

NEW AND RESTRUCTURED CURRICULUM & SYLLABUS

AS PER 6TH DEAN COMMITTEE ICAR RECOMMENDATIONS

B.Sc. (Hons) Agriculture

Implemented from Academic Session 2026-2027



Approved By
Board of Studies –Agriculture
School of Agriculture & Allied Science
&
Academic Council
HNB Garhwal University
(A Central University)
Srinagar-Garhwal

Hemvati Nandan Bahuguna Garhwal University
(A Central University)
Srinagar Garhwal, Uttarakhand (India)-246 174

RESTRUCTURING OF UNDERGRADUATE PROGRAMMES

B.Sc. (Hons.) Agriculture
HNB Garhwal University (A Central University)
Srinagar-Garhwal

Restructuring of UG Programs

The restructuring has been done based on the following NHEQF levels.

Year 1, Certificate Course, NEP-NHEQF Level 4.5

Year-2, Diploma Course, NEP-NHEQF Level 5.0

Year 4, B.Sc. (Hons.) Agriculture NEP-NHEQF Level 6.0

The restructured program for undergraduate agriculture education, with multiple entry and exit options, is illustrated in Figure 1.

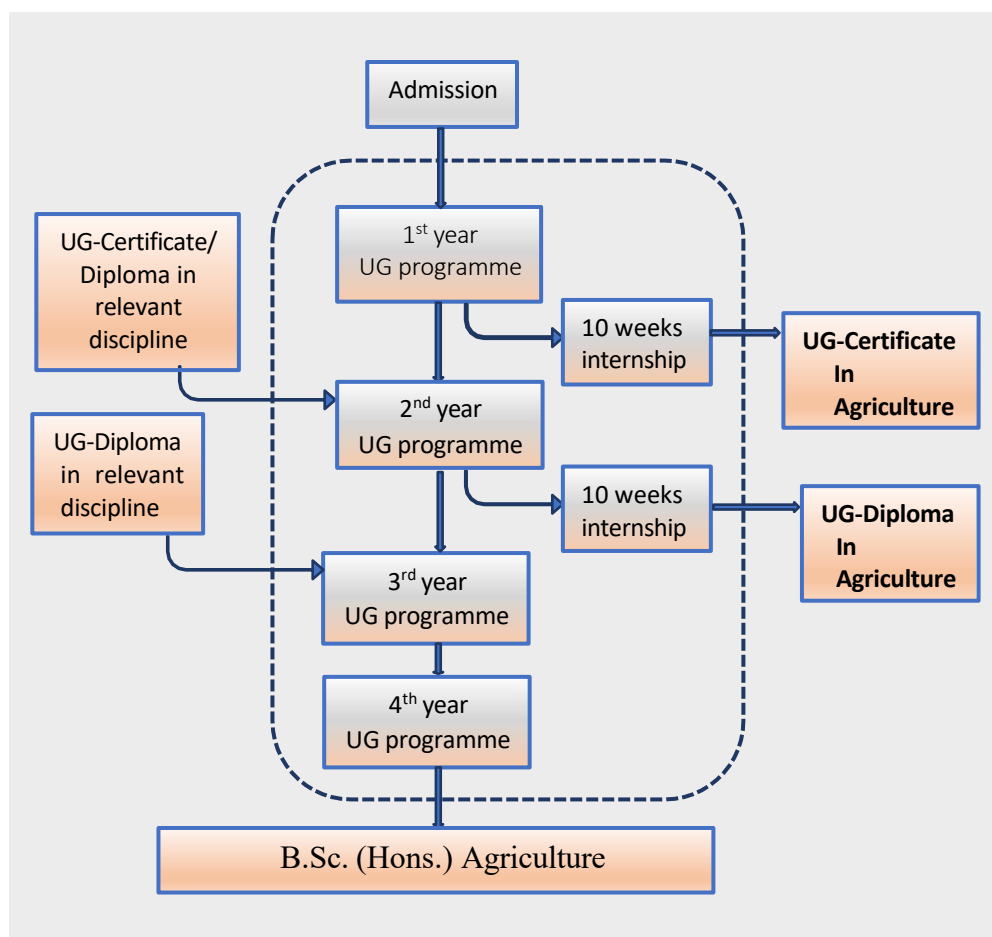


Fig. 1. Framework of Undergraduate Programmes

Eligibility for entry into the UG programmes will be +2 Science (Maths, Biology, and Agriculture streams). Students will be admitted as per the norms of HNB Garhwal University. The first year of the programme will include foundation, introductory, and skill enhancement courses. The second year will include basic core courses, with additional options for skill enhancement. The third year of the programme will focus on advanced core courses. The fourth year of the programme will place greater emphasis on specialisation and elective courses, as well as advanced skill enhancement through internships and research.

