	**No. of weeks**	**Credit Hours**
1.	General orientation & On campus training by different faculties.	1	1
2.	Village Attachment Programme - Unit attachment in University/ College/ KVK/ Research Station Attachment	5	5
3.	Plant clinic/ Agro-Industrial Attachment	4	4
4.	Experiential Learning Programme (ELP)	9	9
5.	Project Report Preparation, Presentation and Evaluation	1	1
	Total weeks for RAWE, AIA & ELP	**20**	**20**

Component-I: RAWE (Village Attachment Training Programme)

S. No.	Activities	Duration
1.	Orientation and survey of village	1 week
2.	Agronomical interventions and Soil improvement interventions (Soil sampling and testing)	1 week
3.	Plant protection interventions and Animal production interventions	1 week
4.	Fruit and vegetable production interventions and Food processing and storage interventions	1 week
5.	Identification of specific problems, Extension and transfer of technology activities	1 week

Component–II: Agro- Industrial Attachment:

The students will be attached with the agro industries for a period of 4 weeks to get an experience of the industrial environment and working. Industries include Seed/Sapling production, Pesticides-insecticides, Post harvest processing-value addition, Agri-finance institutions, etc.

Activities and Tasks during Agro-Industrial Attachment Programme:

- Acquaintance with industry and staff.
- Study of structure, functioning, objective and mandates of the industry.
- Study of various processing units and hands-on trainings under supervision of industry staff.
- Ethics of industry.
- Employment generated by the industry.
- Contribution of the industry promoting environment.
- Learning business network including outlets of the industry.
- Skill development in all crucial tasks of the industry.
- Documentation of the activities and task performed by the students.
- Performance evaluation, appraisal and ranking of students.

Component-III: Experiential Learning Programme (ELP)

Under Experiential Learning Programme (ELP), student will opt one module from the following twelve modules

i. Mushroom Cultivation Technology
ii. Production Technology for Bioagents and Biofertilizer
iii. Soil, plant, water and seed Testing
iv. Poultry Production Technology
v. Commercial Horticulture
vi. Floriculture and Landscaping
vii. Food Processing
viii. Agriculture Waste Management
ix. Commercial Sericulture

ELP-	**Mushroom Cultivation Technology**	**9 (0+9)**
Construction cultivation room/structure and Disinfection; Compost preparation and pasteurization; Procurement of mother culture and spawn preparation; Procurement of casing soil and preparation for production; Mushroom seeding, Casing with soil and maintenance, Harvesting, processing, grading, packing, marketing and cost economics of mushroom culture.		

ELP-	Production Technology for Bioagents and Biofertilizer	9 (0+9)
Isolation and pure culture establishment of bio-fertilizers and bio-pesticides; Culture methods and substrates; Scale of methods for bio-fertilizers and bio-agents; Substrate preparation and mixing techniques; Quality analysis of bio-fertilizers and bio-pesticides.Testing the final product in small scale level. Storage, marketing and cost analysis of bio-fertilizers and bio-pesticides. # Course shall be shared with Soil Science		

ELP-	Soil, Plant and Water Testing	9 (0+9)
Collection and soil water and plant sample for analyses, soil profile study, bulk density, particle density, porosity, water holding capacity, soil texture, estimation of soil moisture by gravimetric and volumetric methods, lime requirement, soil pH, EC, organic carbon and available major and micronutrient in soil and plant sample, leaf area by leaf area meter, relative water content of leaf, specific leaf weight, chlorophyll content of leaf, irrigation water quality analysis, measurement of soil water potential, water flood measurement.		

ELP-	Poultry Production Technology	9 (0+9)
Important Indian and foreign breeds of poultry; Breeding management of Chick, Grower and Layer birds; Incubation and hatching, management of incubator during incubation; care and management of chicks — grown up birds, equipment, feeders, drinker systems, housing programs — Farm knout, house design, orientation of shed, cross ventilation, lighting systems — floor space requirements, brooder space, water space and feeding space at different age of broilers — random weighting of chicks, commonly used major feed in gradients identification — Feed manufacturing — preparation of feed for different age groups of broilers different methods of injection and procedure; structure of poultry eggs, selection and care of hatching egg; disease of poultry, vaccination schedule.		

ELP-	Commercial Horticulture	9 (0+9)
Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, plant certification, packaging and marketing, quality control; Nursery production of ornamentals: Production of plantlets, production of potted plants, management and maintenance, sale and marketing; Protected cultivation of vegetables and flowers: Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.		

ELP-	Floriculture and Landscaping	9 (0+9)
Preparation of project report, soil and water analysis, preparation of land and layout; Production and Management of commercial flowers; Harvesting and postharvest handling of produce; Marketing of produce, Cost Analysis, Institutional Management, Visit to Flower growing areas and Export House, Attachment with private landscape agencies; Planning and designing, site analysis, selection and use of plant material for landscaping; Formal and informal garden, features, styles, principles and elements of landscaping; Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues; Making of lawns, use of software in landscape; Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces; Dry flower Technology (identification of suitable species, drying, packaging and forwarding techniques).		

ELP-	Food Processing	9 (0+9)
Planning and execution of a market survey, preparation of processing schedule, preparation of project module based on market information, calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects, identification of sources for procurement of raw material, production and quality analysis of fruits and vegetables products at commercial scale, packaging, labeling, pricing and marketing of product.		

ELP-	Agriculture Waste Management	9 (0+9)
Analysis and design of systems for vermicomposting and compost; Collection, storage, treatment, transport and utilization of disposable organic water and west waters, operating system and laboratory evaluation of materials and processes, mass and energy balance for process systems, water and water analysis; Physical, chemical and biological basis for waste treatment and recycling; waste treatment systems, management of dead animals rendering plants, incineration, disposal pits; gaseous waste treatment. # Course shall be shared with Agronomy.		

ELP-	Commercial Beekeeping	9 (0+9)
Beneficial insect, scope of apiculture, honey bee colony, different bee hives and apiculture equipment, summer and winter management of colony, Honey extraction and bottling; Study of pests and disease of honey bees; Specifies of honey bees, Bee pasturage, Honey composition and value, bee crop and tissue.		

