Guidelines on

IMPLEMENTATION OF THE RECOMMENDATION

OF

VI DEANS' COMMITTEE REPORT OF ICAR

from

I SEMESTER 2025-26

with

THE START OF CLASS

from

September 1, 2025

B. Sc. (Hons.) Agriculture

Faculty of Agriculture
SRK UNIVERSITY, BHOPAL (M. P.)

ACADEMIC PROGRAMME

Semester wise Course and Credits Allocation

S. No.	Type of Course	Subjects	Course Title	Course Code	Credit Hours	Total credit hours
First Year						
I Semester						
1	NG	Foundation Course	Induction-cum-foundation course (Deeksharambh)		1 WEEK NON GRADIAL	21 (11+10)
2	SEC	Horticulture	Horticulture Nursery management	SEC HORT-111	2(0+2)	
3	SEC	Entomology	Production technology of Bioagents	SEC ENTO-111	2(0+2)	
4	AEC	Extension Education	Communication skills	AEC EXTN-111	2 (1+1)	
5	MDC	Agronomy	Farming based livelihood system	MDC AGRO-111	3 (2+1)	
6	CC	Extension Education	Rural Sociology and Educational Psychology	EXTN-111	2 (2+0)	
7	CC	Agronomy	Fundamentals of Agronomy	AGRO-111	3 (2+1)	
8	CC	Soil Science	Fundamentals of Soil Science	SSAC-111	3 (2+1)	
9	CC	Horticulture	Fundamentals of Horticulture	HORT-111	3 (2+1)	
10	AEC	Students' Welfare	NCC/NSS * (NUE)	SW-111	1 (0+1)	
11	NG	Agricultural Statistics	Introductory Matematics/Basic biology** NEED BASED	MATH-111 BOT-111	1(1+0)	
Minimum Required (do not include Non Gradial Courses)						
* Student have to take 2 Skill Enhancement Course during semester 1st						

II Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	**SEC**	**Horticulture**	**Floriculture and Landscaping**	**SEC HORT-122**	**2 (0+2)**	**21 (10+11)**
2	**SEC**	**Genetics and Plant Breeding**	**Seed Production and Testing Technology**	**SEC GPB-121**	**2 (0+2)**	
3	**AEC**	**Extension Education**	**Personality Development**	**AEC EXTN-122**	**2 (1+1)**	
4	**VAC**	**Agricultural Meteorology**	**Environmental Studies and Disaster Management**	**VAC AG MET-121**	**3 (2+1)**	
5	**CC**	**Soil Science**	**Soil Fertility Management**	**SSAC-122**	**3 (2+1)**	
6	**CC**	**Entomology**	**Fundamentals of Entomology**	**ENTO-122**	**3 (2+1)**	
7	**CC**	**Animal Husbandry**	**Livestock and Poultry Management**	**AHDS-121**	**2 (1+1)**	
8	**CC**	**Plant Pathology**	**Fundamentals of Plant Pathology**	**PATH-121**	**3 (2+1)**	
9	**AEC**	**Students' Welfare**	**NCC-II/NSS-II * (NUE)**	SW-122	**1 (0+1)**	
10	OC	**Online Course**	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						
* Student have to take 2 Skill Enhancement Course during semester 2nd						

Second Year						
III Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	**SEC**	**Entomology**	**Biofertilizer and Biopesticide production**	**SEC ENTO-232**	**2 (0+2)**	
2	**MDC**	**Agricultural Economics**	**Entrepreneurship Development and Business Communication**	**MDC ECON-231**	**3 (2+1)**	**21 (9+12)**
3	**AEC**	**Students' Welfare**	**Physical Education, First Aid and Yoga Practices**	**SW-233**	**2 (0+2)**	
4	**CC**	**Genetics and Plant Breeding**	**Principles of Genetics**	**GPB-231**	**3 (2+1)**	
5	**CC**	**Agronomy**	**Crop Production Technology - I (Kharif crops)**	**AGRO-232**	**3 (1+2)**	
6	**CC**	**Horticulture**	**Production Technology of Fruit and Plantation Crops**	**HORT-232**	**2 (1+1)**	
7	**CC**	**Extension Education**	**Fundamentals of Extension Education**	**EXTN-232**	**2 (1+1)**	
8	**CC**	**Nematology**	**Fundamentals of Nematology**	**NEMA-231**	**2 (1+1)**	
9	**CC**	**Agronomy**	**Principles and Practices of Natural Farming**	**AGRO-233**	**2 (1+1)**	
10	OC	**Online Course**	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						
* Student have to take 1 Skill Enhancement Course during 3RD semester						

IV Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	**SEC**	**Agronomy**	**Organic Production Technology**	**SEC AGRO-241**	**2 (0+2)**	**21(11+10)**
2	**VAC**	**Agricultural Statistics**	**Agri Informatics**	**VAC STAT-241**	**3 (2+1)**	
3	**CC**	**Horticulture**	**Production Technology of Vegetables and Spices**	**HORT-243**	**2 (1+1)**	
4	**CC**	**Agricultural Economics**	**Principles of Agricultural Economics and Farm Management**	**ECON-241**	**2 (2+0)**	
5	**CC**	**Agronomy**	**Crop Production Technology - II (Rabi crops)**	**AGRO-244**	**3 (1+2)**	
6	**CC**	**Agricultural Engineering**	**Farm Machinery and power**	**ENGG-241**	**2 (1+1)**	
7	**CC**	**Agronomy**	**Water Management**	**AGRO-245**	**2 (1+1)**	
8	**CC**	**Soil Science**	**Problematic Soils and their management**	**SSAC-243**	**2 (1+1)**	
9	**CC**	**Genetics and Plant Breeding**	**Basics of Plant Breeding**	**GPB-242**	**3 (2+1)**	
10	OC	Online Course	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						
*Student have to take 1 Skill Enhancement Course during 4TH semester						

Third Year						
V Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	**MDC**	**Agricultural Economics**	**Agricultural Marketing and Trade**	**MDC ECON-352**	**3 (2+1)**	**22(13+9)**
2	**CC**	**Agricultural Meteorology**	**Introduction to Agro-meteorology**	**AG MET-351**	**2 (1+1)**	
3	**CC**	**Crop Physiology**	**Fundamentals of Crop Physiology**	**BOT-352**	**3 (2+1)**	
4	**CC**	**Entomology**	**Pest Management in Crops and Stored Grains**	**ENTO-353**	**3 (2+1)**	
5	**CC**	**Plant Pathology**	**Diseases of Field and Horticultural Crops and their Management**	**PATH-352**	**3 (2+1)**	
6	**CC**	**Genetics and Plant Breedin g**	**Crop Improvement (*Kharif* Crops) - I**	**GPB-353**	**2 (1+1)**	
7	**CC**	**Agronomy**	**Weed Management**	**AGRO-356**	**2 (1+1)**	
8	**CC**	**Horticulture**	**Ornamental Crops, MAPs and Landscaping**	**HORT-354**	**2 (1+1)**	
9	**CC**	**Agronomy**	**Introductory Agro forestry**	**AGRO-357**	**2 (1+1)**	
10	**NG**	**Students' Welfare**	**Study Tour (10-14 days)**	**SW**	2 (0+2) Non-Gradial	
11	OC	Online Course	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						

VI Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	**CC**	**Agricultural Biotechnology**	**Fundamentals of Agricultural Biotechnology**	**BIOTECH-361**	**3 (2+1)**	**21(12+9)**
2	**CC**	**Agricultural Statistics**	**Basic and Applied Agricultural Statistics**	**STAT-361**	**3 (2+1)**	
3	**CC**	**Genetics and Plant Breedin g**	**Crop Improvement (*Rabi* Crops) - II**	**GPB-364**	**2 (1+1)**	
4	**CC**	**Agricultural Engineering**	**Renewable Energy in Agriculture and Allied Sector**	**ENGG-362**	**2 (1+1)**	
5	**CC**	**Agronomy**	**Dryland Agriculture/ Rainfed Agriculture and Watershed Management**	**AGRO-368**	**2 (1+1)**	
6	**CC**	**Plant Pathology**	**Agricultural Microbiology and Phyto-remediation**	**PATH-363**	**2 (1+1)**	
7	**CC**	**Agricultural Economics**	**Agricultural Finance & Cooperation**	**ECON-362**	**2 (1+1)**	
8	**CC**	**Biochemistry**	**Essentials of Plant Biochemistry**	**BIOCHEM-361**	**3 (2+1)**	
9	**CC**	**Genetics and Plant Breedin g**	**Fundamentals of Seed Science & Technology**	**GPB-365**	**2 (1+1)**	
10	OC	Online Course	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						

Fourth Year						
VII Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	ECC	Agribusiness Management	Agri-Business Management	ELE ABM-471	4 (3+1)	**20 (15+5)**
2	ECC	Agribusiness Management	Agricultural Journalism	ELE ABM-472	4 (3+1)	
3	ECC	Agronomy	Principles and Practices of Organic Farming and Conservation Agriculture	ELE AGRO-471	4 (3+1)	
4	ECC	Agricultural Meteorology	System Simulation and Agroadvisory	ELE AG MET-471	4 (3+1)	
5	ECC	Agricultural Meteorology	Climate Resilient Agriculture	ELE AG MET-472	4 (3+1)	
6	ECC	Horticulture	Landscaping	ELE HORT-471	4 (3+1)	
7	ECC	Horticulture	Hi-tech Horticulture	ELE HORT-472	4 (3+1)	
8	ECC	Horticulture	Protected Cultivation	ELE HORT-473	4 (3+1)	
9	ECC	Horticulture	Post Harvest Technology and Value Addition	ELE HORT-474	4 (3+1)	
10	ECC	Soil Science	Management of Natural Resources	ELE SSAC-471	4 (3+1)	
11	ECC	Soil Science	Bioformulation and Nanoformulation	ELE SSAC-472	4 (3+1)	
12	ECC	Entomology, Pathology & Soil Science	Agrochemicals	ELE EPSS-471	4 (3+1)	
13	ECC	Microbiology	Biopesticides and Biofertilizers	ELE MIBO-471	4 (3+1)	
14	ECC	Genetics and Plant Breeding	Commercial Plant Breeding	ELE GPB-471	4 (3+1)	
15	ECC	Genetics and Plant Breeding	Commercial Seed Production	ELE GPB-472	4 (3+1)	

16	ECC	Agricultural Biotechnology	Food Safety and Standards	ELE BIOTECH-471	4 (3+1)
17	ECC	Agricultural Biotechnology	Biotechnology of Crop Improvement	ELE BIOTECH-472	4 (3+1)
18	ECC	Agricultural Biotechnology	Micro-propagation Technologies	ELE BIOTECH-473	4 (3+1)
19	ECC	Agricultural Engineering	Geoinformatics and Remote Sensing, Precision Farming	ELE ENGG-471	4 (3+1)
20	ECC	Food Nutrition and Dietetics	Food Science and Nutrition	ELE FSN-471	4 (3+1)
21	OC	Online Course	Online course (Compulsory minimum 10 credits during whole degree program)		
Minimum Required (do not include Online Courses)					
Note: The students will have the freedom to choose Any 5 elective course among above mentioned courses.					

VIII Semester						
S. No.	**Type of Course**	**Subjects**	**Course Title**	**Course Code**	**Credit Hours**	**Total credit hours**
1	Student READY	Multi Disciplinary Course	For B.Sc. (Hons.)Agriculture Degree Student READY: RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship	RAWE481 / ELP481, ELP482	20 (0+20)	**20 (0+20)**
2	OC	Online Course	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						

DETAILED SYLLABI

First Year

I Semester

1.

Course Code: SW

Course Title: *Deeksharambh* (Induction cum Foundation Course) Non-gradial

Credit Hours: 2 (0+2)

Objectives:

1. Help for cultural integration of students from different backgrounds,
2. Know about the operational framework of academic process in the University/College/Institute
3. Instilling life and social skills
4. Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
5. Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.
6. Identify strength and weakness of the students in different core areas of the discipline.

The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:

1. Discussions on operational framework of academic process in the University, as well as interactions with academic and research managers of the University
2. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
3. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other‘s life experiences
4. iv. Activities to enhance cultural Integration of students from different backgrounds.
5. Field visits to related fields/ establishments
6. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills

2.

Course Code: SEC HORT-111

Course Title: Skill Enhancement Course-I (Horticulture Nursery Management)
Credit Hours: 2 (0+2)

Objective:

1. To provide students with a comprehensive understanding of nursery establishment, layout and management practices.
2. To develop skills in propagation techniques and the production of quality planting material.
3. To educate students on pest and disease management and the economic aspects of nursery development.

Practical:

Unit I

Introduction, Seedling supply chain; Nursery – Definition, its role, importance and types of nursery; Guidelines for nursery raising, Components of a good nursery, Layout of model nursery, nursery inputs and its management; Preparation of nursery beds, Media for propagation of plants in nursery beds and sowing of seeds, Identification and use of different types of tools and implements of nursery.

Unit II

Plant propagation structures, Preparation of plant material for potting and repotting, assessment of quality seedlings; Bureau of Indian Standards (**BIS-2008)** related to nursery; Quality propagules production; Good practices of fruit collection, seed extraction and storage of healthy seeds. Seed dormancy: Definition, various classification of seed dormancy, Seed treatments and different methods of breaking seed dormancy: stratification, scarification, types and use of plant growth regulators.

Unit III

Sexual and asexual plant propagation; Cuttings, Grafting, budding, air-layering, Micropropagation-explant preparation, media preparation, culturing–meristem tip culture, axillary bud culture, micro-grafting. Visit to commercial tissue culture laboratories and accredited nurseries. Hardening off plants in nursery; Soil solarization; Protection of nursery plants against adverse climatic conditions. Protected structures. Common possible errors in nursery activities; Rooting media. Identification and raising of rootstocks for different fruit plants.

Unit IV

Nursery technology for some important tree species; Nursery diseases and their management; Nursery pests and their management; Watering, weeding and nutrient management in nursery; Types and use of PGR, Preparation and application of plant growth regulator solutions for seed germination and vegetative propagation of different crops. Lifting and packing of nursery plants. Digging, labelling and packing of field grown nursery plants. Familiarisation with propagation structures mist chamber, greenhouse, glasshouse, polyhouse and net house; and their maintenance.

Unit V

Project formulation for small and high-tech nurseries. Nursery Accreditation. Planning and scheduling nursery activities, maintenance of nursery records; Examples of successful model nurseries; Economics of nursery development; Record management; Online nursery information and sales systems; Live plant library at nursery: An awareness concept. Pinching, disbudding,

staking in vegetables, flowers and merdicinals. Visit to local nurseries and florist centers. Marketing requirements and strategies for sale of important crops.