Any student who exits the programme during the first or second year under the new syllabus (w.e.f. 2026–27), after being awarded a Certificate or Diploma, as applicable, may re-enter in the second or third year, respectively, and complete the programme within seven years from the date of admission to the first semester in order to obtain a B.Sc. (Hons.) in Agriculture.

Academic Programme
Semester-wise course and credit allocation
First year
B.Sc. (Hons.) Agriculture – Semester-wise Table

Semester I

Course Code	Course Title	Credits (Th+Pr)	Type
AG-1N01	Deeksharambh (Induction-cum-Foundation)	0+2 (NG)	Non-Gradial, mandatory
AG-1S01	Skill Enhancement Course–I (SEC–I)	0+2	SEC
AG-1S02	Skill Enhancement Course–II (SEC–II)	0+2	SEC
AG-1A01	Communication Skills	1+1	AEC
AG-1M01	Farming Based Livelihood Systems	2+1	MDC
AG-1C01	Rural Sociology and Educational Psychology	2+0	Core
AG-1C02	Fundamentals of Agronomy	2+1	Core
AG-1C03	Fundamentals of Soil Science	2+1	Core
AG-1C04	Fundamentals of Horticulture	2+1	Core
AG-1A02	NSS–I / NCC–I	0+1	AEC
AG-1N02	Introductory Mathematics (Need-based)	1+0 (NG)	Non-gradial remedial

Total: 21 credits (11+10) + non-Gradial

Semester II

Course Code	Course Title	Credits (Th+Pr)	Type
AG-2S01	Skill Enhancement Course–III (SEC–III)	0+2	SEC
AG-2S02	Skill Enhancement Course–IV (SEC–IV)	0+2	SEC
AG-2A01	Personality Development	1+1	AEC
AG-2V01	Environmental Studies and Disaster Management	2+1	VAC
AG-2C01	Soil Fertility Management	2+1	Core
AG-2C02	Fundamentals of Entomology	2+1	Core
AG-2C03	Livestock and Poultry Management	1+1	Core
AG-2C04	Fundamentals of Plant Pathology	2+1	Core
AG-2A02	NSS–II / NCC–II	0+1	AEC

Total: 21 credits (10+11). After Sem II: 10-week Internship (10 credits) only for students exiting with UG-Certificate.

For the internship (exit option): UG-Certificate Internship (10 weeks, 10 credits, exit option)

Semester III

Course Code	Course Title	Credits (Th+Pr)	Type
AG-3S01	Skill Enhancement Course–V (SEC–V)	0+2	SEC
AG-3M01	Entrepreneurship Development and Business Management	2+1	MDC
AG-3A01	Physical Education, First Aid, Yoga Practices & Meditation	0+2	AEC
AG-3C01	Principles of Genetics	2+1	Core

AG-3C02	Crop Production Technology–I (Kharif Crops)	1+2	Core
AG-3C03	Production Technology of Fruit and Plantation Crops	1+1	Core
AG-3C04	Fundamentals of Extension Education	1+1	Core
AG-3C05	Fundamentals of Nematology	1+1	Core
AG-3C06	Principles and Practices of Natural Farming	1+1	Core

Total: 21 credits (9+12)

Semester IV

Course Code	Course Title	Credits (Th+Pr)	Type
AG-4S01	Skill Enhancement Course–VI (SEC–VI)	0+2	SEC
AG-4M01	Agricultural Informatics and Artificial Intelligence	2+1	MDC
AG-4C01	Production Technology of Vegetables and Spices	1+1	Core
AG-4C02	Principles of Agricultural Economics and Farm Management	2+1	Core
AG-4C03	Crop Production Technology–II (Rabi Crops)	1+2	Core
AG-4C04	Farm Machinery and Power	1+1	Core
AG-4C05	Water Management	1+1	Core
AG-4C06	Problematic Soils and Their Management	1+1	Core
AG-4C07	Basics of Plant Breeding	2+1	Core

Total: 22 credits (11+10). After Sem IV: 10-week Internship (10 credits) only for students exiting with UG-Diploma.

For the diploma internship (exit option):– UG-Diploma Internship (10 weeks, 10 credits.