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Skill Enhancement Course – I (Floriculture and Landscaping)
Course Code: SEC – I01

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. Develop knowledge of plant identification, classification, morphology, varieties, families, and their cultural requirements in floriculture and landscaping.
2. Build practical skills in plant propagation, pest and disease identification, flower quality assessment, post-harvest handling, and protected cultivation techniques.
3. Enhance creative and technical abilities in designing and maintaining ornamental gardens, indoor plants, bonsai, bottle gardens, terrariums, and other landscaping features.

Course Outcomes:

At the end of the course, the student will be able to:

CO1 Identify and classify ornamental, flowering, indoor, and bonsai plants along with their morphological features, families, and suitable soil and climatic conditions.

CO2 Apply appropriate plant propagation techniques for floriculture and landscaping.

CO3 Demonstrate skills in pest and disease identification, post-harvest handling, quality assessment, storage, and packing of commercial flowers.

CO4 Design and create various garden styles, bottle gardens, terrariums, and layouts using both open-field and protected cultivation methods.

Course Description

Practical	CO Mapping
Unit 1: Floriculture Production technology of commercial flowers (rose, carnation, chrysanthemum, marigold, tuberose, gerbera, gladiolus, jasmines, tulip, anthurium, lilium and orchids). Harvesting and postharvest handling of commercial flowers. Marketing of flowers. Cost Analysis. Visit to flower growing areas and Export Houses. Flower arrangements and making of flower bouquets, garlands, button holes, wreath, veni, gazaras etc. Dry flower technology.	CO-1
Unit 2: Landscaping Principles and elements of landscaping. Planning and designing, site analysis, selection and use of plant material for landscaping (annuals, shrubs, trees, climbers, ferns, bulbous plants, cacti & succulents, palms and grasses). Styles and types of gardens. Garden features, Making of lawns. Bio-aesthetic planning, landscape plans of home gardens, landscaping of places of public importance (public parks, traffic circles, avenues, institutions, high ways, railway stations, dams etc.). Use of softwares in landscaping. Bonsai making. Visit to institutional, industrial and public gardens.	CO-2

Practical schedule:

S. No.	Practicals	Hours
1.	Identify different tools and instruments and its uses in Horticulture	4
2.	Identification of plants based on plant morphology, varieties and family	6
3.	Demonstrate different propagation methods.	6
4.	Identify different ornamental plants, flowering plants, indoor plants, bonsai plants and their pests and diseases.	6
5.	Knowledge on quality assessment, pulsing, conditioning, storage, packing of commercial flowers like loose flowers, long stem cut flowers, perennials, cut greens and annuals.	6
6.	Knowledge on history, styles, scope and importance of gardening	6
7.	Plan and execute survey for landscaping and various types of indoor gardening.	6
8.	Demonstrate different styles of bottle garden and terrarium.	6
9.	Knowledge on the protected cultivation of flowers.	6
10.	Visit to commercial nursery/ institute/park	8

Suggested Readings

1. Arora, J. S. 2010. Introductory Ornamental Horticulture. Kalyani Publisher.

2. Bose, T. K., Malti, R. G., Dhua, R. S. and Das, P. 2012. Floriculture and Landscaping (Vol. 1 &2, 2nd Rev. Edn.). Nayaprakash.

3. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR, New Delhi

4. Randhawa, G. S. and A. Mukhopadhyay. 2004. Floriculture in India. Allied Publishers.

5. Singh, A.K. and Anjana Sisodia. 2017. Textbook of Floriculture and Landscaping. NIPA.

Program: B.Sc. (Hons.) Agriculture
Semester: First
Course: Skill Enhancement Course - II(Horticulture Nursery Management)
Course Code: SEC - 102

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. Provide practical knowledge on types, layout, and infrastructure of nurseries, including growing media preparation and irrigation systems.
2. Develop skills in various plant propagation methods for fruit crops, vegetables, ornamentals, and medicinal plants.
3. Impart knowledge on nursery management practices including pest/disease control, seasonal planning, waste management, and landscaping basics.
4. Build entrepreneurial competence in nursery legislation, market linkages, value addition, cost economics, and preparation of bankable business plans.

Course Outcomes:

At the end of the course, the student will be able to:

CO1 Identify and design different nursery types, layouts, and infrastructure suited to various crops and environments.
CO2 Demonstrate appropriate propagation and transplanting techniques for horticultural and medicinal plants.
CO3 Implement nursery management practices including irrigation, fertigation, pest/disease/weed control, landscaping, and waste management.
CO4 Develop value-added nursery products, comply with legislation, and prepare cost-effective, bankable project proposals.

Course Description

Practical	CO Mapping
Unit 1: Introduction Importance and scope of nurseries. Nursery tools and equipments. Types of nurseries. Planning, site selection and layout of nursery. Components of a model nursery. Types and preparation of nursery beds. Planting and maintenance of mother blocks.	CO-1
Unit 2: Horticultural plant propagation Sexual and asexual methods of horticultural plant propagation with merits and demerits. Seed dormancy: types and methods to overcome dormancy. Use of rootstocks & scions in nursery. Growing media: preparation, sterilization, physical and chemical properties. Plant propagation structures. Nursery containers and raising nursery in pro-trays. Micropropagation of horticultural crops.	CO-2

Unit 3: Nursery management Nursery operations viz., seed treatment, fumigation, irrigation, nutrient management etc. Use of plant growth regulators, biofertilizers and bioagents in nursery. Insect-pest and disease management in nursery. Transplanting of nursery plants. Lifting, labeling and packing of nursery plants. Marketing of seedlings. Economics of nursery production. Nursery registration and record management. Nursery project preparation.	CO-3

Practical:

S. No.	Practicals	Hours
1.	Introduction to Horticulture Nursery Management	4
2.	Plant Propagation methods	4
3.	Nursery raising of vegetable crops	4
4.	Plant Nutrition and its management	4
5.	Nursery irrigation methods and fertigation	4
6.	Raising rootstocks and transplanting protocols	6
7.	Pest, disease, and weed management in nursery environments	4
8.	Seasonal planning and relay nursery production	6
9.	Landscaping basics: laying lawns, hedges, garden beds, and topiary designs	4
10.	Nursery Act, licensing, registration, and quality certification	4
11.	Plant Library Concepts and Operations	4
12.	Cost economics and preparation of bankable business plans	6
13.	Visit to commercial nurseries	6

Suggested Readings

1. Bose, T.K., D. Sanyal and M.L. Sandhu. 1998. Propagation of Horticultural Crops. Naya Prakash Publishers.

2. Chundawat, B.S. 2017. Plant Propagation and Nursery Management. Agrotech Publishing Academy.

3. Devies, F.D., R.L. Geneve, and S.B. Wilson. 2017. Hartmann & Kester's Plant Propagation: Principles and Practices. Pearson Publishers, London.