Suggested readings:

1. ICAR 2019. Handbook of Horticulture 2nd edition ICAR Vol 1 and 2. New Delhi.
1. D avies F T Geneve R L and Wilson S B 2018. Hartmann and Kester‘s Plant Propagation Principles and Practices 9th edn. Pearson. USA.
2. Chadha, K.L. (ICAR) 2002, 2001. Hand book of Horticulture. ICAR, New Delhi.
3. Chundawat, B.S. 1990. Arid fruit culture. Oxford and IBH, New Delhi.
4. Guy W. Adriance and Feed R. Brison. Propagation of Horticultural Plants. Axis Books (India).
5. Hartman, H. T and Kester, D.E.1976.Plant Propagation Principles and practices. Prentice hall of India Pvt. Ltd., Bombay.
6. Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. and Robert L. Geneve. Plant Propagation- Principles and Practices (7th Edition). PHI Learning Private Limited, New Delhi-110001
7. S. Rajan and B. L. Markose (series editor Prof. K.V. Peter). Propagation of Horticultural Crops- Horticulture Science Series vol.6. New India Publishing Agency, Pitam Pura, New Delhi-110088.
8. Sarma, R.R.2002. Propagation of Horticultural Crops. Kalyani Publishers, (Principles and practices) New Delhi.
9. T.K. Bose, S.K. Mitra, M.K. Sadhu, P. Das and D. Sanyal. Propagation of Tropical & Subtropical Horticultural Crops, Volume 1(3rd Revised edition). Naya Udyog, 206, Bidhan Sarani, Kolkata 700006.

3.

Course Code: SEC ENTO-111

Course Title: Skill Enhancement Course-II (Production technology of Bioagents)

Credit Hours: 2 (0+2)

OBJECTIVE

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.

Practical:

Unit 1: Introduction of Bioagents: History, importance, scope and potential of bioagents; Definitions, concepts and classification of bioagents.

Unit 2: Production technology of bioagents: Mass production technology of bioagents *viz., Trichoderma, Bacillus, Pseudomonas* and entomopathogenic pathogens *viz., Metarhyzium, Beauveria, Bt* and nematodes.

Unit 3: Methods of application: Methods of application of bioagents for seeds, seedlings, tubers, sets, soil, etc.

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.

4.

Course Code: **AEC EXTN-111**

Course Title: Communication Skills

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process.

Unit II

Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Unit III

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.

Unit IV

Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbal; phrases and clauses; Case: subjective case, possessive case; objective case.

Unit V

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.

Practical

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

Suggested readings:

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

5.

Course Code: **MDC AGRO-111**

Course Title: Farming based Livelihood Systems

Credit Hours: 3 (2+1)

Objectives:

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

Theory

UNIT-I

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework.

UNIT-II

Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry etc.).

UNIT-III

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 integration of various enterprises of farming for livelihood.

UNIT-IV

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 the farming.

UNIT-V

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.

Practical

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

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.

6.

Course Code: EXTN-111

Course Title: Rural Sociology and Educational Psychology

Credit Hours: 2 (2+0)

Objectives:

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

Theory

Unit I

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.

Unit II

Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation and role of social groups in Agricultural Extension. Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification- characteristics and- differences between class and caste system.

Unit III

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.

Unit IV

Social Control: Meaning, definition, need of social control and means of social control. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change. Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension,

Unit V

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.

Suggested readings:

1. 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.

7.

Course Code: AGRO-111

Course Title: Fundamentals of Agronomy

Credit Hours: 3 (2 +1)

Objectives:

1. To impart the basic and fundamental knowledge of Agronomy

Theory

UNIT I

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.

UNIT II

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. Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients.

UNIT III

Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /un combined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production.

UNIT IV

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. Water management: Water resources of the world, India and the state; Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.

UNIT V

Weeds: Definition, Importance and basics of classification of weeds and their control. Agro climatic 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.

Practical

1 A visit to Instructional Crop farm and study on field crops,
2 Identification of crops, seeds, fertilizers, pesticides,
3 Crops and cropping systems in different Agro-climatic zones of the state,
4 Study of some preparatory tillage implements,
5 Study of inter tillage implements, Practice of ploughing / puddling,
6 Study and practice of inter cultivation in field crops,
7 Numerical exercises on calculation of seed, plant population and fertilizer requirement,
8 Study of yield contributing characters and yield estimation of crops,

9 Identification of weeds in different crops,
10 Seed germination and viability test of seed,
11 Practice on time and method of application of manures and fertilizers.

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.

8.

Course Code: SSAC-111

Course Title: Fundamentals of Soil Science

Credit Hours: 3 (2+1)

Objectives:

1. To impart knowledge on soil genesis, basic soil properties with respect to plant growth

Theory

Unit I

Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering.

Unit II

Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity).

Unit III

Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils.

Unit IV

Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature.

Unit V

Soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

Practical

1. Study of general properties of minerals,
2. Study of minerals-silicate and non-silicate minerals,
3. Study of rocks-igneous, sedimentary and metamorphic rocks;
4. Study of a soil profile, collection and processing of soil for analysis,
5. Study of soil texture-feel method, mechanical analysis,
6. Determination particle density and soil porosity,
7. Determination of soil colour,
8. Study of soil structureand aggregate analysis,
9. Determination of soil moisture,
10. Determination of soil moisture constants- field capacity; water holding capacity.
11. Study of infiltration rate of soil,
12. Determination of pH and Electrical conductivity of soil.

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.

9.

Course Code: HORT-111

Course Title: Fundamentals of Horticulture

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

Horticulture: Its different branches, importance and scope.

Unit II

Horticulture and botanical classification, soil and climate for horticultural crops.

Unit III

Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.

Unit IV

Principles of orchard establishment, principles and methods of training and pruning of fruit crops.

Unit V

Juvenility and flower bud differentiation, 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.

Practical

1. Identification and nomenclature of fruit
2. Layout of an orchard
3. pit making and system of planting
4. Nursery raising techniques of fruit crops
5. Understanding of plant propagation structures
6. Propagation through seeds and plant parts
7. Propagation techniques for horticultural crops
8. Container, potting mixture, potting and repotting
9. Training and pruning methods on fruit crops
10. Preparation of fertilizer mixture and application
11. Layout of different irrigation systems
12. Maturity studies, harvesting, grading, packaging and storage.
13. Preparation and application of PGR.

Suggested readings:

1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N. Kumar
3. Handbook of Horticulture by ICAR

10.

Course Code: SW-111

Course Title: National Cadet Corps-I (NCC-I) / National Service Scheme-I (NSS-I)

Credit Hours: 1 (0+1)

National Cadet Corps-I (NCC-I)

As per government guidelines, for getting B and C certificate in NCC, minimum years of requirement is 2 and 3 years along with 1-2 annual camps

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

Suggested readings:

1. NCC : Handbook of NCC Cadets for ―A‖, ―B‖ and ―C‖ Certificate Examination by RPH Editorial Board
2. A Concise Handbook of NCC Cadets for A, B and C Certificate by RPH Editorial Board
3. Cadet Hand Book (Army Wing) by Major R.C. Mishra
4. Cadet Hand Book (Army Wing) by Directorate General, NCC, Ministry of Defence, R.K. Puram, New Delhi

National Service Scheme-I (NSS-I)

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

All the activities related to the National Service Scheme are distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV; each having one credit load.

The entire four courses should be offered continuously for two years. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year and one special camp for duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and

practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

Introduction and Basic Components of NSS

- Orientation: history, objectives, principles, symbol, badge; regular programs under NSS
- Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers‘ awareness about health.
- NSS program activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.
- Community mobilization: Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration.
- Indian history and culture, role of youth in nation building, conflict resolution and peacebuilding. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism.
- Citizenship, constitution, and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other communitybased organizations) and society.

Suggested readings:

1. NSS volunteer diary – by NSS unit Rani Durgawati Vishwa Vidyalaya, Jabalpur
2. Guideline of NSS - Empanelled Training Institute,Barkatullah University, NSS Bhopal
3. Social thought- by Ravindra Nath Mukerji, Publisher- Vivek Prakashan Delhi
4. Communication and Extension Management- by Dr. Jitendra Chouhan , Publisher- Kushal publications & distribution Varanasi
5. Extension Communication and Management- by G.L.Ray, Publisher- Kalyni publishers, New Delhi
6. Indian philosophy - by Basantlal, Publisher- Motilal Barsidas, New Delhi
7. Text book of Entrepreneurship and Rural development - by Sagar Mandal & G.L.Ray Publisher- Kalyni publishers, New Delhi
8. Extension Education and Rural development - by Santh Govind, G. Tamilselvi & J. Meenambi gai, Publisher- Agrobios (India)
9. Awaking India- Swami Vivekananda- by Ramkrishan Mission, New Delhi, Publisher- Mayur printers & publishers, New Delhi

11.

Course Code: MATH-111

Course Title: Introductory Mathematics (Non Gradial)

Credit Hours: 1 (1+0)

Objectives:

1. To Understand basic mathematical concepts
2. Developing Problem-Solving Skills in students
3. Enhancing Computational Proficiency

Theory

UNIT I

Algebra: Progressions- Arithmetic, Geometric and Harmonic Progressions. 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.

UNIT II

Differential Calculus: Definition- Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions.

UNIT III

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 $y = f(x1, x2)$.

UNIT IV

Integral Calculus: Integration -Definite and Indefinite Integrals-Methods- Integration by substitution, Integration by parts. Area under simple well-known curves.

UNIT V

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

Suggested readings:

1. Agricultural Mathematics by R. Singh; Alok Kansal, Meerut Aman publication house.
2. A Text Book of Matrices by Shanti Narayan, S. Chand publication.
3. Calculus by Gilbert strang, Wellesley Cambridge Press.
4. Mathematics for Agriculture by Betty C. Rogers, 2nd Editions.

II Semester

1.

Course Code: SEC HORT-122

Course Title: Skill Enhancement Course-IV (Floriculture and Landscaping)

Credit Hours: 2 (0+2)

Objectives:

1. To learn about production technology, propagation, and cultural practices and packaging and marketing of various flower crops
2. To learn generating the planting material and their practical use in different landscaping projects

Practical

Unit I

Scope, importance and export potential of floriculture, environment factors influencing plant growth and flower production in cut flowers and cut greens. Production technology including varieties, propagation, soil, nutrition, disease and pests of important cut flowers.

Unit II

Post harvest handling, grading and packing of cut flowers, pot and bedding plants. Flower seed production. Cost of production of commercially important flowers. Principles of art and landscaping. Preparation of landscape plans for homes, farm complexes, small parks and institutions. Development and maintenance of rock, water and terrace gardens. Bonsai and dish gardens, project formulation and evaluation.

Unit III

Preparation of plans and laying out of gardens. Identification of planting material and commercial varieties of flowers. Seed collection, germination tests and storage. Harvesting and handling of cut flowers. Judging of flowers and pot plants. Visit to local nurseries and florist centers.

Unit IV

Identification and use of garden tools and equipment. Study of growth characters, identification and classification of ornamental trees, shrubs, climbers, ground covers, indoor plants, shade loving plants, their analysis and use in landscape composition. Making and maintenance of edge, hedge and topiary. Establishment and maintenance of a lawn. Bonsai making. Formal and informal gardens.

Unit V

Planning, designing and establishment of garden features. Landscape design process: Landscape drafting tools. Dimensioning, graphic symbols and notations. Site analysis and landscape designing of residential, public buildings and religious places. Landscape planning of roads and roundabouts. Visit to community parks and Institutional gardens.

Suggested readings:

1. Arora, J.S. 2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th edn, pp. 230.
2. Randhawa, G. S. and Mukhopadhyay, A. 2001. Floriculture in India. Allied Publishers. pp 660.

2.

Course Code: SEC GPB-121

Course Title: Skill Enhancement Course-V (Seed Production and Testing Technology)

Credit Hours: 2 (0+2)

Objective : To develop analytical and entrepreneurial skills in students and turned them into quality seed producer.

Practical:

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. Visit to seed certification agency. CO-1

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. CO-2

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.

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-3

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.

3.

Course Code: AEC EXTN-122

Course Title: Personality Development

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour.

Unit III

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.

Unit IV

Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values.

Unit V

Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Practical

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

Suggested readings:

1. Andrews, Sudhir. 1988. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGrawHill.
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.

4.

Course Code: VAC AG MET-122

Course Title: Environmental Studies and Disaster Management

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Ecosystems: Concept of an ecosystem- Structure and function of an ecosystem- Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity. Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. Light pollution.

Unit III

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.

Unit IV

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 V

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 f ire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Practical

1. Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain.
2. Energy: Biogas production from organic wastes.

3. Visit to wind mill / hydro power / solar power generation units.
4. Biodiversity assessment in farming system.
5. Floral and faunal diversity assessment in polluted and un polluted system.
6. Visit to local polluted site - Urban/Rural/ Industrial/Agricultural to study of common plants, insects and birds.
7. Environmental sampling and preservation.
8. Water quality analysis: pH, EC and TDS.
9. Estimation of Acidity, Alkalinity.
10. Estimation of water hardness.
11. Estimation of DO and BOD in water samples.
12. Estimation of COD in water samples.
13. Enumeration of E. coli in water sample.
14. Assessment of Suspended Particulate Matter (SPM).
15. Study of simple ecosystem
16. Visit to pond/river/hills
17. Visit to areas affected by natural disaster.

Suggested Readings:

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 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:
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.

5.

Course Code: SSAC-121

Course Title: Soil Fertility Management

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of macro and micronutrients.

Unit II

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. Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches.

Unit III

Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Custom ised fertilisers, water soluble fertilizers nano fertilizers.

Unit IV

Soil amendments, Fertilizer Storage, Fertilizer Control Order. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Unit V

STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes).

Practical

1. Introduction of analytical instruments and their principles, calibration and applications of Coloremetry and flame photometry.
2. Estimation of alkaline hydrolysable N in soils.
3. Estimation of soil extractable P in soils.
4. Estimation of exchangeable K in soils.
5. Estimation of exchangeable Ca and Mg in soils.
6. Estimation of soil extractable S in soils.
7. Estimation of DTPA extractable Zn in soils.
8. Estimation of N in plants.
9. Estimation of P in plants.
10. Estimation of K in plants.
11. Estimation of S in plants.

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.

6.

Course Code: ENTO-122

Course Title: Fundamentals of Entomology

Credit Hours: 3(2+1)

Objectives:

1. To know the history of entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class 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

Theory

Unit I

History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insects with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting.

Unit II

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.

Unit III

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests. Systematics: Taxonomy– importance, history and development and binomial nomenclature.

Unit IV

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.

Unit V

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.

Practical

1. Methods of collection and preservation of insects including immature stages
2. External features of Grasshopper/Blister beetle
3. Types of insect antennae, mouthparts and legs
4. Wing venation, types of wings and wing coupling apparatus.

5. Types of insect larvae and pupae
6. Dissection of digestive system in insects (Grasshopper)
7. Study of characters of orders. Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance.
8. Insecticides and their formulations
9. Pesticide appliances and their maintenance. .
10. Sampling techniques for estimation of insect population and damage.

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

7.

Course Code: AHDS-121

Course Title: Livestock and Poultry Management

Credit Hours: 2(1+1)

Objectives:

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

Theory

Unit I

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry.

Unit II

Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers.

Unit III

Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry. Digestion in livestock and poultry.

Unit IV

Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives.