Semester V

Course Code	Course Title	Credits (Th+Pr)	Type
AG-5M01	Agricultural Marketing and Trade	2+1	MDC
AG-5C01	Introduction to Agro-meteorology	1+1	Core
AG-5C02	Fundamentals of Crop Physiology	2+1	Core
AG-5C03	Pest Management in Crops and Stored Grains	2+1	Core
AG-5C04	Diseases of Field & Horticultural Crops & Their Management	2+1	Core
AG-5C05	Crop Improvement (Kharif Crops) – I	1+1	Core
AG-5C06	Weed Management	1+1	Core
AG-5C07	Ornamental Crops, MAPs and Landscaping	1+1	Core
AG-5C08	Introductory Agroforestry	1+1	Core
AG-5N01	Study Tour	0+2 (NG)	Non-gradual

Credit count: 22 credits (13+9)

Semester VI

Course Code	Course Title	Credits (Th+Pr)	Type
AG-6C01	Fundamentals of Agri Biotechnology	2+1	Core
AG-6C02	Basic and Applied Agricultural Statistics	2+1	Core
AG-6C03	Crop Improvement (Rabi Crops) – II	1+1	Core
AG-6C04	Renewable Energy in Agriculture and Allied Sector	1+1	Core
AG-6C05	Dryland/Rainfed Agriculture and Watershed Management	1+1	Core
AG-6C06	Agricultural Microbiology and Phyto-remediation	1+1	Core
AG-6C07	Agricultural Finance & Cooperation	1+1	Core
AG-6C08	Essentials of Plant Biochemistry	2+1	Core
AG-6C09	Fundamentals of Seed Science & Technology	1+1	Core

Total: 21 credits (12+9)

Semester VII

All are electives. Students may choose any five-course form the following.

Sl. No	Title	Credits
AGE-01	Agri-Business Management	4(3+1)
AGE-02	Management of natural resources	4(3+1)
AGE-03	Agrochemicals	4(3+1)
AGE-04	Agricultural Journalism	4(3+1)
AGE-05	Landscaping	4(3+1)
AGE-06	Commercial Plant breeding	4(3+1)
AGE-07	Food safety and standards	4(3+1)
AGE-08	Bioformulation and Nano formulation	4(3+1)
AGE-09	Biopesticides and Biofertilizers	4(3+1)
AGE-10	System Simulation and Agro-advisory	4(3+1)
AGE-11	Hi-tech Horticulture	4(3+1)
AGE-12	Protected cultivation	4(3+1)
AGE-13	Climate Resilient Agriculture	4(3+1)
AGE-14	Biotechnology of Crop Improvement	4(3+1)
AGE-15	Geoinformatics and Remote Sensing, precision farming	4(3+1)
AGE-16	Micro-propagation Technologies	4(3+1)
AGE-17	Commercial Seed Production	4(3+1)
AGE-18	Principles and Practices of Organic Farming/ Conservation Agriculture	4(3+1)
AGE-19	Food Science and Nutrition	4(3+1)
AGE-20	Post Harvest Technology and Value Addition	4(3+1)

Total: 20 credits Electives from the approved list (Agri-Business Management, Climate Resilient Agriculture, etc.).

Semester VIII

Course Code	Component	Details	Credits
AG-8SR01	Student READY	RAWE / Industrial Attachment / Experiential Learning / Hands-on Training / Project / Internship (as per option)	20

- **Course type:**
 - **C = Core**
 - **M = MDC (Multidisciplinary / Major Discipline Course)**
 - **S = SEC (Skill Enhancement Course)**
 - **A = AEC (Ability Enhancement Course)**
 - **V = VAC (Value Added Course)**
 - **N = Non-Gradual / Non-credit**
 - **E = Elective**
 - SR= Student Ready
- B.Sc. (Hons.) Agriculture – Credit Summary**
- **Core (major + minor):** 112
 - **Common (MDC + VAC + AEC):** 23
 - **Skill Enhancement Courses (SEC):** 12
 - **Internship / Student READY:** 20
 - **Online Courses (MOOCs etc.):** 10 (non-gradual, additional)
 - **Grand Total (for degree):** 167 (GPA) + 10 (online)

Semester-wise Credit Distribution

Semester	Core Courses (Major & Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Internship / Project / Student READY	Total Credits	Non-Gradual	Online Course/MOOC
I	11	3 (3)	—	1 (4) + 2 (5)	4	—	21	2 (1) + 1 (2)	10 (15)
II	11	—	3 (6)	1 (4) + 2 (7)	4	—	21	—	
III	14	3 (8)	—	2 (9)	2	—	21	—	
IV	17	—	3 (10)	—	2	—	22	—	
V	19	3 (11)	—	—	—	--	22	2 (12)	
VI	21	—	—	—	—	—	21	—	
VII	20	—	—	—	—	—	20	—	
VIII	—	—	—	—	—	20	20	—	
Total	112	9	6	8	12	20	168	5	10 (15)

Note: Numbers in parentheses refer to the specific course descriptions listed below.