4. Krishnan P.R., R.K. Kalia, J.C. Tewari and M.M. Roy. 2014. Plant Nursery Management and Plant Nursery Management: Principles and Practices. CAZRI, Jodhpur.

5. Sharma, R.R. and H. Krishna. 2007. Textbook of Plant Propagation and Nursery Management. CBS Publishers & Distributors.

6. Singh, Jitendra. 2022. Basic Horticulture. Kalyani Publishers.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Mushroom Production Technology)
Course Code: SEC – 103

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

To develop analytical and entrepreneurial skills in students and turned them into mushroom entrepreneur.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1: acquaint about the status, scope and importance of mushrooms in the state of Rajasthan.

CO-2: produce spawn and mushrooms at large scale.

CO-3: know about value added products of mushroom and economics/ marketing of mushroom and its products.

Course Description :

Practical:	CO Mapping
Unit 1: Introduction to mushroom cultivation in India and Rajasthan Current status and scope of mushroom cultivation in India and Rajasthan. Important features of edible fungi. Nutritional and medicinal value of mushrooms. Collection of wild mushroom flora of Rajasthan.	CO-1
Unit 2: Spawn production technology Preparation of media. Tissue culture preparation. Sub-culturing for culture maintenance and its preservation. Spawn preparation techniques.	CO-2
Unit 3: Mushroom production technology Mushroom farm design and infrastructure required for the commercial unit. Raw material formulations for Button mushroom (Agaricus bisporus). Composting (long method and short method). Casing preparation. Cultivation techniques of: Dhingri mushroom (Pleurotus florida), Shiitake mushroom (Lentunus edodes), Milky mushroom (Calocybe indica), Paddy straw mushroom (Volvariella volvacea). Crop management practices. Mushroom diseases and their control.	CO-2
Unit 4: Value added products and marketing Preparation of value-added products from mushrooms. Economics of mushrooms. Marketing of mushrooms. Exposure visits to commercial farms.	CO-3

Practical schedule:

SI.NO.	Practical	Hours
1	Current status and scope of mushroom cultivation in India	4
2	Important features of edible fungi.	4
3	Nutritional and medicinal value of mushrooms	4
4	Collection of wild mushroom flora	2
5	Preparation of media.	4
6	Tissue culture preparation.	4
7	Sub-culturing for culture maintenance and its preservation.	4
8	Spawn preparation techniques.	4
9	Mushroom farm design and infrastructure required for the commercial unit.	2
10	Raw material formulations for Button mushroom (Agaricus bisporus).	2
11	Composting (long method and short method).	2
12	Cultivation technique of Dhingri mushroom (Pleurotus florida),	4
13	Cultivation technique of Paddy straw mushroom (Volvariella volvacea).	4
14	Mushroom diseases and their control.	4
15	Preparation of value-added products from mushrooms.	4
16	Marketing of mushrooms.	2
17	Exposure visits to commercial farms.	6

Suggested Readings:

1. Singh, M., Vijay, B., Kamal, S., Wakchaure, G.C. (2011). Mushrooms: cultivation, marketing and consumption. Directorate of Mushroom Research. ICAR-Chambaghat, Solan – 173213 (HP).

2. A textbook on mushroom cultivation: Theory and Practice, Aggarwal, A., Sharma, Y. P. and Jangra, E., Newrays Publishing House.

3. Mushroom Cultivation, Tripathi, D.P. (2005) , Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

4. Mushroom cultivation technology, Acharya, K., Roy, A. and Sarkar, J., Techno world, Kolkata.

5. Mushroom production and processing thechnology (2010), Pathak Yadav Gour, Agrobios (India). 6. Upadhyay, R.C., Singh, S.K., and Tewari, R.P. (2004). Mushroom spawn production and infrastructure requirements. Technical Bulletin, DMR, Solan.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Vermicompost Production Technology)
Course Code: SEC – 104

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. Develop analytical and entrepreneurial skills in students and turned them into mushroom entrepreneur.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1 Acquaint about the status, scope and importance of mushrooms in the state of Rajasthan.

CO-2:Produce spawn and mushrooms at large scale.

CO-3: Know about value added products of mushroom and economics/ marketing of mushroom and its products.

Course Description

Practical	: CO Mapping
Unit 1: Introduction to mushroom cultivation in India ,Current status and scope of mushroom cultivation in India . Important features of edible fungi. Nutritional and medicinal value of mushrooms. Collection of wild mushroom flora .	CO-1
Unit 2: Spawn production technology Preparation of media. Tissue culture preparation. Sub-culturing for culture maintenance and its preservation. Spawn preparation techniques.	CO-2
Unit 3: Mushroom production technology Mushroom farm design and infrastructure required for the commercial unit. Raw material formulations for Button mushroom (Agaricus bisporus). Composting (long method and short method). Casing preparation. Cultivation techniques of: Dhingri mushroom (Pleurotus florida), Shiitake mushroom (Lentunus edodes), Milky mushroom (Calocybe indica), Paddy straw mushroom (Volvariella volvacea). Crop management practices. Mushroom diseases and their control.	CO-2
Unit 4: Value added products and marketing Preparation of value-added products from mushrooms. Economics of mushrooms. Marketing of mushrooms. Exposure visits to commercial farms.	CO-3