Unit V

Feeding of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

Practical

1. External body parts of cattle, buffalo, sheep, goat, swine and poultry.
2. Handling and restraining of livestock.
3. Identification methods of farm animals and poultry.
4. Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.
5. Judging of cattle, buffalo and poultry.
6. Culling of livestock and poultry.
7. Planning and layout of housing for different types of livestock.
8. Computation of rations for livestock.
9. Formulation of concentrate mixtures.
10. Clean milk production, milking methods.
11. Hatchery operations, incubation and hatching equipments.
12. Management of chicks, growers and layers.
13. Debeaking, dusting and vaccination.
14. Economics of cattle, buffalo, sheep, goat, swine and poultry production.

Suggested Readings:

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

8.

Course Code: PATH-121

Course Title: Fundamentals of Plant Pathology

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

Introduction to Plant Pathology: Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India.

Unit II

Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis; Development of disease in plants: Disease Triangle, Disease cycle.

Unit III

Fungi and their morphology, reproduction and classification of fungi; Bacteria: Morphology, reproduction classification of phytopathogenic bacteria.

Unit IV

Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants; Viruses and viroids, virus transmission.

Unit V

Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

Practical

1. Study of the microscope.
2. Acquaintance with laboratory material and equipment.
3. Study of different plant disease symptoms.
4. Microscopic examination of general structure of fungi.
5. Simple staining of bacteria.
6. Direct and indirect staining.
7. Gram staining of bacteria.
8. Microscopic examination of fungal disease specimen.
9. Microscopic examination of bacterial diseased specimen.
10. Preparation of culture media.
11. Isolation of plant pathogens: Fungi, bacteria and viruses.
12. Purification of plant pathogens.
13. Study on plant disease diagnosis.
14. Koch‘s Postulates, Characteristics, formulation, methods of application and calculation on fungicides.

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. 4th 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. 7th 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.

9.

Course Code: SW-122

Course Title: National Cadet Corps-II (NCC-II) / National Service Scheme (NSS-II)

Credit Hours: 1 (0+1)

National Cadet Corps (NCC-II)

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

Suggested readings

1. NCC : Handbook of NCC Cadets for ―A‖, ―B‖ and ―C‖ Certificate Examination by RPH Editorial Board
2. A Concise Handbook of NCC Cadets for A, B and C Certificate by RPH Editorial Board
3. Cadet Hand Book (Army Wing) by Major R.C. Mishra
4. Cadet Hand Book (Army Wing) by Directorate General, NCC, Ministry of Defence, R.K. Puram, New Delhi

National Service Scheme-II (NSS-II)

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

about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

Suggested readings:

1. NSS volunteer diary – by NSS unit Rani Durgawati Vishwa Vidyalaya, Jabalpur
2. Guideline of NSS - Empanelled Training Institute,Barkatullah University, NSS Bhopal
3. Social thought- by Ravindra Nath Mukerji, Publisher- Vivek Prakashan Delhi
4. Communication and Extension Management- by Dr. Jitendra Chouhan , Publisher- Kushal publications & distribution Varanasi
5. Extension Communication and Management- by G.L.Ray, Publisher- Kalyni publishers, New Delhi
6. Indian philosophy - by Basantlal, Publisher- Motilal Barsidas, New Delhi
7. Text book of Entrepreneurship and Rural development - by Sagar Mandal & G.L.Ray Publisher- Kalyni publishers, New Delhi
8. Extension Education and Rural development - by Santh Govind, G. Tamilselvi & J. Meenambi gai, Publisher- Agrobios (India)
9. Awaking India- Swami Vivekananda- by Ramkrishan Mission, New Delhi, Publisher- Mayur printers & publishers, New Delhi

Second Year
III Semester
1.
Course Code: SEC ENTO-232
Course Title: Skill Enhancement Course-VII (Biofertilizer and Biopesticide Production)
Credit Hours: 2 (0+2)

Objectives:

1. To study identify the principles of organic farming and recognize its benefits over conventional farming, as well as evaluate the current status and scope for organic agriculture at local, national, and global levels.
2. To study learn about organic farming techniques, including soil preparation, crop rotation, water management, and contamination control, and apply these to design an organic farm layout with appropriate buffer zones. Gain Knowledge of Organic Certification and Marketing.
3. To study will acquire hands-on knowledge in using organic nutrients (e.g., composting, bio-fertilizers) and organic pest management techniques, such as botanical pesticides, eco-friendly traps, and bio-control methods, with a focus on sustainable farming practices.

Practical

UNIT I

Organic farming and present status and development; principles of organic farming: benefits and scope of organic farming. Chemical farming vs organic farming. Organic Production Technology. International, National and State norms of organic farming. Farm designing, Planning and layout of organic farm, Buffer zone. Land preparation, tillage, Choice of crops and varieties, Seed treatment and planting, Water management and Contamination Control. Crop rotation, cropping pattern and cropping systems, intercropping, Farming system, Integrated farming system, Livestock management in organic farming, Farm implement.

UNIT II

Indigenous Technical Knowledge. Initiatives taken by the central and state governments, NGOs and other organizations for promotion of organic agriculture in India. Nutrient use in organic farming, Residue recycling: Preparation of enriched farm yard manure, Preparation of different methods of composting viz, Indore method, Banglore methods, Coimbatore method and NADEP method, Vermicompost, Application of compost, Different methods of bio-fertilizers (Azatobacter, Azospirillum, Azolla, BGA, Rhizobium, PSB and VAM) application in various crops. Preparation and application of liquid manures viz. Vermi wash, Jeevamrit, Panchagavya, Amrit pani etc.

UNIT III

Fundamentals of insect, disease and weed management under organic mode of production-cultural, mechanical and biological methods-non chemical pest & disease management. Mulching: types, advantages, Identification of beneficial farm insect, Botanical pesticide preparation of Neem products and other botanicals for pest and disease control viz. Neemastra, Agnishtra, Brahmanastra Beejamrit, Deshparni Ark Jeevamrata, Panchgavya, Amritpani, etc. Importance of cow in organic farming. Collection and processing of cow products (ghee, milk, curd, urin dung) for making Bioformulations. Use of eco-friendly insect management techniques viz. Pheronone trap, light trap, yellow cards, bird perch etc. for monitoring and insect management purpose, Dose calculation and application method of bio-pesticides viz. Trichogramma, Pseudomonas, Fusarium, Bacillus thuringiensis, Metrhizium and Beauvaria bassnia; Ha- NPV and SL-NPV etc. Myco-herbicides

2.

Course Code: MDC ECON-231

Course Title: Entrepreneurship Development and Business Communication

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development.

Unit II

Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development.

Unit III

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.

Unit IV

Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation.

Unit V

Enterprise Management. Production management: product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management: raw material costing, inventory control. Personal management: manpower planning, labour turn over, wages / salaries. Financial management /accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.

Practical

1. Visit to small scale industries/agro-industries
2. Interaction with successful entrepreneurs/ agricentrepreneurs.
3. Visit to financial institutions and support agencies.
4. Preparation of project proposal for funding by different agencies.

Suggested Readings:

1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.

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

3.

Course Code: SW-233
Course Title: Physical Education, First Aid, Yoga Practices and Meditation
Credit Hours: 2 (0+2)

Objective

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

Practical

Unit I

Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems;

Unit II

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.

Unit III

Yoga; History of Yog, Types of Yog, Introduction to Yog.

• Asanas (Definition and Importance) Padmasan,san, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan.

• Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari.

• Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh.

• Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra.

• Role of yoga in sports.

• Teaching of Asanas – demonstration, practice, correction and practice.

Unit IV

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

Unit V

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

4.

Course Code: GPB-231

Course Title: Principles of Genetics

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Cell cycle and cell division-mitosis and meiosis. Probability and Chi-square. Types of DNA and RNA, Dominance relationships, Epistatic interactions with example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation.

Unit III

Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanism, chromosome mapping, Structural and numerical variations in chromosomes and their implications.

Unit IV

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.

Unit V

Cytoplasmic inheritance, Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.

Practical

1. Study of microscope.
2. Study of cell structure.
3. Mitosis and Meiosis cell division.
4. Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross.
5. Experiments on epistatic interactions including test cross and back cross.
6. Practice on mitotic and meiotic cell division.
7. Experiments on probability and chi-square test.
8. Determination of linkage and croo-over analysis (through two point test cross data).
9. Study on sex linked inheritance in Drosophila.
10. Study on models on DNA and RNA structures.

Suggested readings:

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

5.

Course Code: AGRO-232

Course Title: Crop Production Technology-I (*Kharif* Crops)

Credit Hours: 3 (1+2*)

Objectives:

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

Theory

Unit I

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops: Cereals- rice, maize, sorghum, pearl millet, finger millet and other minor millets.

Unit II

Pulses- pigeonpea, mungbean and urdbean.

Unit III

Oilseeds- groundnut, soybean, sesame, castor.

Unit IV

fibre crops- cotton and jute.

Unit V

Forage crops- sorghum, cowpea, cluster bean, maize, guinea and napier.

Practical

1. Rice nursery preparation
2. Transplanting of rice
3. Sowing of soybean, pigeon pea and mungbean, maize, groundnut and cotton
4. Effect of seed size on germination and seedling vigour of *Kharif* crops
5. Effect of sowing depth on germination of *Kharif* crops
6. Identification of weeds in *Kharif* crops
7. Top dressing and foliar feeding of nutrients
8. Study of yield contributing characters and yield calculation of *Kharif* crops
9. Study of crop varieties and important agronomic experiments at experiential farm
10. Recording biometric observations
11. Study of forage experiments
12. Morphological description of *Kharif* crops
13. Silage and hay making
14. Visit to research centres of related crops.

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

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

6.

Course Code: HORT-232
Course Title: Production Technology of Fruit and Plantation Crops
Credit Hours: 2 (1+1)

Objectives:

1. To educate about the different forms of classification of fruit crop
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

Theory

Unit I

Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit crops; area, production, productivity and export potential of fruit and plantation crops.

Unit II

Crop production techniques in tropical, 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 and harvest, value addition. Fruit crops: mango, banana, papaya, guava, sapota.

Unit III

Citrus, grape, litchi, pineapple, pomegranate, minor fruits- date, ber.

Unit IV

Peach, strawberry, nut crops Jackfruit and, apple, pear

Unit V

Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition Palms: Coconut, Arecanut, Oil palm and Palmyrah, Plantation crops: Tea, Coffee, Cocoa, Cashewnut, Rubber.

Practical

1. Propagation techniques, selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, sapota, grapes, Citrus (mandarin and acid lime), pomegranate, jackfruit.
2. Preparation and application of PGR‘s for propagation.
3. Micro propagation.
4. Protocol for mass multiplication and hardening of fruit crops.
5. Identification and description of varieties, mother palm and seed nut selection.
6. Nursery practices, seedling selection, fertilizers application, nutritional disorders, pests and diseases of Coconut, Arecanut and cocoa, Tea and coffee, Rubber and cashew.
7. Visit to commercial orchard and plantation industries.

Suggested Readings:

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

2. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture Vol.1. Naya Prokash, Calcutta.
4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
5. Chadha, T.R. 2001 Textbook of temperate fruits. ICAR, New Delhi.
6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.
7. Chattopadhyay. 1998. A textbook on pomology (sub-tropical fruits) vol.III. Published by M/s. Kalyani publishers, Ludhiana, New Delhi, Noida. UP.
8. Chudawat, B. S.1990. Arid fruit culture Oxford &IBH, New Delhi.
9. Das, B.C. and Das S.N. Cultivation of minor fruits. Kalyani Publishers, Ludhiana
10. David Jackson and N.E. Laone, 1999. Subtropical and temperate fruit production. CABI publications.
11. H.P. Singh and M.M. Mustafa 2009. Banana-new innovations Westville publishing House, New Delhi
12. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, Tamil Nadu.
13. Mitra, S.K., T.K. Bose and D.S. Rathore. 1991. Temperate fruits. Horticulture and allied Publishers, Calcutta.
14. Pal, J.S. 1997. Fruit Growing. Kalyani Publishers, New Delhi.
15. Radha, T. and Mathew, L.2007. Fruit crops. New India publishing Agency
16. Rajput, CBS and Srihari babu, R.1985. Citriculture, Kalyani Publishers, Ludhiana
17. Sadhu, M.K. and P.K. Chattopadhyay. 2001. Introductory Fruit Crops. Naya Prokash, Calcutta.
18. Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers, Ludhiana
19. Symmonds. 1996. Banana, II Edn.Longman, London
20. Veeraragavathatham, D., Jawaharlal, M., Jeeva, S., Rabindran, R and Umapathy, G. 2004 (2nd edition). Scientific fruit culture. Published by M/s. Suri associates, 1362/4, Velraj Vihar Complex, Thadagam Road, Coimbatore- 2
21. W.S. Dhillon. 2013. Fruit production in India. Narendra publishing House, New Delhi
22. Kavino, M, V. Jegadeeswari, R. M. Vijayakumar and S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops by Narendra Publishing House.
23. Kumar, N.J. B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.
24. Nair. 1979. Cashew, CPCRI, Kerela
25. Sharma, A., Kumar, P., Tripathi, V.K. 2024. Production Technology of Fruits and Plantation Crops. Elite Publishing House
26. Thampan, P.K.1981. Handbook of coconut palm. Oxford &IBH, New Delhi.
27. Thompson, P.K.1980. Coconut. Oxford &IBH, New Delhi
28. V. Ponnuswami, M. Kumar; S. Ramesh Kumar and C. Krishnamoorthy 2015. Fruit and Plantation Crops Narendra Publishing House.

7.

Course Code: EXTN-232
Course Title: Fundamentals of Extension Education
Credit Hours: 2 (1+1)

Objectives:

1. State the importance of extension education in agriculture
2. Familiarize with the different types of agriculture and rural development programs launched by govt. of India
3. Classify the types of extension teaching methods
4. Elaborate the importance and different models of communication
5. Explain the process and stages of adoption along with adopters‘ categories

Theory

Unit I

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. 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.);

Unit II

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.

Unit III

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).

Unit IV

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.

Unit V

Extension administration: meaning and concept, principles and functions. 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, 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.

Practical

1. To get acquainted with university extension system.
2. Group discussion- exercise.
3. Identification of rural leaders in village situation.
4. Preparation and use of AV aids.

5. Preparation of extension literature (leaflet, booklet, folder, pamphlet news stories and success stories).
6. Presentation skills exercise.
7. Micro teaching exercise.
8. A visit to village to understand the problems being encountered by the villagers/ farmers.
9. To study organization and functioning of DRDA/PRI and other development departments at district level.
10. Visit to NGO/FO/FPO and learning from their experience in rural development.
11. Understanding PRA techniques and their application in village development planning.
12. Exposure to mass media.
13. Visit to community radio and television studio for understanding the process of programme production.
14. Script writing, writing for print and electronic media, developing script for radio and television.

Suggested readings:

1. Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi press, Bapatla.
2. Dahama, O. P. and Bhatnagar, O.P. 1998. Education and Communication for Development, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
3. Jalihal, K. A. and Veerabhadraiah, V. 2007. Fundamentals of Extension Education and Management in Extension, Concept publishing company, New Delhi.
4. MuthaiahManoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
5. Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.
6. Rathore, O. S. et al. 2012. Handbook of Extension Education, Agrotech Publishing Academy, Udaipur.
7. Dudhani, C.M., Hirevenkatgoudar, L.V., Manjunath, L. Hanchinal, S.N. and Patil, S.L. 2004. Extension Teaching Methods and Communication Technology, UAS, Dharwad.
8. Sandhu, A.S. 1993. Text book on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Pvt. Ltd, New Delhi.
9. Singh, A.K., Lakhan Singh, R. and Roy Burman. 2006. Dimensions of Agricultural Extension. Aman Publishing House, Meerut.