Course Descriptions (Numbered References)

1. **(1)** Deeksharambh (Induction-cum-Foundation Course) – 2 credits (2 weeks duration)
2. **(2)** Remedial Course: Mathematics – 1 credit
3. **(3)** Farming-based Livelihood Systems
4. **(4)** NCC/NSS
5. **(5)** Communication Skills
6. **(6)** Environmental Studies and Disaster Management
7. **(7)** Personality Development
8. **(8)** Entrepreneurship Development and Business Management
9. **(9)** Physical Education, First Aid and Yoga Practices
10. **(10)** Agricultural Informatics and Artificial Intelligence
11. **(11)** Agricultural Marketing and Trade
12. **(12)** Study Tour (10–14 days)
13. **(13)** Only for those opting for an exit with a UG-Certificate
14. **(14)** Only for those opting for an exit with the UG-Diploma
15. **(15)** Online course: student will make their own planning and execution of online courses with intimation to the Dean/Principles

Summary of Credit Distributions by Type of Course

Type of Courses	Credits
Core Courses (Major & Minor/s)	112
Common Courses (MDC + VAC + AEC)	23
Skill Enhancement Courses (SEC)	12
Internship / Student READY	20
MOOCs/SWAYAM (Non-Gradial)	10
Total	167 + 10

List of Courses as per the above Categories

Course category	Course title	Credit Hours
Induction cum Foundation course	Deeksharambh	2 weeks (non-gradial)
Common courses	Farming based livelihood systems	3 (2+1)
	Communication skill	2 (1+1)
	Personality development	2 (1+1)
	Environmental studies and disaster management	3 (2+1)
	Agricultural Informatics and Artificial Intelligence	3 (2+1)
	Entrepreneurship Development and Business Management	3 (2+1)
	Agricultural Marketing & Trade	3 (2+1)
	NSS/ NCC-I	2 courses each of 1 (0+1)
	Physical Education, First Aid and Yoga Practices	2 credits
	Total credits	23
Core Courses	Fundamentals of Agronomy	3 (2+1)
	Crop Production Technology-I (Kharif Crops) including Practical Crop Production	3 (1+2)
	Crop Production Technology-II (Rabi Crops) including Practical Crop Production	3 (1+2)
	Water Management	2 (1+1)
	Weed Management	2 (1+1)
	Introductory Agro forestry	2 (1+1)
	Dryland agriculture/ Rainfed agriculture and watershed management	2 (1+1)
	Principles and Practices of Natural Farming	2 (1+1)
	Fundamentals of Soil Science	3 (2+1)
	Soil Fertility Management	3 (2+1)
	Problematic Soils and their management	2 (1+1)
	Fundamentals of Horticulture	3 (2+1)
	Production Technology of Fruit and Plantation Crops	2 (1+1)
	Production Technology of Vegetables and Spices	2 (1+1)
	Ornamental Crops, MAPs, , and Landscaping	2 (2+1)
	Principles of Genetics	3 (2+1)
	Basics of Plant Breeding	3 (2+1)
	Crop Improvement (kharif crops)- I	2 (1+1)
	Crop Improvement (Rabi crops)- II	2 (1+1)
	Fundamentals of Seed Science Technology	2 (1+1)
	Fundamentals of Entomology	3 (2+1)
	Pest management in Crops and Stored Grains	3 (2+1)

	Fundamentals of Plant Pathology	3 (2+1)
	Diseases of Field & Horticultural Crops & their Management	3 (2+1)
	Agricultural Microbiology and Phyto -remediation	2 (1+1)
	Rural Sociology and Educational Psychology	2 (2+0)
	Fundamentals of Extension Education	2 (1+1)
	Introduction to Agro-meteorology	2 (1+1)
	Principles of Agricultural Economics and Farm Management	3 (2+1)
	Agricultural Finance & Cooperation	2 (1+1)
	Basic and Applied Agril. Statistics	3 (2+1)
	Farm Machinery and Power	2 (1+1)
	Renewable energy in Agriculture and Allied Sector	2 (1+1)
	Fundamentals of Nematology	2 (1+1)
	Essentials of Plant Biochemistry	3 (2+1)
	Fundamentals of Crop Physiology	3 (2+1)
	Livestock and poultry Management	2 (1+1)
	Fundamentals of Agri Biotechnology	3 (2+1)
	TOTAL	93
Elective Courses	20 credits will be taken from list of choice-based course list to be decided by host institution	20
	TOTAL	20
Skill Enhancement Courses (indicative)	SEC-I (Biofertilizer and biopesticide production)	2 (0+2)
	SEC-II (Mushroom production technology)	2 (0+2)
	SEC-III (Seed Production Technology)	2 (0+2)
	SEC-IV (Post harvest processing technology)	2 (0+2)
	SEC-V (Beneficial insect farming)	2 (0+2)
	SEC-VI (Plantation Crop Production and Processing)	2 (0+2)
	TOTAL	12
Students READY	Students READY	10+10
	TOTAL	20
Other courses	Remedial course on 1. Mathematics	1 credit (Non-gradial)
	Study tour (2 weeks in 5th semester)	2 (0+2) (Non-Gradial)
	Total for offline course credits	167
Online courses	Online courses	10
	Grand Total	167+10