Practical Schedule:

SI. No	Practical	Hours
1	Current status and scope of mushroom cultivation in India	2
2	Important features of edible fungi.	2
3	Nutritional and medicinal value of mushrooms	2
4	Preparation of media.	4
5	Tissue culture preparation.	4
6	Sub-culturing for culture maintenance and its preservation.	4
7	. Spawn preparation techniques.	2
8	Mushroom farm design and infrastructure required for the commercial unit.	2
9	Raw material formulations for Button mushroom (Agaricus bisporus).	2
10	Composting (long method and short method).	2
11	Casing preparation.	2
12	Cultivation technique of Dhingri mushroom (Pleurotus florida),	4
13	Cultivation technique of Shiitake mushroom (Lentunus edodes),	4
14	. Cultivation technique of Milky mushroom (Calocybe indica),	4
15	. Cultivation technique of Paddy straw mushroom (Volvariella volvacea).	4
16	. Crop management practices.	2
17	. Mushroom diseases and their control.	2
18	. Preparation of value-added products from mushrooms.	2
19	Economics of mushrooms.	2
20	Marketing of mushrooms.	2
21	Exposure visits to commercial farms.	6

Suggested Readings:

1. Singh, M., Vijay, B., Kamal, S., Wakchaure, G.C. (2011). Mushrooms: cultivation, marketing and consumption. Directorate of Mushroom Research. ICAR-Chambaghat, Solan – 173213 (HP).

2. A textbook on mushroom cultivation: Theory and Practice, Aggarwal, A., Sharma, Y. P. and Jangra, E., Newrays Publishing House.

3. Mushroom Cultivation, Tripathi, D.P. (2005) , Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

4. Mushroom cultivation technology, Acharya, K., Roy, A. and Sarkar, J., Techno world, Kolkata.

5. Mushroom production and processing thechnology (2010), Pathak Yadav Gour, Agrobios (India).

6. Upadhyay, R.C., Singh, S.K., and Tewari, R.P. (2004). Mushroom spawn production and infrastructure requirements. Technical Bulletin, DMR, Solan.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course - III(Food processing)
Course Code:SEC – 105

L	T	P	C
0	0	2	2

Course Objective:
This course intends to provide a basic knowledge different food product preparations.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1: know about the machines and equipments used in food processing and preparation.

CO-2: know about the different types of food products.

Course Description :

Practical:	CO Mapping
Unit 1: Introduction to food processing Familiarization of machine and equipment used in food processing, Preparation of ready to serve drink, preparation of nectar, squash, carbonated beverage, fruit-based whey beverage, whey-based tomato soup, sherbet.	CO1
Unit 2: Preparation different food products Preparation of medium and heavy tomato puree, tomato paste, tomato ketchup, Drying of onion slices by sun and oven drying, green leafy vegetable, Microwave drying of curry leaves, channa. Preparation of flavored milk, curd/yogurt, lassi, to perform conditioning of wheat, determination of gluten content in wheat flour, to perform milling of pearl millet, manufacture of dalia from cereal and legumes, preparation and evaluation of wheat-based cookies, cookies with variable formulations, unleavened flat breads, Preparation of spaghetti pasta, penne pasta, fusilli pasta, fettuccine/tagliatelle pasta, noodles, vermicelli, instant noodles.	CO2

Practical Schedule:

SI. No	Practical	Hours
1	Familiarization of machine and equipment used in food processing.	4
2	Preparation of ready to serve drink.	4
3	Preparation of squash.	4
4	Preparation of carbonated beverage.	4
5	Preparation of fruit-based whey beverage.	4
6	Preparation of whey-based tomato soup.	4
7	Preparation of sherbet.	2
8	Preparation of medium and heavy tomato puree.	2
9	Preparation of tomato paste.	4
10	Preparation of tomato ketchup.	4
11	Drying of onion slices by sun and oven drying.	4
12	Drying of green leafy vegetable.	2
13	Microwave drying of curry leaves.	2
14	Preparation of flavored milk.	4
15	Preparation of curd/yogurt.	2
16	Preparation of lassi.	2
17	Manufacture of dalia from cereal and legumes.	4
18	Preparation and evaluation of wheat-based cookies.	4
19	Preparation of cookies with variable formulations.	2
20	Preparation of spaghetti pasta.	4
21	Preparation of vermicelli.	4

Suggested Readings:

1. Gibney, M. J., Lanham-New, S.A., Cassidy, A. and Voster, H.H. (Ed.). 2009. Introduction to Human Nutrition. Wiley-Blackwell.

2. Rekhi, Tejmeet and Yadav, Heena. 2014. Fundamentals of Food and Nutrition. Elite Publishing House. 257p.

3. Dharmesh Kumar. Food Science and Nutrition. Random.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Soil Plant and Water testing)
Course Code:SEC – 106

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

To impart the knowledge of Soil, Plant and Water testing to the students.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1: will have the skill of testing the different parameters of soil, plant and water.

CO-2:.The student will be specialist in rapid test of plant tissue.

Course Description :

Practical:	CO Mapping
Unit 1: Unit-1: Standardization of solutions and reagents Standardization of solutions and reagents, collection and preparation of soil samples, estimation of pH, EC, organic carbon, NPKS, micronutrients, CEC and exchangeable sodium in soil. Determination of EC and pH of saturation extract/ paste.	CO1
Unit 2: Plant sampling and Estimation of ions Estimation of cations (Ca++, Mg++ and Na +) and anions (CO3- - and HCO3 “) in saturation extract. Plant sampling and sample preparation for analysis, digestion of plant material and estimation of N, P, K in plant.	CO1
Unit 3: Rapid plant tissue test Rapid plant tissue test for N, P and K Determination of EC, pH, cations (Ca++ +Mg++, Na+, K+) and anions (CO3- -, HCO3-, Cl-) in irrigation water and computation of SAR and RSC.	CO2

Practical Schedule:

SI. No	Practical	Hours
1	Standardization of solutions and reagents	2
2	Collection and preparation of soil samples	2
3	Estimation of pH	2
4	Estimation of EC	2
5	Determination of organic carbon in soil	2
6	Determination of available nitrogen in soil	2
7	Determination of available phosphorus in soil	2
8	Determination of available potassium in soil	2
9	Determination of available sulphur in soil	2
10	Determination of available DTPA extractable Zn ,Fe, Mn and Cu in soil	4
11	Determination of CEC in soil	2
12	Determination of exchangeable sodium in soil	2
13	Determination of EC and pH of saturation extract of soil	2
14	Determination of Ca++ and Mg++ in saturation extract of soil	2
15	Determination Na+ in saturation extract of soil	2
16	Determination of CO3 and HCO3 in saturation extract of sol	2
17	Plant sampling and sample preparation for analysis	4
18	Digestion of plant material	2
19	Estimation of nitrogen content in plant	2
20	Estimation of phosphorus content in plant	2
21	Estimation of potassium content in plant	2
22	Rapid plant tissue test for N, P and K	2
23	Determination of pH and EC in irrigation water	2
24	Determination of Ca++ and Mg++ in irrigation water	2
25	Determination of Na+ and K+ in irrigation water	2
26	Determination of Cl - in irrigation water	2
27	Determination of CO3 and HCO3 in irrigation water	2
28	Computation of SAR and RSC in irrigation water	2

Suggested Readings:

1. S.L. Chopra and J.S. Kanwar, 1999. Analytical Agriculture Chemistry,Kalyani Publisher, Lucknow.

2. M.L. Jackson 1973. Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.

3. H.L.S. Tandon 1990. Methods of Analysis of soil, plant, water and fertilizers, FDCO, New Delhi.

4. P. K. Gupta 1999-2000. Soil, Plant, Water and Fertilizer Analysis, AgroBotanica, Bikaner.

5. Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Hand book No. 60, Washington, DC USA.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Production Technology of Bioagents)
Course Code: SEC – 107

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

To equip the students with the practical knowledge of mass production techniques, application methods, and quality control practices for the effective use of bioagents in the management of diseases and other stresses.

Course Outcomes (CO) :

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

CO-1: Acquaint the comprehensive knowledge of bioagents.

CO-2: Gain practical skills in mass production, handling and effective use of bioagents.

CO-3: Understand the challenges and limitations in their production and application for sustainable agriculture.

CO-4: Know the application, storage, shelf life, and marketing strategies for bioagents.

Course Description:

Practical:	CO Mapping
Unit 1: Introduction of Bioagents: History, importance, scope and potential of bioagents; Definitions, concepts and classification of bioagents.	CO1
Unit 2: Production technology of bioagents: Mass production technology of bioagents viz., Trichoderma, Bacillus, Pseudomonas and entomopathogenic pathogens viz., Metarhyzium, Beauveria, Bt and nematodes.	CO2
Unit 3: Methods of application: Methods of application of bioagents for seeds, seedlings, tubers, sets, soil, etc.	CO3
Unit 4 Storage and Marketing Bioagents, shelf life, quality control, and marketing. Factors influencing the efficiency of bioagents. Impediments and limitations in production and use of bioagents.	CO4

Practical Schedule:

SI NO.	Practical	Hours
1	Laboratory equipment for biocontrol laboratory.	2
2	Isolation and purification of Trichoderma viride from soil.	2
3	Isolation and purification of Pseudomonas fluorescence, Bacillus thuringiensis and Bacillus subtilis from soil.	2
4	Isolation and purification of Metarhyzium and Beauveria from soil and infected insects by these entomopathogenic fungi.	4
5	Mass production technology of Trichoderma viride.	4
6	Mass production technology of Pseudomonas fluorescence.	4
7	Mass production technology of Bacillus subtilis.	4
8	Mass production technology of Metarhyzium and Beauveria.	4
9	Mass production technology of Bacillus thuringiensis.	4
10	Visit to bioagents laboratory in the nearby area.	6
11	Field visit for identification of bioagents.	6
12	Methods of evaluation of biopesticides.	4
13	Methods of application of bioagents for seeds, seedlings, tubers, sets, soil etc.	2
14	Shelf life and Quality control of bioagents.	4
15	Factors influencing the efficiency of bioagents.	4
16	Impediments and limitations in the production and use of bioagents.	4

Suggested Readings:

1. Campbell, R. 1989. Biological Control of Microbial Plant Pathogens. Cambridge Univ. Press, Cambridge.

2. Cook, R. J. and Baker, K. F. 1983. The Nature and Practice of Biological Control of Plant Pathogens. APS, St Paul, Minnesota.

3. Dhaliwal, G. S. and Koul, O. 2007. Biopesticides and Pest Management. Kalyani Publ., New Delhi. 4. Mukerji, K. G., Tewari, J. P., Arora, D. K. and Saxena, G. 1992. Recent Developments in Biocontrol of Plant Diseases. Aditya Books, New Delhi.

5. Mukherjee, N. and Ghosh, T. 1998. Agricultural Microbiology. Kalyani Publishers, New Delhi.

6. Rangaswami, G. and Bagyaraj, D. J. 1993. Agricultural Microbiology. Prentice Hall of India Pvt. Limited, New Delhi.

7. Srivastava, K. P. 2004. A Text Book of Entomology. Vol. I, Kalyani Publishers, New Delhi.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Post-harvest Processing Technology)
Course Code:SEC – 108

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. To educate about processing techniques of fruits and vegetables.

2. To educate about quality control measures, HACCP, FSSAI and FPO license.

Course Outcomes (CO) :

After the completion of this course the student will be able to-

CO-1: Prepare processed products of fruits and vegetables.

CO-2: Obtain FPO license and establish processing unit.