Course Code: NEMA-231
Course Title: Fundamentals of Nematology
Credit Hours: 2 (1+1)

Objectives:

1. To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.
2. To impart knowledge on nematode pests of different crops of national and local importance and their management.

Theory

Unit I

Introduction: History of phytonematology, habitat and diversity, economic importance of nematodes. General characteristics of plant parasitic nematodes.

Unit II

Nematode: definition, general morphology and biology. Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit.

Unit III

Symptomatology, role of nematodes in disease development, Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses.

Unit IV

Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseed and fiber crops, citrus and banana, tea, coffee and coconut.

Unit V

Different methods of nematode management: Cultural methods, physical; methods, Biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.

Practical

1. Sampling methods, collection of soil and plant samples.
2. Extraction of nematodes from soil and plant tissues following Cobb‘s sieving and decanting technique, Baermann funnel technique.
3. Picking and counting of plant parasitic nematode.
4. Identification of economically important plant nematodes up to generic level with the help of keys and description.
5. Meloidogyne, Pratylenchus; Heterodera, Tylenchulus, Xiphinema, and Helicotylenchus etc.
6. Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops etc.
7. Methods of application of nematicides and organic amendments.

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. Text book on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj.

Course Code: AGRO-233
Course Title: Principles and Practices of Natural Farming
Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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),

Unit II

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.

Unit III

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,

Unit IV

Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches on a natural farm, Rearing practices for animals under natural farming, Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming; Mechanization in natural farming, Processing, labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products.

Unit V

Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

Practical

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. Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management.
3. On-farm inputs preparation methods and protocols.
4. Studies in green manuring in-situ and green leaf manuring.
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.
6. Weed management practices in natural farming.
7. Techniques of Indigenous seed production- storage and marketing.
8. Partial and complete nutrient and financial budgeting in natural farming.

9. Evaluation of ecosystem services in natural farming (Crop, Field and System).

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, 199 pp.
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. 181 pp
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. 38 pp.
13. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
14. 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. 94pp.
16. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
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. 64p
18. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022)
19. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021)
20. Plenty for All: Natural Farming A to Z Prayog Pariwar Methodology by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021)

21. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
22. Shamasastry, R. 1915. Kautilya‘s Arthashastra.
23. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016)
24. U. K. Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.
25. deykxrçk—rrd—fr% vkpk;Znsoozr, pp 1-166.

IV Semester

1.

Course Code: SEC AGRO-241

Course Title: Skill Enhancement Course-I (Organic Production Technology)

Credit Hours: 2 (0+2)

Objectives:

4. To study identify the principles of organic farming and recognize its benefits over conventional farming, as well as evaluate the current status and scope for organic agriculture at local, national, and global levels.
5. To study learn about organic farming techniques, including soil preparation, crop rotation, water management, and contamination control, and apply these to design an organic farm layout with appropriate buffer zones. Gain Knowledge of Organic Certification and Marketing.
6. To study will acquire hands-on knowledge in using organic nutrients (e.g., composting, bio-fertilizers) and organic pest management techniques, such as botanical pesticides, eco-friendly traps, and bio-control methods, with a focus on sustainable farming practices.

Practical

UNIT I

Organic farming and present status and development; principles of organic farming: benefits and scope of organic farming. Chemical farming vs organic farming. Organic Production Technology. International, National and State norms of organic farming. Farm designing, Planning and layout of organic farm, Buffer zone. Land preparation, tillage, Choice of crops and varieties, Seed treatment and planting, Water management and Contamination Control. Crop rotation, cropping pattern and cropping systems, intercropping, Farming system, Integrated farming system, Livestock management in organic farming, Farm implement.

UNIT II

Indigenous Technical Knowledge. Initiatives taken by the central and state governments, NGOs and other organizations for promotion of organic agriculture in India. Nutrient use in organic farming, Residue recycling: Preparation of enriched farm yard manure, Preparation of different methods of composting viz, Indore method, Banglore methods, Coimbatore method and NADEP method, Vermicompost, Application of compost, Different methods of bio-fertilizers (Azatobacter, Azospirillum, Azolla, BGA, Rhizobium, PSB and VAM) application in various crops. Preparation and application of liquid manures viz. Vermi wash, Jeevamrit, Panchagavya, Amrit pani etc.

UNIT III

Fundamentals of insect, disease and weed management under organic mode of production-cultural, mechanical and biological methods-non chemical pest & disease management. Mulching: types, advantages, Identification of beneficial farm insect, Botanical pesticide preparation of Neem products and other botanicals for pest and disease control viz. Neemastra, Agnishtra, Brahmanastra Beejamrit, Deshparni Ark Jeevamrata, Panchgavya, Amritpani, etc. Importance of cow in organic farming. Collection and processing of cow products (ghee, milk, curd, urin dung) for making Bioformulations. Use of eco-friendly insect management techniques viz. Pheronone trap, light trap, yellow cards, bird perch etc. for monitoring and insect management purpose, Dose calculation and application method of bio-pesticides viz. Trichogramma, Pseudomonas, Fusarium, Bacillus thuringiensis, Metrhizium and Beauvaria bassnia; Ha- NPV and SL-NPV etc. Myco-herbicides

UNIT IV

Visit of organic farm and field based organic experiments to study the various components, Visit to organic clusters and bio control lab to study the maintenance of biofertilizers / bio-inoculant cultures, Case studies of Indigenous Technical knowledge (ITK) for nutrient, insect, pest, disease and weed management**.**

UNIT V

Organic certification- Requirement, guidelines, agencies, registration, documentation, advantages and procedure of organic certification, Visit to organic certification agencies for understating certification procedure. Various Current Government schemes related to organic farming. Crop production standards, Quality consideration- labelling and accreditation procedures for organic products, Marketing Strategies of organic produces - past experiences and future prospects, import and export polices, requirements for export, agencies involved in export of organic produce and incentives for organic production & geo-tagging. Start-Ups and Funding Avenues in Organic farming.

Suggested readings:

1. Organic Food Production in India Status, Strategy and Scope Bhattacharya, P. 2003, Agribios (India), Jodhpur.
2. Organic Farming-Theory and Practices Palanniappan, S. P. and Anandurai, K 1999, Scientific Publisher, Jodhpur.
3. Organic Farming Lumpkin, N. 1990, Farming Press Books, IPSWITCH, U.K.
4. Hand Book of Organic Farming Sharma, A. K. 2001, Agribios (India), Jodhpur.
5. Organic Farming Gupta, M. K. 200, Moraka Foundation, jodhpur.
6. Organic Farming for Sustainable Horticulturen Parvatha Reddy, P, Agribios (India), Jodhpur.
7. Emerging Trends in Biological Control of Phytophageous insects AnanthakrishnanT.N. 1992, Oxford & IBH, New Delhi.

2.

Course Code: VAC STAT -241

Course Title: Agricultural Informatics and Artificial Intelligence

Credit Hours: 3 (2+1)

Objectives:

1. To acquaint student 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 students familiar with Agricultural-Informatics, its components and applications in agriculture

Theory

Unit I

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, Database, concepts and types, creating data base, Uses of DBMS in Agriculture. Internet and World Wide Web (WWW): Concepts and components.

Unit II

Computer programming: General concepts, Introduction general programming concepts. Concepts and standard input/output operations. e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture.

Unit III

Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, 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, post-harvest management etc.

Unit IV

Geospatial technology: Concepts, techniques, components and uses for 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.

Unit V

Digital India and schemes to promote digitalization of agriculture in India. 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.

Practical

1. Study of computer components and accessories.
2. Practice of important DoS Commands.
3. Introduction of different operating systems such as Windows, Unix/Linux, creating files and folders. File Management.

4. Use of MS-Word and MS Power-point for creating, editing and presenting a scientific documents.
5. MS-EXCEL-Creating a spreadsheet.
6. Use of statistical tools.
7. Writing expressions, Creating graphs.
8. Analysis of scientific data.
9. MS-ACCESS: Creating Database, preparing queries and reports.
10. Demonstration of Agri- information system.
11. Introduction to World Wide Web (WWW) and its components.
12. Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost,
13. Preparation of inputs file for CSM and study of model outputs.
14. computation of water and nutrient requirements of crop using CSM and IT tools.
15. Use of smartphones and other devices in agro-advisory and dissemination of market information.
16. Introduction of Geospatial technology, AR/ VR demonstration.
17. Preparation of contingent crop planning.
18. India Digital Ecosystem of Agriculture (IDEA).

Suggested Readings:

1. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
2. Fundamentals of Computer by V. Rajaroman.
3. Introduction to Information Technology by Pearson.
4. Introduction to Database Management System by C. J. Date.
5. Introductory Agri-Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.

3.

Course Code: HORT-243

Course Title: Production Technology of Vegetables and Spices

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

Importance of vegetables and spices in human nutrition and national economy, kitchen gardening. Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important vegetable and spices such as tomato, okra, brinjal, chili, capsicum, cucumber, bitter gourd , bottle gourd.

Unit II

Production technology of sweet potato, cassava and moringa, pumpkin, French bean, peas; cole crops such as cabbage, cauliflower, khol-khol.

Unit III

Bulb crops such as onion, garlic; root crops such as carrot, radish, beetroot; tuber crops such as potato.

UnitIV

Leafy vegetables such as amaranthus, palak, perennial vegetables, spice crops like turmeric, zinger, garlic.

Unit V

Spice crops like coriander, cumin, black pepper, cardamom, fenugreek, fennel, clove, nutmeg, cinnamon, curry leaf, tamarind and herbal spices.

Practical

1. Identification of vegetables and spice crops and their seeds.
2. Description of varieties.
3. Propagation methods - rapid multiplication techniques.
4. Seed collection and extraction.
5. Nursery raising. Direct seed sowing and transplanting.
6. Study of morphological characters of different vegetables and spices.
7. Fertilizers applications.
8. Harvesting and post-harvest practices.
9. Economics of vegetables and spices cultivation
10. Visit to spice gardens.

Suggested readings:

1. Olericulture, Fundamentals of Vegetable Production (Vol.1) by K.P. Singh, Anant Bahadur
2. Vegetable crops by J. Kabir, T.K. Bose, M.G. Som
3. Vegetable crops (Production technology, Vol II) by M.S. Fagaria, B.R. Choudhury, R.S. Dhaka

4.

Course Code: ECON-241

Course Title: Principles of Agricultural Economics and Farm Management

Credit Hours: 2 (2+0)

Objectives:

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

Theory

Unit I

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.

Unit II

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.

Unit III

Law of diminishing marginal utility, equi-marginal utility principle. Consumer‘s equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. 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.

Unit IV

Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programs on population control.

Unit V

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.

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

6.

Course Code: AGRO-244

Course Title: Crop Production Technology-II (*Rabi* Crops)

Credit Hours: 3 (1+2*)

Objectives:

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

Theory

Unit I

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops. Cereals- wheat and barley.

Unit II

Pulses- chickpea, lentil, peas. *Rabi* redgram and, rajmash.

Unit III

Oilseed- rapeseed, mustard, sunflower, safflower; and linseed.

Unit IV

Sugar crops-sugarcane and sugar beet. Medicinal and aromatic crops- mentha, lemon grass and citronella.

Unit V

Forage crops –barseem, lucerne and oat; potato, quinoa, tobacco.

Practical

1. Sowing methods of wheat and sugarcane.
2. Identification of weeds in *rabi* season crops.
3. Study of morphological characteristics of *rabi* crops.
4. Study of yield contributing characters of *rabi* season crops.
5. Yield and juice quality analysis of sugarcane.
6. Study of important agronomic experiments of *rabi* crops at experimental farms.
7. Study of *rabi* forage experiments.
8. Oil extraction of medicinal crops.
9. Visit to research stations of related crops.

*** 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.**

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.

7.

Course Code: ENGG-241

Course Title: Farm Machinery and Power

Credit Hours: 2 (1+1)

Objectives:

1. 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.

Theory

Unit I

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.

Unit II

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.

Unit III

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.

Unit IV

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.

Unit V

Familiarization with plant protection equipment. Familiarization with harvesting and threshing equipments.

Practical

1. Study of different components of I.C. engine.
2. To study air cleaning and cooling system of engine.
3. Familiarization with clutch, transmission, differential and final drive of a tractor.
4. Familiarization with lubrication and fuel supply system of engine.
5. Familiarization with brake, steering, hydraulic control system of engine.
6. Learning of tractor driving.
7. Familiarization with operation of power tiller.
8. Implements for hill agriculture.
9. Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow.
10. Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and trans planter.
11. Familiarization with different types of sprayers and dusters.
12. Familiarization with different inter-cultivation equipment.
13. Familiarization with harvesting and threshing machinery.
14. Calculation of power requirement for different implements.

Suggested readings:

1. Jagdiswar Sahay – Elements of Agricultural Engineering

2. Jain, S.C. and C.R. Rai-Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak. Delhi- 110006
3. 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
4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi

8.

Course Code: AGRO-245

Course Title: Water Management

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

Irrigation: definition and objectives; Importance: Function of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships. Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth.

Unit II

Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation; Methods of irrigation: surface and sub-surface, pressurized methods, viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water;

Unit III

Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management.

Unit IV

Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); quality of irrigation water, irrigation management practices for different soils and crops, drip, sprinkler.

Unit V

Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.

Practical

1. Determination of bulk density by field method.
2. Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter.
3. Determination of field capacity by field method.
4. Determination of permanent wilting point.
5. Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices.
6. Calculation of irrigation water requirement (Problems).
7. Determination of infiltration rate.
8. Demonstration of furrow method of irrigation.
9. Demonstration of check basin and basin method of irrigation.
10. Visit to farmers‘ field and cost estimation of drip irrigation system.
11. Demonstration of filter cleaning, fertigation, injection and flushing of laterals.
12. layout for different methods of irrigation.

13. Erection and operation of sprinkler irrigation system.
14. Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability.
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.

9.

Course Code: SSAC-243

Course Title: Problematic Soils and their Management

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties.

Unit II

Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils.

Unit III

Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, Waterlogged soils,

Unit IV

Irrigation water – quality and standards, utilization of saline water in agriculture. Use of Remote sensing and GIS in diagnosis and management of problem soils.

Unit V

Irrigation and water quality. Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

Practical

1. Determination of pHs and EC of saturation extract of problematic soil.
2. Determination of redox potential in soil.
3. Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil.
4. Determination of Gypsum requirement of alkali / sodic soil.
5. Determination of lime requirement of acidic soil.
6. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO_3 , HCO_3 , Cl, SAR and RSC),
7. Determination of nitrate (NO_3^-) from irrigation water.
8. Determination of dissolved oxygen and free carbon dioxide levels in water samples.

Suggested readings:

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

10.