General Credits Allocation Scheme of UG Programs

Sem-ester	Core Courses (Major+Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Internship / Project/ Student READY	Total Credits	Non-Gradual	Online Courses/ MOOC
I	12	3(2)		1(3) + 2(4)	4	-	22	2(1)	10
II	10	3(5)	3(6)	1(3) + 2(7)	4	-	23	-	
Post-II semester						10(12)			
III	16	----		2(8)	2	-	20		
IV	12	3(9)	3 (10)	----	2	-	20	-	
Post-IV semester						10(13)			
V	21	-	-	-	-	-	21	2(12)	
VI	21	-	-	-	-	-	21	-	
VII	20	-	-	-	-	-	20	-	
VIII	-	-	-	-	-	20	20	-	
Total	112	9	6	8	12	20	167	4	10

DETAILED SYLLABI

Types of courses and learning outcomes for the restructured undergraduate programs for the HAEIs

Year	Types of courses	Learning outcome	Exit option
YEAR 1 NHEQF Level 4. 5	Foundation courses, introductory courses and skills enhancement training/ training in the chosen area, ability enhancement courses	The student will acquire the basic knowledge in respective disciplines and adequate skill in some selected areas, to enable him for employment/student entrepreneurship.	The student must complete 10 weeks of internship (10 credits) after 1st year if exit with UG-Certificate is opted.

Semester 1

S. No.	Course Title	Credit hours
AG-1N01	Induction-cum-Foundation course (Deeksha Arambh)	2 weeks (NG)
AG-1S01	Skill Enhancement course	2(0+2)
AG-1S02	Skill Enhancement course	2(0+2)
AG-1A01	Communication Skills	2(1+1)
AG-1M01	Farming based livelihood systems	3 (2+1)
AG-1C01	Rural Sociology and Educational Psychology	2 (2+0)
AG-1C02	Fundamentals of Agronomy	3(2+1)
AG-1C03	Fundamentals of Soil Science	3(2+1)
AG-1C04	Fundamentals of Horticulture	3(2+1)
AG-1A02	NCC/ NSS	1(0+1)
AG-1N02	Introductory mathematics (need based)	1(1+0) non-grdial
	Total	21(11+10)

Course Title: AG-1N01 - Induction cum Foundation Course (Deeksharambh)-Non-Gradual Credit: 1(1+0)

Objectives:

Help for the cultural Integration of students from different backgrounds,

Know about the operational framework of the academic process in the University/College/Institute

Instilling life and social skills,

Social Awareness, Ethics and Values, Teamwork, Leadership, Creativity, etc.

Identify the traditional values and indigenous cultures along with diverse potentialities both in the indigenous and developed scenarios.

Identify the strengths and weaknesses of students across the discipline's core areas.

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

Discussions on the operational framework of the academic process in the University, as well as interactions with academic & research managers of the University

Interaction with alumni, business leaders, prospective employers, outstanding achievers in related fields, and people with inspiring life experiences

Group activities to identify the strengths and weaknesses 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

Activities to enhance the cultural Integration of students from different backgrounds.

Field visits to related fields/ establishments

Sessions on personality development (instilling life and social skills, social awareness, ethics and values, teamwork, leadership, etc.) and communication skills

Course Title: AG-1A01 - Communication Skills

Credits: 2 (1+1)

Objectives:

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

Theory

Communication Process: The magic of effective communication; building self-esteem and overcoming fears; concept, nature and significance of communication process; meaning, types and models of communication; verbal and non-verbal communication; linguistic and non-linguistic barriers to communication and reasons behind communication gap/miscommunication. Basic Communication Skills: Listening, speaking, reading and writing skills; précis writing/abstracting/summarizing; style of technical communication; curriculum vitae/résumé writing; innovative methods to enhance vocabulary; analogy questions. Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; phrases and clauses; case: subjective case, possessive case, objective case; 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

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

Suggested readings

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

Course Title: AG-1M01- Farming-based livelihood systems 3 (2+1)

Objectives

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

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban & rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS) : Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional & modern farming systems. Components of farming system/ farming based livelihood systems- Crops and cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems across agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR, and other organisations across the country, Case studies on different livelihood enterprises associated with farming. Risk & success factors in farming-based livelihood systems, Schemes & programmes by Central & State Government, Public & Private organisations 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 lifestyle.

Practical

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

Suggested Readings

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

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

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

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

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

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

Livelihood Improvement of Underprivileged Farming Community : Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey Ujjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan , S.