Course Description:

Practical:	CO Mapping
Unit 1: Processing and value-addition Machinery and equipments used in processing. Preservatives and food additives. Value addition and preservation techniques of fruits and vegetables. Intermediate moisture foods (jam, jelly, marmalade, preserve, candy), Fermented and non-fermented beverages. Drying/dehydration of fruits and vegetables, Osmotic drying. Tomato products; Chutneys, Pickles, Canning. Utilization of fruit and vegetable processing waste.	CO1
Unit 2: HACCP and quality control FSSAI, HACCP and quality control. Physio-chemical and sensory analysis of processed products. Packaging, labelling and storage of processed products. Layout and establishment of processing unit. FPO license.	CO2

Practical Schedule:

SI NO.	Practical	Hours
1	Study of machinery and equipments used in processing of fruits and vegetables.	2
2	Study of food preservatives.	2
3	Study of food additives, food colours and food flavours.	2
4	Study of pasteurization and sterilization techniques.	2

5	Blanching and pre-treatments of fruits and vegetables.	2
6	Extraction and preservation of pulp and juices.	2
7	Preparation of Jam.	2
8	Preparation of Jelly.	2
9	Preparation of Marmalade.	2
10	Preparation of RTS.	2
11	Preparation of Nectar.	2
12	Preparation of Squash/Syrup.	2
13	Preparation of Carbonated beverages.	2
14	Drying/dehydration of fruits and vegetables.	2
15	Preparation of Osmotically dried products.	2
16	Preparation of Fruit bar/leather.	2
17	Preparation of Fruit candy.	2
18	Preparation of Fruit preserve.	2
19	Preparation of Tomato puree/paste/soup.	2
20	Preparation of Tomato sauce/ketchup.	2
21	Preparation of Chutneys.	2
22	Preparation of Pickles.	2
23	Preparation of Canned products.	2
24	Utilization of processing waste.	2
25	FSSAI, HACCP and quality control	2
26	Quality evaluation of processed products- Sensory and Physico chemical analysis.	2
27	Different types of food packages and containers.	2
28	Labelling and storage of processed products.	2
29	Visit to processing unit/industry.	4

Suggested Readings

: 1. Goel, A.K., R. Kumar and S.S. Mann. 2007. Postharvest Management and Value Addition. Daya Publishing House.

2. Kureel, M.K., D.S. Mandloi, K.V. Singh and R. Lekhi. 2007. Postharvest Management and Value Addition of Fruits and Vegetables. Biotech.

3. Rajarathnam, S. and R.S. Ramteke. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. NIPA.

4. Ranganna, S. 2017. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd Edn.). Tata McGraw Hill Publishing Company. 5. Srivastava, R.P. and Kumar,

S. 2007. Fruits and Vegetable Preservation: Principles and Practice. IBDC. 6. Sudheer, K.P. and V. Indira. 2007. Postharvest Technology of Horticultural Crops. NIPA.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Organic Production Technology)
Course Code: SEC – 109

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. To teach students the principles of crop production under organic situation.

2. To impart practical knowledge of organic agriculture practices.

Course Outcomes (CO) :

CO-1 Students will be able to explain the principles, methods, and inputs involved in organic crop production, including organic seed production, nutrient management, and soil fertility enhancement.

CO-2 Students will be able to demonstrate practical skills in organic farming practices such as composting, vermicomposting, biofertilizer application, organic pest and disease management, and integrated farming systems.

Course Description:

Practical:	CO Mapping
Unit 1: Organic production requirement, Crop management in organic farming, organic seed production, organic manures, composting, vermi composting, Green manuring, biofertilizers, organic liquid fertilizers	CO-1
Unit 2: organic management protection for controlling insects, disease and weeds, organic certification, processing and marketing, Quality standards; Important herbs, shrubs and trees their identification, uses and characteristics; habitat management is rainfed and integrated farm, integrated farming system.	CO-2

Practical schedule:

SI.NO.	Practical	Hours
1	Organic production requirement.	2
2	Crop management in organic farming.	2
3	Organic seed production.	2
4	Organic manures.	2
5	Composting.	3
6	Vermi composting.	3
7	Green manuring.	2
8	Biofertilizers.	2

9	Organic liquid fertilizers.	2
10	Organic management protection for controlling insects, disease and weeds.	2
11	Organic certification, processing and marketing.	2
12	Quality standards.	2
13	Important herbs, shrubs and trees their identification uses and characteristics.	3
14	Habitat management is rainfed and integrated farm	2
15	Integrated farming system.	2

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Poultry Production Technology)
Course Code: SEC – 110

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. Introductory knowledge of poultry farming.

2. Breed and breeding management.

3. Nutrition and health management of poultry birds.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1: Importance of poultry industry in national economy.

CO-2:.Breed and their breeding management.

CO-3:.Care and management practices of poultry

CO-4: Nutrition practices of poultry.

CO-5: Health management of poultry.

Course Description :

Practical:	CO Mapping
Unit 1: Unit-1: Introduction of poultry husbandry Importance of poultry industry including backyard poultry farming in national economy. Improved strains for backyard poultry farming in Rajasthan. Housing principles, layout, space requirements for chick, grower and layer.	CO-1
Unit 2: Poultry breed and breeding management Reproduction in poultry and their improvement & conservation.Important Indian breeds of poultry. Important Exotic breeds of poultry. Incubation & Care and management during Hatching of fertile eggs.	CO-2
Unit 3: Care and Management of poultry Brooding of layer chicks (0 to 08 weeks). Brooding of broiler chicks (0 to 08 weeks). Management of grower and Layer.	CO-3
Unit 4: Poultry Nutritional practices Feed formulation for chicks, grower and layer. Feed supplements & Feed additives and feed ingredients for ration. Digestion & feeding of poultry.	CO-4
Unit-5: Poultry health Practices Introduction of important diseases of poultry and their control. Prevention measurement of disease management of poultry. Project formulation.	CO-5

Practical schedule:

SI.NO.	Practical	Hours
1	Importance of poultry industry including backyard poultry farming in national economy.	4
2	Improved strains for backyard poultry farming	4
3	Housing principles, layout ,space requirements for chick, grower and layer.	4
4	Reproduction in poultry and their improvement and conservation.	4
5	Important Indian breeds of poultry.	2
6	Important Exotic breeds of poultry.	2
7	Incubation & Care and management during Hatching of fertile eggs.	4
8	Brooding of layer chicks (0 to 8 weeks).	4
9	Brooding of broiler chicks (0 to 8 weeks).	4
10	Management of grower and Layer.	4
11	Feed formulation for chicks, grower and layer.	4
12	Feed supplements & Feed additives and feed ingredients for ration.	4
13	Digestion & Feeding of poultry.	4
14	Introduction of important diseases of poultry and their control.	4
15	Prevention measurement of disease management of poultry.	4
16	Project formulation.	4