Course Code: GPB-242

Course Title: Basics of Plant Breeding

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Self incompatibility and male-sterility-genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation. Domestication, Acclimatization and Introduction. Centres of origin/ diversity.

Unit III

Components of Genetic variation. Heritability and genetic advance. 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,

Unit IV

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.

Unit V

Breeding methods in asexually propagated crops, clonal selection and hybridization. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding-methods and uses. Breeding for important biotic and abiotic stresses. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer‘s Rights.

Practical

1. Plant Breeder‘s kit.
2. Study of germplasm of various crops.
3. Study of floral structures of self pollinated and cross-pollinated crops.
4. Emasculation and hybridization techniques in self and cross pollinated crops.
5. Consequences of inbreeding on genetic structure of resulting populations.
6. Study of male sterility system.
7. Handling of segregating populations.
8. Methods of calculating mean, range, variance, standard deviation, heritability.
9. Designs used in plant breeding experiments.
10. Analysis of Randomized Block Design.
11. To work out the mode of pollination in a given crop and extent of natural out-crossing.
12. Prediction of performance of double cross hybrids.
13. Maintenance of breeding records and data collection.

14. Screening tests for biotic and abiotic stresses.

Suggested Readings:

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

Third Year
V Semester
1.
Course Code: MDC ECON-352
Course Title: Agricultural Marketing and Trade
Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; 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.

Unit II

Marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits. Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark);

Unit III

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs;

Unit IV

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.

Unit V

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.

Practical

1. Plotting and study of demand and supply curves and calculation of elasticities.

2. Study of relationship between market arrivals and prices of some selected commodities.
3. Computation of marketable and marketed surplus of important commodities.
4. Study of price behaviour over time for some selected commodities.
5. Construction of index numbers.
6. Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class.
7. Visit to market institutions –NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning.
8. Application of principles of comparative advantage of international trade.

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.

2.

Course Code: AG MET-351
Course Title: Introduction to Agro-meteorology
Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

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;

Unit III

Energy balance of earth; Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking.

Unit IV

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.

Unit V

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.

Practical

1. Visit of Agrometeorological Observatory.
2. Site selection of observatory, exposure of instruments and weather data recording.
3. Measurement of total shortwave and long wave radiation and its estimation using Planck‘s intensity law.
4. Measurement of albedo and sunshine duration.
5. Computation of Radiation Intensity using BSS.
6. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis.
7. Measurement of soil temperature and computation of soil heat flux.
8. Determination of vapor pressure and relative humidity.
9. Determination of dew point temperature.
10. Measurement of atmospheric pressure and analysis of atmospheric conditions.

11. Measurement of wind speed and wind direction, preparation of windrose.
12. Measurement, tabulation and analysis of rain.
13. Measurement of open pan evaporation and evapotranspiration.
14. Computation of PET and AET, Use of synoptic charts, weather reports.
15. Weather forecasting-types and methods.
16. Crop weather calendar.

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

3.

Course Code: BOT-352
Course Title: Fundamentals of Crop Physiology
Credit Hours: 3 (2+1)

Objectives:

1. 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

Theory

Unit I

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. Significance of transpiration. Stomatal opening and closing mechanisms. Water use efficiency; Essential and beneficial elements; Passive and active transport of mineral element.

Unit II

Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms. 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. Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand 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.

Unit III

Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II. 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);

Unit IV

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.). Introduction to CGR, RGR, NAR etc. Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc.

Unit V

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).

Practical

1. Study on structure and distribution of stomata.
2. Demonstration of imbibition, osmosis, plasmolysis.
3. Estimation of water potential, relative water content.
4. Tissue test for mineral nutrients.
5. Identification of nutrient deficiency and toxicity symptoms in plant.
6. Identification of nutrients by hydroponics.
7. Estimation of photosynthetic pigments, rate of photosynthesis and respiration.
8. Estimation of transpiration.
9. Plant growth analysis.
10. Study on senescence and abscission, hormonal regulation of senescence.
11. Demonstration of the effects of different PGRs on plants.
12. Leaf anatomy of C3 and C4 plants.

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

4.

Course Code: ENTO-353

Course Title: Pest Management in Crops and Stored Grains

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Structural entomology and important household pests, their nature of damage and management. Factors affecting loss of stored grains.

Unit III

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

Unit IV

Management of non insect pest of mites, snails and slugs. Concept of IPM, Practices, scope and limitations of IPM.

Unit V

Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management.

Practical

1. Field visit, identification of major insect pests and their damage symptoms.
2. Collection and preservation of major insect pests.
3. Collection of damage samples, their identification and herbarium preparation.
4. Methods of monitoring of pest incidence in situ.
5. Management strategies of insect pests of different crops.
6. Study on structural entomology and household pests.
7. Storage structures and methods of grain storage.
8. Spraying techniques for selected field and horticultural crops.
9. Vertebrate pest management.
10. Mass multiplication of NPV and entomopathogenic nematodes.

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.

5.

Course Code: PATH-352

Course Title: Diseases of Field and Horticultural Crops and their Management

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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).

Unit II

Groundnut (early and late leaf spots, rust, wilt), Soybean (rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic), Grams (Ascochyta blight, wilt, grey mold), Pea (downy mildew, powdery mildew, rust), Black gram and Green gram (web blight, Cercospora leaf spot, anthracnose, yellow mosaic), Sugarcane (red rot, smut, grassy shoot, ratoon stunting, PokahBoeng), Mustard (Alternaria blight, white rust, downy mildew, sclerotinia stem rot), Sunflower (sclerotinia stem rot, Alternaria blight) and Cotton (anthracnose, vascular wilts, black arm).

Unit III

Horticultural crops: Citrus (canker, gummosis), Guava (wilt, anthracnose), Banana (sigatoka, Panama wilt, bacterial wilt, bunchy top), Papaya (foot rot, leaf curl, mosaic), Pomegranate (bacterial blight), Apple (scab, powdery mildew, fire blight, crown gall), Peach (leaf curl), Grapevine (downy mildew, powdery mildew, anthracnose) and Strawberry (leaf spot).

Unit IV

Coconut (bud rot, Ganoderma wilt), Tea (blister blight), Coffee (rust), Mango (anthracnose, malformation, bacterial blight, powdery mildew), Potato (early and late blight, black scurf, leaf roll, mosaic), Tomato (damping off, wilt, early and late blight, leaf curl, mosaic), Brinjal (phomopsis blight and fruit rot, sclerotinia blight), Chilli (anthracnose and fruit rot, wilt, leaf curl) and Cucurbits (powdery and downy mildew, wilts).

Unit V

Cruciferous vegetables (Alternaria leaf spot, black rot, cauliflower mosaic), Beans (anthracnose, bacterial blight), Okra (yellow vein mosaic), Ginger (soft rot), Turmeric (leaf Spot), Coriander (stem gall), Rose (dieback, powdery mildew, black leaf spot) and Marigold (botrytis blight, leaf spots).

Practical

1. To study the symptoms of different diseases of field and horticultural crops.
2. Blast and brown spot disease of rice.
3. Sheath blight and bacterial leaf blight disease of rice.

4. Downy mildew and powdery mildew disease of cucurbits.
5. Rhizoctonia and Cercospora leaf spot disease of green gram / black gram.
6. Alternaria blight and downy mildew disease of mustard.
7. Early blight and late blight disease of potato and tomato.
8. Phomopsis blight disease of brinjal.
9. Powdery mildew and rust disease of pea.
10. Stem gall disease of coriander.
11. Anthracnose and fruit rot disease of chilli.
12. Taphrina leaf spot disease of turmeric.
13. Red rot disease of sugarcane.
14. Acquaintance with fungicides, antibiotics and biopesticides and their use in management of diseases of horticultural crops.
15. Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory.
16. Field visit for the diagnosis of field problems.
17. Collection and preservation of plant diseased specimens for herbarium.

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

6.

Course Code: GPB-353

Course Title: Crop Improvement (*Kharif* Crops) - I

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Plant genetic resources, its utilization and conservation. Study of genetics of qualitative and quantitative characters.

Unit III

Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops.

Unit IV

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).

Unit V

Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeopea etc. Ideotype concept, climate resilient crop varieties for future.

Practical

1. Botany of crops.
2. Floral biology, emasculation and hybridization techniques in different crop species, *viz*. rice, jute, maize, sorghum, pearl millet, ragi, pigeopea, urdbean, mungbean, soybean, groundnut, sesame, castor, cotton, cowpea, tabacco, brinjal, okra and cucurbitaceous crops.
3. Maintenance breeding of different *kharif* crops.
4. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods.
5. Study of field techniques for seed production and hybrid seed production in *kharif* crops.
6. Estimation of heterosis, inbreeding depression and heritability.
7. Layout of field experiments.
8. Study of quality characters.
9. Donor parents for different characters.
10. Visit to seed production plots.
11. Visit to AICRP breeding plots of different crops.

Suggested Readings:

1. 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

7.

Course Code: AGRO-356
Course Title: Weed Management
Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds, crop-weed completion, factors of competition, factors affecting growth and development.

Unit II

Studies on weed seed bank, weed shifts. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management.

Unit III

Implements for weed control, robotic weed control, weed management in organic / natural farming. Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management.

Unit IV

Mode of action of herbicides and selectivity phenomenon. Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application.

Unit V

Herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management, weed management in cropping systems.

Practical

1. Techniques of weed preservation.
2. weed identification and losses caused by weeds.
3. Biology of important weeds.
4. Study of weeds in different situations.
5. Study of herbicide formulations and mixture of herbicide.
6. Study methods of herbicide application.
7. Herbicide application equipment- their parts, use, maintenance and calibration.
8. Weed control implements.
9. Calculation of herbicide doses and requirement.
10. weed control efficiency and weed index.
11. Phytotoxicity of herbicides.
12. Weed management in fallow lands.
13. Management of problem and parasitic weeds.

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.

8.

Course Code: HORT-354

Course Title: Ornamental Crops, MAPs and Landscaping

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

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.

Unit III

Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and lilium; Production technology of chrysanthemum and carnation.

Unit IV

Package of practices for loose flowers like marigold and jasmine under open conditions; Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, flower arrangement, Herbaceous Border, Hedge, Edge etc.

Unit V

Processing and value addition important ornamental crops; Processing and value addition of MAPs produce.

Practical

1. Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants).
2. Propagation of MAPs.
3. Bed preparation and planting of MAP; Nursery bed preparation and sowing of seasonal flower seeds; Propagation of ornamental plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of bougainvillea; Planting of gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden.

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.

9.

Course Code: AGRO-357
Course Title: Introductory Agro forestry
Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling; 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.

Unit III

Socio- economic aspects of Agroforestry system; 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.

Unit IV

Nursery bed preparation and management; Cultural practices for bare root and seedling, field handling of nursery stock; 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.

Unit V

Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI; Agroforestry models developed by Indian council of Forestry Research and Education.

Practical

1. Identification of tree species in agro-forestry.
2. Study of tree growth measurement.
3. Study of environmental parameters affecting AF System.
4. Plant propagation methods.
5. Pre-sowing seed treatment.
6. Preparation of nursery bed exercise.
7. Practicing propagation techniques for trees.
8. Afforestation methods.
9. Practical training, pruning, coppicing, pollarding etc.
10. Planting pattern and designs for plantation.
11. Natural and artificial regeneration.
12. Design and diagnostic survey of agro forestry system.
13. Evaluation of agro-forestry system in different agro climatic zones.

14. Exposure Visit to prevailing agroforestry systems of the state and related important institutions.
15. Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.

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).

VI Semester

1.

Course Code: BIOTECH-361

Course Title: Fundamentals of Agricultural Biotechnology

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

Introduction to Plant Tissue Culture and Genetic Engineering: History; Cellular totipotency and cytodifferentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement; Embryo rescue technique and its significance in hybrid development.

Unit II

In vitro fertilization, ovule culture and its significance in hybrid development. Protoplast isolation, culture and regeneration; Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement; Anther and pollen culture for haploid production; Development of disease-free (virus free) plants through apical meristem culture. Micropropagation technique for the generation of quality planting material; Synthetic seeds and its applications**.** National certification and Quality management of TC plants-secondary metabolite production- in vitro germplasm conservation.

Unit III

Introduction to Molecular Biology: DNA structure, structure and function; DNA replication, transcription and translation, RNA, types and function; Structure of prokaryotic and eukaryotic gene; Central dogma of life - DNA replication, transcription, genetic codes- translation and protein synthesis; Lac Operon concept - Nucleic acid hybridization.

Unit IV

Polymerase chain reaction- DNA sequencing – Sanger method; PCR and its applications. Introduction to recombinant DNA technology: DNA modifying enzymes and vectors; plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated gene transfer methods.

Unit V

Transgenic and its importance in crop improvement with successful stories; biosafety. Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement.

Practical

1. Introduction to Plant Tissue Culture Laboratory.
2. Good Laboratory Practices.
3. Media Preparation and sterilization; Glassware sterilization.
4. Micropropagation.
5. Callus induction and culture.
6. Anther culture.
7. Apical meristem culture.
8. Preparation of synthetic seeds.
9. Isolation of plasmid DNA.
10. Quantification of DNA.

11. Agarose Gel Electrophoresis and visualization of plasmid DNA.
12. Restriction digestion of plasmid DNA.
13. Isolation of Plant genomic DNA.
14. PCR amplification of DNA.
15. Gel electrophoresis of amplified DNA.
16. Visit to tissue culture units / biotech labs.

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.

2.

Course Code: STAT-361

Course Title: Basic and Applied Agricultural Statistics

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median- Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.

Unit III

Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.

Unit IV

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. 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.

Unit V

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.

Practical

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

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.

3.

Course Code: GPB-364

Course Title: Crop Improvement (*Rabi* Crops) - II

Credit Hours: 2 (1+1)

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

Theory

Unit I

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops of *rabi* season.

Unit II

Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters.

Unit III

Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops.

Unit IV

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);

Unit V

Hybrid seed production technology in wheat, oat, chickpea, rapeseed and mustard etc. Ideotype concept, climate resilient crop varieties for future.

Practical

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

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

4.

Course Code: ENGG-362

Course Title: Renewable Energy in Agriculture and Allied Sector

Credit Hours: 2 (1+1)

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

Theory

Unit I

Classification of energy sources, contribution of these of sources in agricultural sector; Familiarization with biomass utilization for biofuel production and their application.

Unit II

Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource.

Unit III

Introduction of solar energy, collection and their application. Familiarization with solar energy gadgets: solar cooker, solar water heater.

Unit IV

Application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application.

Unit V

Introduction of wind energy and their application. Availability of bio mass and their application in different places.

Practical

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

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. T hird Edition (Tata McGraw-Hill).
3. V.V.N. Kishore. 2008. Renewable Energy Engineering and Technology: Principles and Practice, Teri, India.

5.

Course Code: AGRO-368

Course Title: Dryland Agriculture/ Rainfed Agriculture and Watershed Management

Credit Hours: 2 (1+1)

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

Theory

Unit I

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.

Unit II

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.

Unit III

Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices; Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas;

Unit IV

Contingent crop planning for aberrant weather conditions; Concept, history, objective, principles and components of watershed management, factors affecting watershed management.