K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Patna, P.O. Bihar Veterinary College, Patna - 800 014, Bihar

Carlioni, A (2001) Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy

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

Agarwal, A. & Narain, S. (1989). Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India

Course Title: AG-1C01 - Rural Sociology and Educational Psychology

Credit: 2(2+0)

Objective:

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

Theory

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

J.B. Chitambar -Introductory Rural Sociology

Ray, G. L. -Extension Communication and Management

Dahama O. P. and Bhatnagar, O. P. - Education and Communication for Development

Sandhu A. S. -Textbook on Agricultural Communication

A. R. Desai -Rural Sociology in India

R Velusamy Textbook on Rural Sociology and Educational Psychology

M.B. Ghorpade- Essential of psychology

Web Materials

Prepared You Tube videos

Course Title : AG-1C02 - Fundamentals of Agronomy

Credit : 3 (2+1)

Objectives: To impart the basic and fundamental knowledge of Agronomy.

Theory:

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

Tillage and 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. 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

Integrated Nutrient Management: Meaning, different approaches and advantages of INM

Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring ,

Water management: Water resources of the world, India and the state; Soil Moisture Constants –gravitational water, capillary water, hygroscopic water, Soil moisture constants, Concept of water availability to plants, soil- plant-water relationship, crop water requirement, water use efficiency, Methods of irrigation : Scheduling of irrigation, different approaches of scheduling irrigation

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

Cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation, pollution and pollutants,

Allelopathy: Meaning and importance in crop production , Growth and development of crops: Definition, Meaning and factors affecting growth and development

Practical:

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

Suggested readings:

William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.

Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.
Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers Ludhiana.
Reddy , S. R. 2008. principle of Crop Production, Kalyani Publisher, Ludiana

Course : AG-1C03 - Fundamentals to Soil Science

Credit : 3(2+1)

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

Theory :

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

Practical :

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

Suggested readings:

Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers

Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers

Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York

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

Course: AG-1C04 - Fundamentals of Horticulture

Credit: 3 (2+1)

Objectives:

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

Theory:

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

Practical:

Identification and nomenclature of fruit, Layout of an orchard, pit making and system of planting, Nursery raising techniques of fruit crops, Understanding of plant propagation structures, Propagation through seeds and plant parts, Propagation techniques for horticultural crops, Container, potting mixture, potting and repotting, Training and pruning methods on fruit crops, Preparation of fertilizer mixture and application, Preparation and application of PGR, Layout of different irrigation systems, Maturity studies, harvesting, grading, packaging and storage

Suggested readings:

Basics of Horticulture by Jitendra Singh

Course Title: AG-1A02 - National Cadet Corps (NCC) / National Service Scheme (NSS) Credit : 1(0+1)

National Cadet Corps- As per government guidelines, for getting a B and C certificate in NCC, the minimum years of requirement is 2 & 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.

National Service Scheme (NSS)

Evoking social consciousness among students through various activities, viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skills in programme, to be able to seek self-employment, reducing the gap between the educated and the 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 the NSS course should put in at least 60 hours of social work in different activities in a semester, other than five regular one-day camps in a year, and one special camp for a 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 Governments 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 peace- building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism

Citizenship, constitution, and human rights. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family,

community (PRIs and other community-based organizations) and society

AG-1N02	Introductory mathematics (need based)	1(1+0) non-grdial
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Objective: To provide basic knowledge of basic mathematics.

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.

Differential Calculus: Definition - Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions. Application of differentiation: growth rate, Average Cost, marginal cost, and marginal revenue. Partial differentiation: Homogeneous function, Euler's theorem, Maxima and Minima of functions of the form $y = f(x)$ and $y = f(x_1, x_2)$.

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

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

Semester II

Code	Course Title	Total Credits
AG-2S01	Skill Enhancement Course	2 (0+2)
AG-2S02	Skill Enhancement Course	2 (0+2)
AG-2A01	Personality Development	2 (1+1)
AG-2V01	Environmental Studies and Disaster Management	3 (2+1)
AG-2C01	Soil Fertility Management	3 (2+1)
AG-2C02	Fundamentals of Entomology	3 (2+1)
AG-2C03	Livestock and Poultry Management	2 (1+1)
AG-2C04	Fundamentals of Plant Pathology	3 (2+1)
AG-2A02	NSS-II / NCC-II	1 (0+1)
Total		21 (10+11)

Course Title : AG-2A01- Personality Development

Credit : 2 (1+1)

Objectives:

To help students recognize their potential strengths, develop interpersonal skills, and enhance their employability.

Theory:

Definition and nature of personality; major theories and types of personality. The humanistic approach – Maslow's self-actualization theory. Shaping of personality; determinants of personality; Myers-Briggs Type Indicator (MBTI); locus of control and performance; Type A and Type B behaviours; personality and organizational behaviour. Foundations of individual behavior and factors influencing individual behavior; models of individual behavior. Perception and attribution; factors affecting perception; attribution theory and case studies on perception and attribution.