Suggested Readings:

1. Banerjee, G. C. 2011. A Text Book of Animal Husbandry. VIII ed. Oxford and IBH Publications. New Delhi.

2. Choudhary, J. L. and Gupta L. 2016. A Text Book of Animal Husbandry. Somani Publication

3. Singh, R. A. 1996. Poultry Production. 3rd ed. Kalyani Publications. New Delhi.

4. Thomas, C. K., Sastry, N. S. R. and Singh, R. A. 1982. Farm Animal Management and Poultry Production. Vikas Publications. New Delhi.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Seed Production and Testing Technology)
Course Code: SEC – 111

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

To develop analytical and entrepreneurial skills in students and turned them into quality seed producer.

Course Outcomes (CO) :

After the completion of this course, the student will be able to -

CO-1: Acquaint about the basic concepts of seed production and certification.

CO-2:Produce seeds/hybrid seeds at large scale.

CO-3:Know about seed processing and seed testing.

Course Description :

Practical:	CO Mapping
Unit 1: Basic concept of seed production and certification Techniques of seed production in self- and cross-pollinated crops, Maintenance and Requirements for different classes of seeds in field crops, Concept and objectives of seed certification.	O1
Unit 2: Seed production technology Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, field inspection.	CO2
Unit 3: Hybrid seed production Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of hybrid seed production, field inspection, exposure visits to commercial seed production farms.	CO2
Unit 4: Seed Testing Seed sampling methods, physical purity test, moisture determination, germination test, seed and seedling vigour test, seed viability test, genetic purity test: grow out test, seed health testing using blotter method seed health testing agar plate method.	CO3
Unit 5: Seed Processing seed drying and storage structure in quality seed management, screening techniques during seed processing viz., grading and packaging, exposure visits to seed processing units.	CO3

Practical schedule:

SI.NO.	Practical	Hours
1	Techniques of seed production in self- and cross-pollinated crops.	4
2	Maintenance and Requirements for different classes of seeds in field crops.	4
3	Concept and objectives of seed certification.	2
4	Seed sampling methods.	4
5	Physical purity test.	4
6	Moisture determination.	4
7	Germination test	4
8	Seed and seedling vigour test.	4
9	Seed viability test.	4
10	Genetic purity test: Grow out test.	4
11	Seed drying and storage structure in quality seed management	4
12	. Exposure visits to commercial seed production farms.	6
13	. Exposure visits to seed processing units	6
14	Exposure visits to seed testing laboratory	6

Suggested Readings:

1. Agarwal, R.L. 1997. Seed Technology. 2nd edn. Oxford & IBH.

2. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall

3. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.

4. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani.

5. Justice, O.L. and Bass, L.N. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd. 6. Tunwar, N.S. and Singh S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Agriculture Waste Management)
Course Code:SEC – 112

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. To impart knowledge on various aspects of biowastes and agricultural wastes for managing as organic amendments in agricultural production system.

2. To develop skills on various methods of conversion of decomposable wastes into organic manures.

Course Outcomes (CO) :

After the completion of this course the student will be able to learn-

CO-1: Use of organic waste in production of manures.

CO-2: aware about biogas production technology.

Course Description :

Practical:	CO Mapping
Unit 1: Organic waste and its use Introduction to agricultural waste management, type of wastes, and sources of agriculture waste. Visit of different agriculture waste management units, Collection, transport, sorting, treatment, storage and utilization of Agriculture Wastes, Preparation of Organic Manures from agriculture Wastes, Production of compost by aerobic and anaerobic methods from agriculture waste, Enriched compost production from agriculture waste, Production of Vermicompost from agriculture wastes, Production of enrich vermicompost from agriculture waste.	CO-1
Unit 2: Biogas Production Technology Biogas Production from Agriculture waste and utilization of slurry, Production of enriched biogas slurry, Collection and preparation agricultural waste sample for analysis, Quality analysis (N, P, and K) of manure, compost, vermicompost and biogas slurry. Collection and preparation agricultural waste sample for analysis. Quality analysis (N, P, and K) of manure, compost, vermicompost and biogas slurry. Recommended doses and application of manure, compost, vermicompost and biogas slurry for major crops and others.	CO-2

Practical schedule:

SI.NO.	Practical	Hours
1	Introduction to agricultural waste management, type of wastes, and sources of agriculture waste.	4
2	Visit of different agriculture waste management units.	6
3	Collection, transport, sorting, treatment, storage and utilization of Agricultural wastes.	4
4	Preparation of Organic Manures from agriculture Wastes	4
5	Production of compost by aerobic and anaerobic methods from agriculture wastes.	4
6	Enriched compost production from agriculture wastes.	4
7	Production of Vermicompost from agriculture wastes.	6
8	Production of enrich vermicompost from agriculture waste.	6
9	Biogas Production from Agriculture waste and utilization of slurry.	4
10	Production of enriched biogas slurry.	4
11	Collection and preparation agricultural waste sample for analysis.	4
12	Quality analysis (N, P, and K) of manure, compost, vermicompost and biogas slurry.	4
13	Recommended doses and application of manure, compost, vermicompost and biogas slurry for major crops and others.	6

Suggested Readings:

1. Bhatnagar, R.K. and Palta, R.K. (2002). Vermiculture and vermicomposting. Kalyani Publishers, Ludhiana.

2. Clive A. Edwards, Norman Q. Arancon, and Rhonda L. Sherman (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management". CRC Press.