Unit V

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.

Practical

1. Studies on climate classification.
2. Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
3. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA).
4. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India.
5. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops.
6. Critical analysis of rainfall and possible drought period in the country.
7. Effective rainfall and its calculation.
8. Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure.
9. Soil moisture determination under different land situations.
10. Importance of seed priming to mitigate drought.
11. Assessment of meteorological drought.
12. Characterization and delineation of model watershed.

13. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops.
14. Field demonstration on soil and moisture conservation measures.
15. Field demonstration on construction of water harvesting structures.
16. Visit to rainfed research station / watershed.

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.

6.

Course Code: PATH-363

Course Title: Agricultural Microbiology and Phyto-remediation

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, genetic engineering. Soil Microbiology: Nutrient mineralization and transformation.

Unit III

Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning.

Unit IV

Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc.

Unit V

Biological control: Microbial biopesticides for plant disease management Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome residents and their roles. Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability. Bioremediation of polluted soils using microbial mediators. Phytoremediation of polluted soils.

Practical

1. Study of the microscope.
2. Acquaintance with laboratory material and equipment.
3. Microscopic observation of different groups of microorganisms: moulds (Fungi).
4. Direct staining of bacteria by crystal violet.
5. Negative or indirect staining of bacteria by nigrosin.
6. Gram staining of bacteria.
7. Study of phyllosphere and rhizosphere microflora.
8. Measurement of microorganisms.

9. Preparation of culture media.
10. Isolation and purification of rhizospheric microbes.
11. Isolation and purification of N-fixers.
12. Isolation and purification of Nutrient solubilizers.
13. Isolation and purification of Endophytes.

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
4. Dubey, H.C. 2007. A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi – 10014
5. Salyers, A. A. and Whitt, D. D. 2001. Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.
6. Prescott, L. M. 2002. Microbiology 5th Edition. McGraw-Hill Inc, US

7.

Course Code: ECON-362

Course Title: Agricultural Finance & Cooperation

Credit Hours: 2 (1+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Sources of agricultural finance: institutional and non institutional sources, commercial banks, social control and nationalization of commercial banks. Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost.

Unit III

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. Preparation and analysis of financial statements – Balance Sheet and Income Statement.

Unit IV

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. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers‘ service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3 R‘s, 5 C‘s and 7 P‘s of credit.

Unit V

Crop insurance: its scope, significance and limitations and the potential of the newly launched _Pradhan Mantri Fasal Bima Yojana‘ (Prime Minister‘s Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

Practical

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

12. Different types of repayment plans.

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.

8.

Course Code: BIOCHEM-361

Course Title: Essentials of Plant Biochemistry

Credit Hours: 3 (2+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Vitamins – physiological and metabolic role. Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes.

Unit III

Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation.

Unit IV

Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation.

Unit V

Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

Practical

1. Preparation of standard solutions and reagents.
2. Determination of pH.
3. Qualitative tests of carbohydrates and amino acids.
4. Quantitative estimation of soluble sugars and starch.
5. Estimation of protein by Kjeldhal method and Lowry‘s method.
6. Preparation of mineral solution from ash.
7. Estimation of fat by Soxhlet method.
8. Determination of acid value, saponification value and iodine number.
9. Estimation of ascorbic acid.
10. Qualitative / quantitative tests of secondary metabolites.

Suggested readings:

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.

9.

Course Code: GPB-365

Course Title: Fundamentals of Seed Science & Technology

Credit Hours: 2 (1+1)

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

Theory

Unit I

Introduction to seed technology, definition and importance; Seed quality -definition, characters of good quality seed.

Unit II

Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed. Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures.

Unit III

Post-harvest seed quality management; seed processing procedures, seed drying; Seed treatment, its importance, method of application and seed packing; seed storage - general principles, stages and factors affecting seed longevity during storage.

Unit IV

Seed health management during storage. Seed Certification and legislation; Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties.

Unit V

Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques.

Practical

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

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.
6. Tunwar, N.S. and Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Fourth Year
VII Semester

Sr. No.	Course Title	Total Credits
1	5 Elective Courses each of 4 (3+1) credits/Research Project with related courses	20 (15+5)
Total		**20 (15+5)**

ELECTIVE CORE COURSES

S. No.	Type of Course	Subjects	Course Title	Course Code	Credit Hours	Total credit hours
1	ECC	Agribusiness Management	Agri-Business Management	ELE ABM-471	4 (3+1)	**20 (15+5)**
2	ECC	Agribusiness Management	Agricultural Journalism	ELE ABM-472	4 (3+1)	
3	ECC	Agronomy	Principles and Practices of Organic Farming and Conservation Agriculture	ELE AGRO-471	4 (3+1)	
4	ECC	Agricultural Meteorology	System Simulation and Agroadvisory	ELE AG MET-471	4 (3+1)	
5	ECC	Agricultural Meteorology	Climate Resilient Agriculture	ELE AG MET-472	4 (3+1)	
6	ECC	Horticulture	Landscaping	ELE HORT-471	4 (3+1)	
7	ECC	Horticulture	Hi-tech Horticulture	ELE HORT-472	4 (3+1)	
8	ECC	Horticulture	Protected Cultivation	ELE HORT-473	4 (3+1)	
9	ECC	Horticulture	Post Harvest Technology and Value Addition	ELE HORT-474	4 (3+1)	
10	ECC	Soil Science	Management of Natural Resources	ELE SSAC-471	4 (3+1)	
11	ECC	Soil Science	Bioformulation and Nanoformulation	ELE SSAC-472	4 (3+1)	
12	ECC	Entomology, Pathology & Soil Science	Agrochemicals	ELE EPSS-471	4 (3+1)	
13	ECC	Microbiology	Biopesticides and Biofertilizers	ELE MIBO-471	4 (3+1)	
14	ECC	Genetics and Plant Breeding	Commercial Plant Breeding	ELE GPB-471	4 (3+1)	

15	ECC	Genetics and Plant Breeding	Commercial Seed Production	ELE GPB-472	4 (3+1)	
16	ECC	Agricultural Biotechnology	Food Safety and Standards	ELE BIOTECH-471	4 (3+1)	
17	ECC	Agricultural Biotechnology	Biotechnology of Crop Improvement	ELE BIOTECH-472	4 (3+1)	
18	ECC	Agricultural Biotechnology	Micro-propagation Technologies	ELE BIOTECH-472	4 (3+1)	
19	ECC	Agricultural Engineering	Geoinformatics and Remote Sensing, Precision Farming	ELE ENGG-471	4 (3+1)	
20	ECC	Food Nutrition and Dietetics	Food Science and Nutrition	ELE FSN-471	4 (3+1)	
21	OC	Online Course	Online course (Compulsory minimum 10 credits during whole degree program)			
Minimum Required (do not include Online Courses)						
Note: The students will have the freedom to choose Any 5 subjects among these courses.						

1.

Course Code: ELE ABM-471

Course Title: Agri-Business Management

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy.

Unit II

Distinctive features of Agribusiness Management: Importance and needs of agro-based industries. Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries.

Unit III

Agri-value chain: Understanding primary and support activities and their linkages. Business environment: PEST and SWOT analysis. Management functions: Roles and activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget.

Unit IV

Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting and positioning. Marketing mix and marketing strategies.

Unit V

Consumer behaviour analysis, Product Life Cycle (PLC). Sales and Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Practical

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

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 T heory and Practices, Write and Print Publications.
5. Virender Kamalvanshi. Agribusiness Management. Random.

2.

Course Code: ELE ABM-472

Course Title: Agricultural Journalism

Credit Hours: 4 (3+1)

Objectives:

1. To impart knowledge and skill in agricultural journalism

Theory

Unit I

Journalism – Meaning, nature, importance, and types of journalism. Agricultural Journalism – Meaning, definition, principle, objectives, types, and scope. Similarities and difference between agricultural journalism and other types of journalism. Role of agricultural journalist, Training of agricultural journalist. Qualities of journalist, Role of journalist / journalism in agricultural development and development of newspaper and magazines readers.

Unit II

Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers. Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines. The agricultural story: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story.

Unit III

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 writing a news story,

Unit IV

Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body. Readability measure-readability ease score, automated readability index, gunning fog index, How to improve readability of articles and stories. Use of photograph in agricultural journalism- Basic principles of photography – composition, exposure, lens, light. Use of artwork (Graphs, charts maps, etc.).

Unit V

Writing the captions. Editorial mechanism: Copy reading, headline and title writing. Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader. Layout – meaning, principles of layout and design.

Practical

1. Practice in writing an agricultural news story.
2. Practice in writing an agricultural feature story.
3. Covering agricultural events for the information collection.
4. Practice in interviewing for the information collection.
5. Abstracting stories from research and scientific materials and wire services.
6. Selecting pictures and artwork for the agricultural story.
7. Practice in editing, copy reading.
8. Practice in headline and title writing.
9. Practicing proof reading.
10. Practice in lay outing of newspaper.
11. Testing copy with a readability formula.
12. Visit a publishing office.

Suggested readings:

1. Introduction to Journalism by Carole Fleming, Emma Hemmingway, and Gillian Moore.
2. Basic Journalism by Rangaswami Parthasarathy.
3. News Reporting and Editing by K. M. Shrivastava.
4. Professional Journalism by M. V. Kamath.
5. The Journalist‘s Handbook Book by M. V. Kamath.
6. Farm Journalism and Media Management – Bhaskaran et al.
7. Agricultural Extension and farm Journalism – A. K. Singh.
8. Farm Journalism – Jana and Mitra.
9. Web Materials.
10. Prepared You Tube videos.

3.

Course Code: ELE AGRO-471

Course Title: Principles and Practices of Organic Farming and Conservation Agriculture

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

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.

Unit II

Fundamentals of insect, pest, disease and weed management under organic mode of production.

Unit III

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.

Unit IV

Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.

Unit V

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.

Practical

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

Suggested readings:

1. A. C. Gaur. Handbook of Organic farming and biofertilizers.
2. A. K. Dahama. Organic Farming for Sustainable Agriculture. Agrobios (India), Jodhpur.
3. Arun. K. Sharma. Handbook of Organic Farming. Agrobios (India), Jodhpur.
4. S. P. Palaniappan and K. Annadurai. Organic Farming – Theory and Practice. Scientific Publishers. Jodhpur.
5. U. 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. T hampan, 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. Singh, Abhinandan, Pankaj Kumar Ojha and Rahul Kumar, 2018. Conservation Agriculture Technologies. Biotech Books.
11. Acharya Sankar Kr, Sreemoyee Bera, Cornea Saha, Prabhat Kumar, Monirul Haque, Riti Chatterjee and Anwesha Mandal. 2022. Conservation Agriculture Approach and Application. Scholars World. 292p.

4.

Course Code: ELE AG MET-471

Course Title: System Simulation and Agroadvisory

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

System approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams.

Unit II

Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis. Potential and achievable crop production-concept and modelling, techniques for their estimation.

Unit III

Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance.

Unit IV

Weather forecasting, types methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity.

Unit V

Crop- Weather Calendars; Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro- advisory and its effective dissemination.

Practical

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

Suggested readings:

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

5.

Course Code: ELE AG MET-472

Course Title: Climate Resilient Agriculture

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

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.

Unit II

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.

Unit III

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, agro advisories,

Unit IV

ICTs and simulation models; climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management, organic / natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling; use of renewable sources of energy; climate resilient pest-disease management strategies.

Unit V

Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant / resistant cultivars under changed climatic scenarios including extreme weather events.

Practical

1. Acquaintance with meteorological instruments including AWS.
2. Statistical techniques to study trend of climatic parameters.
3. Analysis of extreme weather events using non-parametric tests.
4. Building climate change scenarios under different futuristic emission of GHGs.
5. Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars.
6. Climate resilient technologies and manipulation of cropping patterns.
7. Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories.
8. Analysing carbon sequestration potential of different agro-ecosystems.
9. Designing climate smart village model considering the availability of resources.

10. Awareness programme on climate change and climate resilient agriculture among farming community.

Suggested readings:

1. Climate Resilient Animal Agriculture by GSLHV Prasada Rao. New India Publishing Agency.
2. Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish. New India Publishing Agency.
3. Climate-Smart Agriculture Sourcebook. FAO (2013).
4. Implications for Climate Smart Agriculture by Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari. Biotech Books, 357p.
5. Climate Resilient Agriculture, Adaptation and Mitigation Strategies by Manish Bhan. New India Publishing Agency, 294p.
6. Climate Change and Agriculture Over India by Prasad Rao. PHI Learning, 352p.
7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M. Satish Serial Publishing House.178p.

6.

Course Code: ELE HORT-471

Course Title: Landscaping

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Importance and scope of landscaping. Principles of landscaping, garden styles and types terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery water garden, walk-paths, bridges, other constructed features etc. Gardens for special purposes.

Unit II

Trees: selection, propagation, planting schemes, canopy management. Shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture.

Unit III

Climber and creepers importance, selection, propagation, planting. Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents.

Unit IV

Pot plants: selection, arrangement, management. Bio aesthetic planning: definition, need, planning.

Unit V

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.

Practical

1. Identification of trees, shrubs, annuals, pot plants.
2. Propagation of trees, shrubs and annuals.
3. Care and maintenance of plants, potting and repotting.
4. Identification of tools and implements used in landscape design.
5. Training and pruning of plants for special effects.
6. Lawn establishment and maintenance.
7. Layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house.
8. Use of computer software.
9. Visit to important gardens / parks / institutes.

Suggested readings:

1. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia
2. Principles of Landscape Gardening: Y. Chandrasekhar and Hemla Naik B. 2020. ICAR.
3. Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh. 2020, Bio-Green Books.
4. Principles of Landscape Architecture: Pragnyashree Mishra and Bhimasen Naik. 2022. New India Publishing Agency.
5. Landscape Gardening: Sudhir Pradhan. 2018. Scientific Publishers India.

7.

Course Code: ELE HORT-472

Course Title: Hi-tech Horticulture

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Introduction and importance; Nursery management and mechanization.

Unit II

Micro propagation of horticultural crops; Modern field preparation and planting methods. Protected cultivation: advantages, controlled conditions, method and techniques.

Unit III

Micro irrigation systems and its components; EC, pH based fertilizer scheduling. Canopy management; high density orcharding.

Unit IV

Components of precision farming: Remote sensing; Geographical Information System (GIS); Differential Geo-positioning System (DGPS); Variable Rate Applicator (VRA).

Unit V

Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical

1. Types of polyhouses and shade net houses.
2. Intercultural operations: tools and equipment identification and application.
3. Micro propagation.
4. Nursery- portrays.
5. Micro-irrigation.
6. EC, pH based fertilizer scheduling.
7. Canopy management.
8. Visit to hi-tech orchard / nursery.

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.

8.

Course Code:ELE HORT-473

Course Title: Protected Cultivation

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Protected cultivation- importance and scope, status of protected cultivation in India and World. Types of protected structure based on site and climate. Cladding material involved in greenhouse / poly house.

Unit II

Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management, Substrate management.

Unit III

Types of benches and containers, Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops.

Unit IV

Greenhouse cultivation of important horticultural crops-rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc.