Learning: meaning and definition; theories and principles of learning; learning and organizational behavior; learning and training; learning feedback. Attitude and values. Intelligence – types of intelligence; theories of intelligence; measurement of intelligence; factors influencing intelligence; intelligence and organizational behavior; emotional intelligence. Motivation – theories and principles. Teamwork and group dynamics.

Practical:

MBTI personality analysis; learning styles and strategies; motivational needs; FIRO-B; interpersonal communication; teamwork and team building; group dynamics; win-win games; conflict management; leadership styles; case studies on personality and organizational behavior.

Suggested Reading:

Andrews, Sudhir. 1988. How to Succeed at Interviews (21st rep.). New Delhi: Tata McGraw-Hill.

Heller, Robert. 2002. Effective Leadership. Essential Manager Series. DK Publishing.
Hindle, Tim. 2003. Reducing Stress. Essential Manager Series. DK Publishing.
Lucas, Stephen. 2001. The Art of Public Speaking. New Delhi: Tata McGraw-Hill.
Mile, D. J. 2004. The Power of Positive Thinking. Delhi: Rohan Book Company.
Pravesh Kumar. 2005. All About Self-Motivation. New Delhi: Goodwill Publishing House.
Smith, B. 2004. Body Language. Delhi: Rohan Book Company.
Shaffer, D. R. 2009. Social and Personality Development (6th ed.). Belmont, CA: Wadsworth.

Course Title: AG-2V01 -Environmental Studies and Disaster Management Credits Hours : 3 (2+1)

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

Theory

Introduction to Environment – Environmental Studies: Definition, scope and importance. Multidisciplinary nature of environmental studies. Segments of the environment. Spheres of the Earth: Lithosphere, Hydrosphere, Atmosphere. Different layers of the atmosphere.

Natural Resources: Classification of natural resources. Forest resources. Water resources. Mineral resources. Food resources. Energy resources. Land resources. Soil resources.

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Energy flow in ecosystems. Types of ecosystems.

Biodiversity and Its Conservation: Introduction, definition and types of biodiversity. Biogeographical classification of India. Importance and value of biodiversity. Biodiversity hotspots. Threats to biodiversity and its conservation.

Environmental Pollution: Definition, causes, effects and control measures of: (a) Air pollution, (b) Water pollution, (c) Soil pollution, (d) Marine pollution, (e) Noise pollution, (f) Thermal pollution, (g) Light pollution.

Solid Waste Management: Classification of solid wastes and management methods – composting, incineration, pyrolysis, biogas production. Causes, effects and control measures of urban and industrial wastes.

Social Issues and the Environment: Urban problems related to energy. Water conservation, rainwater harvesting and watershed management. Environmental ethics: issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment (Protection) Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife (Protection) Act. Forest (Conservation) Act.

Human Population and the Environment: Environment and human health. Human rights. Value education. Women and child welfare. Role of information technology in environment and human health.

Disaster Management: Definition and types of disasters.

Natural Disasters: Floods, drought, cyclones, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves.

Man-made Disasters: Nuclear, chemical and biological disasters; building fire, coal fire, forest fire, oil fire; road, rail, air and sea accidents. International and national strategies for disaster reduction. Concept of disaster management, national disaster management framework, financial arrangements. Role of NGOs, community-based organizations and media in disaster management. Role of central, state, district and local administration in disaster control. Role of armed forces, police and other organizations in disaster management.

Practical

Visit to a local area to document environmental assets: river/forest/grassland/hill/mountain. Energy: Biogas production from organic wastes. Visit to windmill/hydropower/solar power generation units. Biodiversity assessment in farming systems. Floral and faunal diversity assessment in polluted and unpolluted systems. Visit to a local polluted site – urban/rural/industrial/agricultural – to study common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of acidity and alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of E. coli in water samples. Assessment of Suspended Particulate Matter (SPM). Study of a simple ecosystem – visit to pond/river/hills. Visit to areas affected by natural disasters.

Suggested Readings

- De, A.K. 2010. Environmental Chemistry. New Age International Publishers, New Delhi. ISBN: 13-978-81-224-2617-5. 384 pp.
- Dhar Chakrabarti, P.G. 2011. Disaster Management – India's Risk Management Policy Frameworks and Key Challenges. Centre for Social Markets (India), Bangalore. 36 pp.
- Erach Bharucha. Textbook for Environmental Studies. University Grants Commission, New Delhi.
- Parthiban, K.T., Vennila, S., Prasanthrajan, M., Umesh Kanna, S. Forest, Environment, Biodiversity and Sustainable Development. Narendra Publishing House, New Delhi, India, 2023 (In press).
- Prasanthrajan, M., and Mahendran, P.P. 2008. A Textbook on Ecology and Environmental Science. Agrotech Publishing Academy, Udaipur – 313 002. ISBN 81-8321-104-6. First Edition: 2008.
- Prasanthrajan, M. 2018. Objective Environmental Studies and Disaster Management. Scientific Publishers, Jodhpur, India. ISBN 978-93-87893-82-5. 146 pp.
- Sharma, P.D. 2009. Ecology and Environment. Rastogi Publications, Meerut, India.
- Tyler Miller and Scott Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/Cole, Cengage Learning, Belmont, USA.