3. M. Devender Reddy, Mandapati Roja, Ch. Deepthi (2019). Agricultural Waste Management. Kalyani Publishers, Delhi.

4. Thelma Bosso (2016). Agricultural Waste Management. Callisto Publishers,U.K. 5. Vir Singh, Poonam Gusain, Meenakshi Arya (2018). Agro Waste Management, SSDN Publishers.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Goat Farming)
Course Code:SEC – 113

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

1. To acquaint students about importance of goat farming.
2. Important species of livestock provide employment and supplementary income.
3. Principles of Housing, Feeding, and breeding management of goats.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1: Importance of goat husbandry in national economy.

CO-2: Breed and their breeding management.

CO-3: Care and management practices of goats.

CO-4: Nutrition practices of goats.

CO-5: Health management of goats.

Course Description :

Practical:	CO Mapping
Unit 1: Introduction of goats husbandry Importance of goats farming in State and National economy. Housing principles, layout ,space requirements for kids, yearling and doe's. Milk and its therapeutic use, milking, avoidance of goaty odour in milk.	CO-1
Unit 2: Goat breed and breeding management Important Indian breeds of goats. Important Exotic breeds of goats. Breeding management to improve the reproductive efficiency.	CO-2
Unit 3: Care and Management of goats Goat farming under different system of management. Care and management of different classes of goat. Selection of breeding animals.	CO-3
Unit 4: Nutritional practices Feed and fodder resources for small ruminants. Principles and system of feeding in different categories of goat. Pasture utilization and improvement.	CO-4
Unit 5: Health Practices Introduction of important diseases of goat and their control. Prevention & control measures including vaccination and deworming and spraying. Transportation of small ruminants.	CO-5

Practical schedule:

SI.NO.	Practical	Hours
1	Importance of goats farming in State and National economy.	4
2	Housing principles, layout ,space requirements for kids, yearling and doe's.	4
3	Milk and its therapeutic use, milking, avoidance of goaty odour in milk.	4
4	Important Indian breeds of goats.	2
5	Important Exotic breeds of goats.	4
6	Goat farming under different system of management.	4
7	Care and management of different classes of goat.	4
8	Selection of breeding animals.	4
9	Feed and fodder resources for small ruminants.	4
10	Principles and system of feeding in different categories of goat.	4
11	Pasture utilization and improvement.	4
12	Introduction of important diseases of goat and their control.	4
13	Prevention & control measures including vaccination and deworming and spraying.	4
14	Transportation of small ruminants.	2
15	Breeding management to improve the reproductive efficiency.	4
16	Project formulation.	4

Suggested Readings:

1. Banerjee, G. C. 2011. A Text Book of Animal Husbandry. VIII ed. Oxford and IBH Publications. New Delhi.

2. Choudhary, J. L. and Gupta L. 2016. A Text Book of Animal Husbandry. Somani Publication.

Program: B.Sc. (Hons.) Agriculture
Semester:
Course: Skill Enhancement Course – III (Beneficial Insect Farming)
Course Code: SEC – 114

L	T	P	C
0	0	2	2

Course Objective:
The course objective will be to make the students to:

This course intends to provide a basic knowledge about beneficial Insect and their management.

Course Outcomes (CO) :

After the completion of this course, the student will be able to –

CO-1: Rear and management beehives for bee products.

CO-2: Cultivate mulberry and rear the silkworm for silk production.

CO-3: Inoculate lac insect and commercial production of lac.

CO-4: Mass produce natural enemies and identify various other beneficial insects.

Course Description

Practical:	CO Mapping
Unit 1: Introduction and Apiculture Importance and scope of beneficial insects, types of beneficial insects. Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication.	CO-1
Unit 2: Sericulture Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing techniques of silkworm and Pest and diseases of silkworm.	CO-2
Unit 3: Lac culture Species of lac insect, host plant identification. Lac cultivation and lac production – seed lac, button lac, shellac, lac-products. Natural enemies of lac and their managemment	CO-3
Unit 4: Seed Testing: Seed sampling methods, physical purity test, moisture determination, germination test, seed and seedling vigour test, seed viability test, genetic purity test: grow out test, seed health testing using blotter method seed health testing agar plate method.	CO-4
Unit 5: Other beneficial insects Identification of major parasitoids and predators commonly being used in biological control; Insect orders bearing predators and parasitoids used in pest management; Identification and techniques for mass multiplication of natural enemies. Important species of pollinator, weed killers and scavengers with their importance. Entomophagy, and medicinal uses of insects. Insects of forensic importance and insects in waste management.	CO-5

Practical schedule:

SI.NO.	Practical	Hours
1	Importance and scope of beneficial insects, types of beneficial insects. Honey bee species, castes of bees.	6
2	Beekeeping appliances and seasonal management, bee enemies and disease.	4
3	Bee pasturage, bee foraging and communication.	4
4	Types of silkworm, voltinism and biology of silkworm.	4
5	Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves.	6
6	Rearing techniques of silkworm and Pest and diseases of silkworm.	6
7	Species of lac insect, host plant identification.	4
8	Lac cultivation and lac production – seed lac, button lac, shellac, lac- products. Natural enemies of lac and their management.	4
9	Identification of major parasitoids and predators commonly being used in biological control	4
10	Insect orders bearing predators and parasitoids used in pest management.	4
11	Identification and techniques for mass multiplication of natural enemies.	4
12	Important species of pollinator, weed killers and scavengers with their importance.	4
13	Entomophagy, and medicinal uses of insects. Insects of forensic importance and insects in waste management.	6

Suggested Readings:

1 Abrol, D. P. 2013. Beekeeping: A Comprehensive Guide to Bee and Beekeeping. Scientific Publishers, Jodhpur.

2. Aruga, H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi.

3. Atwal, A. S. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.

4. De Bach, P. 1974. Biological control by Natural enemies. Cambridge University Press.

5. Dhaliwal, G. S. and Arora, R. 2001. Integrated Pest Management: Concepts and approaches. Kalyani Publ., New Delhi.

6. Dhaliwal, G. S. and Koul, O. 2007. Biopesticides and Pest Management. Kalyani Publ., New Delhi. 7. Gautam, R. D. 2008. Biological Pest Suppression. Westville Publising House, New Delhi.

8 Srivastava, K. P. 2004. A Text Book of Entomology. Vol. I, Kalyani Publishers, New Delhi.