Unit V

Cultivation of economically important medicinal and aromatic plants. Off- season production of f lowers and vegetables. Insect pest and disease management.

Practical

1. Raising of seedlings and saplings under protected conditions.
2. Use of portrays in quality planting material production.
3. Bed preparation and planting of crop for production.
4. Inter cultural operations.
5. Soil EC and pH measurement.
6. Regulation of irrigation and fertilizers through drip, fogging and misting.

Suggested readings:

1. Greenhouse operation and management by Paul V. Nelson.
2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu.
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.
4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA,252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar. New Delhi Publishers, 263p.
6. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V. Jain Brothers.

9.

Course Code:ELE HORT-474

Course Title: Post Harvest Technology and Value Addition

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Importance of post –harvest processing of fruits and vegetables, extent and possible causes of post-harvest losses.

Unit II

Pre-harvest factors affecting post-harvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling;

Unit III

Storage (ZECC, cold storage, CA, MA and hypobaric); Value addition concept; Principles and methods of preservation;

Unit IV

Intermediate moisture food (jam, jelly, marmalade, preserve, candy) - concepts and standards; Fermented and non-fermented beverages. Tomato products -concepts and standards;

Unit V

Drying /Dehydration of fruits and vegetables –concept and methods, osmotic drying. Canning – concepts and standards, packaging of products.

Practical

1. Applications of different types of packing, containers for shelf-life extension.
2. Effect of temperature on shelf life and quality of produce.
3. Demonstration of chilling and freezing injury in vegetables and fruits.
4. Extraction and preservation of pulps and juices.
5. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar candy and tomato products, canned products.
6. Quality evaluation of products- Physico-chemical and sensory.
7. Visit to processing unit/industry.

Suggested readings:

1. Post-harvest technology of horticultural crops by S. K. Sharma and M. C Nautiyal.
2. Post-Harvest Technology by Suja Nabi Qureshi, Kounser Javeed and Abhay Kumar Sinha. Bioscientific Publishers.
3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira. New India Publishing Agency. 320p.
4. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann. Daya Publishing House.
5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p.

10.

Course Code: ELE SSAC-471

Course Title: Management of Natural Resources

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

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.

Unit II

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.

Unit III

Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies.

Unit IV

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.

Unit V

Principles of erosion control - Introduction to contouring, strip cropping. Contour bund - Graded bund and bench terracing. Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures, Water harvesting techniques - Lining of ponds, tanks and canal systems.

Practical

1. Identifying natural resources and their utility.
2. Practicing survey - Principles and educating to use pacing technique for measurement.
3. Area calculations through chain survey - GPS demo for tracking and area measurement.
4. Estimation of soil loss and calculation of erosion index.
5. Leveling concepts and practical utility in agriculture.
6. Preparation of contour maps.
7. Concept of vegetative water ways and design of grassed water ways.
8. Wind erosion and estimation process.
9. Different irrigation pumps and their constructional differences.
10. Farm pond construction and its design aspects.
11. Visit to nearby farm pond.

12. Visit to an erosion site.
13. Exposure to strip cropping / contour bunding.

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.

11.

Course Code:ELE SSAC-472

Course Title: Bioformulation and Nanoformulation

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Introduction and history of biological control of pests and diseases; Microbial biopesticides: the global and Indian market scenario; biopesticides for organic agriculture; Different phytopathogenic biocontrol agents: Mode of action.

Unit II

Different entomopathogenic biocontrol agents: Mode of action; Microbial inoculants as biofertilizer candidates, Production, quality assessment and methods of application of biopesticides and biofertilizers.

Unit III

Regulatory system of biopesticides in India; Formulations of plant essential oils, botanicals, pheromone, and parapheromone and their application in insect pest management; Use of predators and parasitoids for insect pest management.

Unit IV

Nanotechnology: its applications in pest and disease diagnosis and management; Nano biopesticides: Concept and importance, different techniques of producing nano biopesticides.

Unit V

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.

Practical

1. Introduction and acquaintance with biopesticide laboratory.
2. Preparation of culture media.
3. Isolation and purification of bioagent from soil and infected insects.
4. Microscopic study of different microbial bioagents.
5. In vitro assay of microbial bioagents against plant pathogens.
6. In vitro compatibility study among different microbial bioagents.
7. Mass multiplication of biopesticides.
8. Population enumeration of biocontrol agents in different biopesticides.
9. Preparation of plant extracts and their efficacy test against insect pests.
10. Use of pheromone parapheromone for monitoring and management of insect pests.
11. Bioassay of Entomopathogenic biocontrol agents on insect pests.
12. Preparation of microbial inoculants of biofertilizer microbes.

13. Compatibility of biofertilizer microbes.
14. Preparation of solid and liquid consortia of biofertilizer microbes.

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. Kuykendall Marel Dekker, INC.
4. Ciancia, A. and Mukerji, K. J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
5. Cincholkar, S. B. and Mukherji, K. G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural products.
6. Gnanamanickam, S. S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.
7. Ramanujam, B. and Rabindra, R. J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services, Bengaluru.
8. Singh, S. P. and Hussanini, S. S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services, Bengaluru.
9. Allhoff, Fritz and Lin, Patrick (Eds). 2009. Nanotechnology and Society. ISBN: 978-1-4020-6208-7 Springer Publications, UK.
10. Prasad, Ram, Vivek Kumar, Manoj Kumar and Devendra Choudhary Eds, 2019. Nanobiotechnology in Bioformulations, Kindle Edition.
11. Koul, Opender Ed, 2019. Nano-biopesticides Today and Future Perspectives. Academic Press.
12. Shah, M. A. and Tokeer Ahmad. Nano Science and Technology, Wiley India.

12.

Course Code:ELE EPSS-471
Course Title: Agrochemicals
Credit Hours: 4 (3+1)

Objectives:

1. To impart knowledge on different classes of agrochemicals

Theory

Unit I

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

Unit II

Herbicides -Major classes, properties and important herbicides. Fate of herbicides. Fungicides-classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxychloride. Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

Unit III

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.

Unit IV

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

Unit V

Mixed and complex fertilizers: Sources and compatibility- preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistic and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

1. Sampling of fertilizers and pesticides.
2. Pesticides application technology to study about various pesticides appliances.
3. Quick tests for identification of common fertilizers.
4. Identification of anion and cation in fertilizer.
5. Calculation of doses of insecticides to be used.
6. To study and identify various formulations of insecticide available in market.
7. Estimation of nitrogen in Urea.
8. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate.
9. Estimation of potassium in Muraite of Potash / Sulphate of Potash by flame photometer.
10. Determination of copper content in copper oxychloride.
11. Determination of sulphur content in sulphur fungicide.

Suggested readings:

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

13.

Course Code: ELE MIBO-471

Course Title: Biopesticides and Biofertilizers

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

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.

Unit II

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.

Unit III

Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers – Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia.

Unit IV

Cynobacterial bio fertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers – AM mycorrhiza and ectomycorhiza. Nitrogen fixation –Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers.

Unit V

FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.

Practical

1. Isolation and purification of important biopestisides: trichoderma Pseudomonas, Bacillus, Metarhyzium etc. and its production.
2. Identification of important botanicals.
3. Visit to biopesticide laboratory in nearby area.
4. Field visit to explore naturally infected cadavers.
5. Identification of entomopathogenic entities in field condition.
6. Quality control of biopesticides.
7. Isolation and purification of Azospirillum, Azotobactor, Rhizobium, P-solubilizers and cyanobacteria.
8. Mass multiplication and inoculums production of biofertilizers.
9. Isolation of AM fungi- Wet sieving method and sucrose gradient method.
10. Mass production of AM inoculants.

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.

14.

Course Code: ELE GPB-471
Course Title: Commercial Plant Breeding
Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self- and cross- pollinated crops (A/B/R and two-line system) for development of hybrids and seed production.

Unit II

Genetic test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Speed Breeding, Breeding Management systems, High-throughput phenotyping and genotyping platforms,

Unit III

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.

Unit IV

IPR issues in commercial plant breeding: DUS testing and registration of verities under PPV and FR Act.

Unit V

Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self- and cross- pollinated crops.

Practical

1. Floral biology in self- and cross- pollinated species.
2. Selfing and crossing techniques.
3. Techniques of seed production in self- and cross- pollinated crops using A/B/R and two-line system.
4. Learning techniques in hybrid seed production using male- sterility in field crops.
5. Understanding the difficulties in hybrid seed production.
6. Tools and techniques for optimizing hybrid seed production.
7. Concept of rouging in seed production plot.
8. Concept of line its multiplication and purification in hybrid seed production.
9. Role of pollinators in hybrid seed production.
10. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops.
11. Sampling and analytical procedures for purity testing and detection of spurious seed.
12. Seed drying and storage structure in quality seed management.

13. Screening techniques during seed processing, viz. grading and packaging.
14. Visit to public private seed production and processing plants.

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. GeneTech Books

15.

Course Code:ELE GPB-472

Course Title: Commercial Seed Production

Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

General Principles of Seed Production: 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.

Unit II

General Principles of Seed Processing: 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.

Unit III

General Principles of Seed Testing: 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.

Seed Certification: 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 IV

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.

Unit V

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.

Practical

1. Planning of Seed Production, requirements for different classes of seeds in field crops- unit area and rate.
2. Operation and handling of mechanical drying equipment.
3. Effect of drying temperature and duration on seed germination and storability.
4. Seed processing equipment.
5. Seed treating equipment.
6. Seed production in cross pollinated crops with special reference to land, isolation, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage.
7. Hand emasculation and pollination in tomato.
8. Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity and gametocide application.
9. Visits to seed production plots etc.
10. Visit to seed processing plant and commercial controlled and uncontrolled seed stores.
11. Seed industries and local entrepreneurships visit to nearby areas.
12. Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed-borne fungi, bacteria and viruses, identification of storage fungi.
13. Control of seed borne diseases.
14. Seed treatment methods.
15. Maintenance of aseptic conditions and sterilization techniques.
16. Preparation of nutrient stocks for synthetic media.
17. Selection of explants for callus induction.
18. Preparation of MS medium for micro-propagation and callus induction.
19. Selection of explants for callus induction.
20. Preparation of MS medium for micro-propagation and callus induction.
21. Inoculation of explants for micro-propagation.
22. Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops.
23. Synthetic seed preparation.

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 Publishers.

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 Shahpur Jat, New Delhi-110049.

16.

Course Code: ELE BIOTECH-471
Course Title: Food Safety and Standards
Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

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. Temperature Control.

Unit II

Food Storage. Production Design. Hygiene and Sanitation in Food Service Establishments-Introduction. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control. Personnel Hygiene.

Unit III

Food safety Measures. Food Safety Management Tool- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc. HACCP.ISO series. TQM- concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygine.

Unit IV

Food laws and Standards Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food. Recent concerns -New and Emerging Pathogens. Packaging, Product labelling and Nutritional labelling.

Unit V

Genetically modified food/transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

Practical

1. Water quality analysis physico – chemical and microbiological.
2. Preparation of different types of media.
3. Microbiological examination of different food samples.
4. Assessment of surface sanitation by swab/rinse method.
5. Assessment of personal hygiene.
6. Biochemical tests for identification of bacteria.
7. Scheme for the detection of food borne pathogens.
8. Preparation of plants for Implementation of FSMS-HACCP, ISO:22000.

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.

17.

Course Code: ELE BIOTECH-472
Course Title: Biotechnology of Crop Improvement
Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

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.

Unit II

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.

Unit III

Direct and Indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots; Direct DNA delivery methods (microinjection, particle gun method, electroporation); gene targeting; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems.

Unit IV

Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into CRISPR/Cas9 plasmids; electroporation of Cas9 plasmids into cells; purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing; in vitro synthesis of single guide RNA (sgRNA); using Cas9/sgRNA complexes to test for activity on DNA substrates; evaluate Cas9 activity by T7E1 assays and DNA sequence analysis; Applications of CRISPR/cas9 technology in crop plants.

Unit V

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.

Practical

1. Agrobacterium-mediated transformation in Tobacco – preparation of construct.
2. Transfer to binary vector.
3. Transform Agrobacterium.
4. Prepare explant.
5. Inoculation and Co-cultivation.
6. Antibiotic based selection of putative transformants.
7. Validation using PCR.

8. Genome editing- preparation of CRISPR/CAS construct, direct transfer to plant, analysis of the targets.
9. Planning of a MABB programme – selection of parents, crossing strategies, marker analysis.

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, Hari Har. 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

18.

Course Code: ELE BIOTECH-473
Course Title: Micro-propagation Technologies
Credit Hours: 4 (3+1)

Objectives:

1. To educate the students in detail about the sterilization techniques for explants, preparation of stocks and working solution, culturing of explants, regeneration of whole plants from different explants and hardening procedures.

Theory

Unit I

Introduction, History, Advantages and limitations.

Unit II

Types of cultures (seed, embryo, organ, callus, cell).

Unit III

Stages of micro propagation; Axillary bud proliferation (Shoot tip and meristem culture, bud culture).

Unit IV

Organogenesis (calluys and direct organ formation); Somatic embryogenesis; Cell suspension cultures.

Unit V

Production of secondary metabolites, Somaclonal variation, Cryopreservation.

Practical

1. Identification and use of equipment in tissue culture Laboratory.
2. Nutrition media composition.
3. Sterilization techniques for media, containers and small instruments.
4. Sterilization techniques for explants.
5. Preparation of stocks and working solution.
6. Preparation of working medium.
7. Culturing of explants: Seeds, shoot tip and single node.
8. Callus induction.
9. Induction of somatic embryos regeneration of whole plants from different explants.
10. Hardening procedures.

Suggested readings:

1. Basics of Horticulture by Jitendra Singh.
2. Introduction to Horticulture by N. Kumar.
3. Handbook of Horticulture by ICAR.
4. Plant Tissue Culture: Basic and Applied by Timir Baran Jha and Biswajit Ghosh. Platinum Publishers.439p.

19.

Course Code: ELE ENGG-471

Course Title: Geoinformatics and Remote Sensing, Precision Farming

Credit Hours: 4 (3+1)

Objectives:

1. Enabling students acquire 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

Theory

Unit I

Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in atmosphere; Interaction with matter;

Unit II

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;

Unit III

Basic Concepts about geoinformatics. Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system,

Unit IV

Rule based system architecture; Software Agents; Impact of Block chain and it's concepts; Probability and Statistics: Bayes Theorem, correlation and Covariance, Continuous Random variables and probability distribution function, various forms of distributions, central limit theorem;

Unit V

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.

Practical

1. Familiarization with different remote sensing equipments and data products.
2. Interpretation of aerial photographs and satellite data for mapping of land resources.
3. Global positioning system (GPS).
4. Basics of Geographic Information System (GIS).
5. Georeferencing of toposheets.
6. Digital soil mapping with different variables.
7. Basics of multivariate data analytics.
8. Principal component analysis and regression applications, clustering methods and geostatistics are essential in agricultural studies.

Suggested readings:

1. Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor (s): Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy and Sachi Nandan.
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 By A 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, Gouri Sankar, Uday Chatterjee and Gopal Krishna Panda. BIO GREEN.
7. Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes by John Adamssen. Efalon Acies.
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.

20.

Course Code: ELE FSN-471
Course Title: Food Science and Nutrition
Credit Hours: 4 (3+1)

Objectives:

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

Theory

Unit I

Introduction on fundamentals of foods and human nutrition; Basic food groups; Concept of balanced diets; Recommended Daily Allowances (RDA) for various age groups;

Unit II

Biochemical composition, energy and food value of various food grains, fruits and vegetables. Carbohydrates, proteins, fats as nutrients and their interactions; Physio-chemical, functional and nutritional characteristics of essential nutrients- sources and functions,

Unit III

Nutritional requirements, malnutrition, inborn errors of metabolism, deficiency diseases; Digestion, absorption, transport and metabolism of nutrients in human system.

Unit IV

Protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinational factors and biochemistry of post harvest storage, losses during processing.

Unit V

Effect of cooking, processing and preservation on nutrients of different food products, biochemical aspects of food spoilage; Food fads, food safety and quality standards. Enzymes in food industry, food additives, nutritional quality of plant, animal, dairy, marine and fermented products.

Practical

1. Proximate analysis of foods.
2. Calorific value of foods.
3. Estimation of vitamins, phenols and flavonoids, carotenoids, antinutrients like Phytate/ Oxallate, Trypsin and Chymotrypsin inhibitor activities.
4. Limiting amino acids in food stuff.

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.

VIII Semester

Sr. No.	Course Title	Total credits
1.	For student opting 4 year BSc. (Hons.) Agriculture degree Student READY (RAWE) / Experiential Learning / Hands on Training / Industrial Attachment / Project Work / Internship	20 (0+20)
Total		**20 (0+20)**

Rural Agricultural Work Experience (RAWE)
Credit Hours: 20 (0+20)

Sr. No.	Components	Total credits
1.	**Rural Agricultural Work Experience (RAWE)**	**16 (0+16)**
2.	**Agro –Industrial Attachment (AIA)**	**4 (0+4)**
	Total	**20 (0+20)**

Component –I

Rural Agricultural Work Experience (RAWE) **Credits 16 (0+16)**

Objectives:

1. To provide an opportunity to the students to understand the rural setting in relation to agriculture and allied activities.
2. To make the students familiar with socio-economic condition of the farmers and their problems.
3. To impart diagnostic and remedial knowledge to the students relevant to real field situations through practical training.
4. To develop communication skills in students using extension teaching methods in transfer of technology.
5. To develop confidence and competence to solve agricultural problems.
6. To acquaint students with on-going extension and rural development programmes.

Component –II

Agro-Industrial Attachment (AIA) **Credits 4 (0+4)**

Objectives:

1. To expose the students to industrial environment, this cannot be simulated in the University.
2. To familiarize the students with various materials, machines, processes, products and their applications along with relevant aspects of shop management.
3. To make the students understand the psychology of the workers, and approach to problems along with the practices followed at factory.
4. To understand the scope, functions and job responsibility-ties in various departments of an organization.
5. To expose various aspects of entrepreneurship during the programme period.

Registration

The students shall register for RAWE programme during VIII semester in B.Sc. (Hons.) Agriculture degree programme.

Eligibility for registration and other requirements

- Students undergoing studies leading to the award of B.Sc. or B.Tech. and its equivalent a degree at Agricultural Sciences at Agricultural University shall be eligible for a period of one semester.

- The stipend will be admissible to persons of Indian Nationality as defined in the Constitution of India or persons domiciled in India; irrespective of sex, race or religion.
- A student will be under the administrative control of the Head of the institution as he joins. The Head of the Institution will ensure that all the rules and regulations of **ICAR** are strictly adhered to.
- A student will devote his whole time to the approved training and will not be allowed to accept or hold another appointment paid or otherwise.
- If a student shows unsatisfactory progress during the course of his training or gives up the chosen course of studies before its completion without any prior approval of the Head of Institution, or is irregular in attendance, the Head of institute itself will cancel the stipend. The stipend once cancelled will not be restored, no matter whatever the reasons adduced.
- 85 per cent attendance is compulsory for students registered for RAWE programme, failing which they will have to repeat the programme at their own cost.
- The students registered for RAWE are not allowed to leave the venue of their placement without written permission of Coordinator RAWE/ Dean, college of Agriculture, Permission will be granted only under emergency.
- Good conduct and regularity in attendance are also implied conditions for the continuance of stipend.
- The Head of the Institution is expected to bring to the notice of the Council any adverse report that may have been necessitated due to habitual/irregularity, misbehavior, participation in strikes etc. suggesting suspension/cancellation of stipend. The students will not be paid their stipend during the period of strike or during the period the trainee remains on conduct probation.
- A student undergoing RAWE will not be allowed to avail of any other fellowship/scholarship during tenure of stipend of the Council. In case a candidate is already receiving any other fellowship/Scholarship it will be surrendered by him before accepting stipend of the Council. Merit cum means scholarship, Fresship is, however, not covered under the above conditions.

Monitoring

1. The advisory committee for monitoring of RAWE programme will comprise of the following members-
    a. Principal Scientist/Senior Scientist/Senior Scientist and Head (**KVK**) of concerned station (Chairman).
    b. Dean‘s nominee (Dean will be the overall in-charge of the programme).
    c. Head/representative of the departments involved in the RAWE programme.
2. Students will be required to submit a final comprehensive report on or before the date specified in the academic calendar.
3. The students will be required to maintain a daily diary as per the prescribed proforma. They shall produce their diary to the visiting teacher for inspection and for recording their observation & suggestions. The visiting teachers shall verify the work and sign the diary.
4. The Chairman of the committee shall monitor daily activities of individual student.

Evaluation

1. Students shall be evaluated component wise under village attachment/agro-industrial attachment.
2. Each college will designate a Student READY Programme Coordinator and component wise evaluation committees. These committees will evolve a method of evaluation depending

upon the component undertaken giving due weight are to the observations made by the Scientists/Agro-industrial officer and Senior Scientist & Head (KVK) with whom they are attached.

3. Since the credit hours allotted to the Student READY programme are gradial, the minimum condition of attendance and grading system will apply for the programme as will be applicable to other courses.
4. It is expected that at the end of Student READY programme, the students should gain competency for entrepreneurship, which should be innovative and creative in nature. The evaluation committee must ensure percentage increase in this competency at the end & successful organization of all Student READY programes.
5. The 50 marks allotted to each activities will be awarded by considering the performance of student viz. work done in respective subject with the host farmer, observation of the teacher recorded during the visits, punctuality, enthusiasm, rapport with the host farmer and any other significant achievements of the students. All the course teacher will evaluate the comprehensive report, submitted by the student & conduct viva-voce examination as per their course.

Sr. No.	Activity	Credits
Component-I Rural Agricultural Work Experience (RAWE) 16 (0+16)		
1.	Survey of Village	1 (0+1)
2.	Agronomical Interventions	3 (0+3)
3.	Plant Protection Interventions	2 (0+2)
4.	Soil Improvement Interventions (Soil Sampling & Testing)	2 (0+2)
5.	Fruit and Vegetable Production Interventions	3 (0+3)
6.	Food Processing and Storage Interventions	1 (0+1)
7.	Animal Production Intervention	1 (0+1)
8.	Extension and Transfer of Technology activities	3 (0+3)
Component-II Agro-Industrial Attachment (AIA) 4 (0+4)		
9.	Agro –Industrial Attachment	4 (0+4)
	Total	**20 (0+20)**

Thus, a student registered for RAWE will have to obtain 50% marks to pass RAWE; OGPA will be worked as University prescribed procedures. In case, a student failed to secure the required marks will have to repeat the programme at their own cost, in the next year / semester as and when RAWE will be offered.

Implementation of the Programme

The students from each college will be placed in KVKs/ Research Station and a small group of 4-5 students will work in the villages of Krishi Vigyan Kendra/ Research Station under the jurisdiction of JNKVV.

Norms for Allotment of Villages

1. The students will be placed in KVK or Research Station and they will be equally distributed in different villages depending on availability of enterprising and innovative host-farmers. The ADR/Senior Scientist and Head (KVK) must satisfy them selves with regard to

suitability of selected farmers/villages for fulfilling the overall objectives of RAWE programme.

2. Among the student placed in a village, one student nominated by Station in-charge will function as a student group leader and coordinate the activities in the assigned village.

Orientation

Students have to report to the In-charge RAWE programme in their respective colleges as per the prescribed schedule of work for orientation immediately after registration. The Heads of concerned departments will ensure that the students are well exposed to the latest practices/technologies available in their respective fields before under going training on Agronomical interventions, plant protection interventions, soil improvement interventions, Fruit and Vegetable production interventions, Animal production interventions and Extension and Transfer of technology activities.

Programme of Work

The RAWE programme comprises of nine components as under:

1. Survey of Village
2. Agronomical Interventions
3. Plant Protection Interventions
4. Soil Improvement Interventions (Soil Sampling & Testing)
5. Fruit and Vegetable Production Interventions
6. Food Processing and Storage Interventions
7. Animal Production Intervention
8. Extension and Transfer of Technology activities
9. Agro –Industrial Attachment

1. Survey of Village **1 Credit**

The Students shall take-up survey of the village as per the prescribed scheduled. The students shall be required to collect the data on overall condition of village, resource endowment and its utilization, problems of labour and employment and other important economics aspect detailed in the schedule. The student shall also conduct a PRA of the village.

2. Agronomical Interventions **3 Credits**

In agronomical interventions, the students will be exposed to various crops and different agronomical practices in farmer‘s field. He/She will also involve in production technology and management of various crops. The student shall maintain a record of work done in prescribed proforma.

3. Plant Protection Interventions **2 Credits**

Under this the students will be exposed to various plant diseases, insect-pests, and physiological disorders prevailing in the area and prescribe remedial measures.

4. Soil Improvement Interventions (Soil Sampling & Testing) **2 Credits**

Under this component the students shall involve in activities i.e. Soil testing, collection of soil sample by using Geo-positioning system (GPS). Students shall study the use of soil health card for fertilizer schedule, Integrated Nutrient Management (INM) and its importance in soil quality improvement, role and importance of micronutrients in crop production, soil salinity, alkalinity and acidity and its reclamation. Natural Resource Management (NRM), role of Bio-fertilizer in improving soil health, soil properties important for soil health, Quality control in fertilizer, soil degradation, improvement of soil health for sustainable agriculture, vermin-compost and its role in improving soil health, classification of green manures & role in improving soil health, Water management, Crops rotation.

5. Fruit and Vegatable Production Interventions **3 Credits**

In fruits and vegetables crops the student shall involve themselves in field operation viz., seedbed preparation, nursery management, propagation etc. along with their host farmers. The student shall maintain a record of work done.

6. Food Processing and Storage Interventions **1 Credit**

Students shall involve themselves to study and collect the information i.e. methods of food processing and preservation, importance of processing of fruits and vegetables, spices, condiments and flowers, Packaging of horticultural commodities, common methods of storage, Post harvest management and equipment for spices and flowers, quality control in Fruit and vegetable processing industry, Storage structure and methods of grain storage, Traditional and modern storage structures, Indigenous Technological Knowledge used for food storage.

7. Animal Production Intervention **1 Credit**

Under this, the students shall collect the information of livestock on various aspects i.e. daily maintenance and feed expenses, milk production, milk disposal, dairy products, egg and birds, pig etc.

8. Extension and Transfer of Technology activities **3 Credits**

The students shall involve themselves in the following activities i.e. Participatory Rural Appraisal, identification of agricultural problems of the village and training needs of the farmers,

conduction method demonstrations of improved practices, Organization of short duration farmers training camp, field visits and agricultural exhibitions, Study of the on-going rural and agriculture development programme in the villages, Arrange farmers meeting to discuss agricultural aspects, Visit to various village institutions and study their role in development programmes and other extension activities, Motivate farmers through different extension teaching methods, Documentation of success stories.

Each student will prepare a report with respect to the activities indicated above and submit it to the Chairman off Advisory Committee for its evaluation. The students shall be given an opportunity to acquaint themselves with on-going programme and activities of research, development, marketing, extension agencies and organizations in the village. The students will submit report on the institutions he/she has visited.

9. Agro –Industrial Attachment **4 Credits**

The students shall involve themselves in the activities and tasks during Agro industrial attachment for 3 weeks duration viz. 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.

SKILL ENHANCEMENT COURSE (SEC)

A student admitted into 1st year of B.Sc. (Hons) Agriculture degree program will take 2 skill enhancement courses each of 2 credits in each semester of first year. Likewise, the student continuing his study into 2nd year of B.Sc. (Hons) Agriculture will undergo 1 skill enhancement course of 2 credits in each of the 2 semesters of 2nd year.

The student can select these courses from a bouquet of skill enhancement courses as indicated below or courses offered by a college. The courses may be offered as module of complementing courses to help the student to achieve skill in a specific area of his interest.

The University/HAEIs may offer such skill enhancement courses in which it has strength/ expertise as well as there is prospect of local employment and entrepreneurship development. The courses included in the list are indicative and the University/HAEIs may add more need-based courses in the list depending on their facilities and expertise available.

Indicative skill Enhancement courses

Sr. No.	Course title	Total credits
1	**Biofertlizer and biopesticide production**	2 (0+2)
2	**Production Technology of Bioagents**	2 (0+2)
3	**Seed Production and Testing Technology**	2 (0+2)
4	**Mushroom Production Technology**	2 (0+2)
5	**Soil, Plant and Water Testing**	2 (0+2)
6	**Post-harvest Processing Technology**	2 (0+2)
7	**Beneficial Insect Farming**	2 (0+2)
8	**Plantation Crop Production and Processing**	2 (0+2)
9	**Poultry Production Technology**	2 (0+2)
10	**Piggery Production Technology**	2 (0+2)
11	**Commercial Horticulture**	2 (0+2)
12	**Floriculture and Landscaping**	2 (0+2)
13	**Food Processing**	2 (0+2)
14	**Agriculture Waste Management**	2 (0+2)
15	**Organic Production Technology**	2 (0+2)
16	**Commercial Sericulture**	2 (0+2)
17	**Video Production**	2 (0+2)
18	**Horticulture Nursery Management**	2 (0+2)
19	**Commercial Beekeeping**	2 (0+2)
20	**Custom Hiring Services**	2 (0+2)
21	**Current Food Processing Technologies**	2 (0+2)
22	**Plantation crops Production and Management**	2 (0+2)
23	**Traditional Indian Dairy Products**	2 (0+2)

ONLINE COURSES

The students will have to take a minimum of 10 credits of online courses (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Hons) Agriculture.

The online courses can be from any field such as Basic Sciences, Humanities, Commerce, Business Management, Languages including foreign language, Communication skills, Music, etc. and can be taken from SWAYAM, Diksha, NPTEL, mooKIT, edX, Coursera, or any other portal.

The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses.

The students will take prior approval of the courses they opt from the concerned Dean/Assoc. Dean/Principal of the Faculty/College/Institute.

The courses will be non-gradial as separate certificates would be issued by the Institute/ University offering the courses.

However, the University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (successfully completed) courses in final transcript issued to the student.