Course Title: AG-2C01 - Soil Fertility Management

Credits: 3 (2+1)

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

Theory :

Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches. Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

History of soil fertility and plant nutrition. Criteria of essentiality; role, deficiency, and toxicity symptoms of essential plant nutrients. Mechanisms of nutrient transport to plants and factors affecting nutrient availability to plants. Chemistry of macro- and micronutrients. Soil fertility evaluation and soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests, and indicator plants. Methods of fertilizer recommendations for crops. Factors influencing nutrient use efficiency (NUE) and methods of fertilizer application under rainfed and irrigated conditions. STCR/RTNM/IPNS.

Practical:

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

Suggested readings:

Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers

Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers

Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York

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

Course Title: AG-2C02 -Fundamentals of Entomology**Credits :3 (2+1)****Objectives:**

To know the history of entomology, classification of insects and their relationship with other arthropods

To study the various morphological characters of class insecta and their importance for classification of insects

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

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

Theory

History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom.

Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda.

Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory

(Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs. Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophoridae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Practical

Methods for the collection and preservation of insects, including immature stages; external features of grasshoppers

and blister beetles; types of insect antennae, mouthparts, and legs; wing venation, types of wings, and wing-coupling apparatus; types of insect larvae and pupae; dissection of the digestive system in insects (grasshopper); study of the diagnostic characters of the orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, and Diptera, and their families of agricultural importance; insecticides and their formulations; pesticide appliances and their maintenance; and sampling techniques for estimating insect population and damage.

Suggested readings:

Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies

Introduction to the study of Insects –D. J. Borror and DeLong's

Fundamentals of Ecology - Eugene P. Odum & Gray W. Barrett

Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora

Course Title: AG-2C03 - Livestock and poultry Management

Credits: 2(1+1)

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

Theory:

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

Practical:

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

Suggested readings:

1. A Textbook of Animal Husbandry by G. C Banerjee

2. A textbook of Livestock Production management in Tropic by D. N. Verma

Course Title: AG-2C04 - Fundamentals of Plant Pathology

Credits: 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:

Introduction to Plant Pathology: Concept of disease in plants; different terms used in Plant Pathology; history of Plant Pathology with special reference to India; causes of plant diseases: inanimate and animate causes; classification of plant diseases; parasitism and pathogenesis; development of disease in plants: disease triangle and disease cycle; fungi and their morphology, reproduction, and classification; bacteria: morphology, reproduction, and classification of phytopathogenic bacteria; other plant pathogens: Mollicutes, flagellate protozoa, FVB, green algae, and parasitic higher plants; viruses and viroids, virus transmission; principles of plant disease management: disease management with chemicals, host resistance, cultural and biological methods of Integrated Disease Management (IDM).

Practical:

Study of the microscope; acquaintance with laboratory materials and equipment; study of different plant disease symptoms; microscopic examination of the general structure of fungi; simple staining of bacteria: direct and indirect staining; Gram staining of bacteria; microscopic examination of fungal diseased specimens; microscopic examination of bacterial diseased specimens; preparation of culture media; isolation of plant pathogens: fungi, bacteria, and viruses; purification of plant pathogens; study on plant disease diagnosis: Koch's postulates; characteristics, formulation, methods of application, and calculation of fungicides.

Suggested readings:

Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
Agrios, GN. 2010. Plant Pathology. Acad. Press.
Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur
Singh RS. 2008. Plant Diseases. 8 th Ed. Oxford & IBH. Pub. Co.
Singh RS. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.
Alexopoulos, Mims and Blackwel. Introductory Mycology
Mehrotra RS & Aggarwal A. 2007. Plant Pathology. 7 th Ed. Tata Mc Graw Hill Publ. Co. Ltd.
Gibbs A & Harrison B. 1976. Plant Virology - The Principles. Edward Arnold, London
Hull R. 2002. Mathew.s Plant Virology. 4th Ed. Academic Press, New York.
Verma JP. 1998. The Bacteria. Malhotra Publ. House, New Delhi.
Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
Dhingra OD & Sinclair JB. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.
Nene YL & Thapliyal PN. 1993. Fungicides in Plant Disease Control. 3rd Ed. Oxford & IBH, New Delhi.
Vyas SC. 1993. Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.
Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.
Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

Course Title: AG-2A02 - National Cadet Corps (NCC) ,National Service Scheme (NSS)**Credit: 1(0+1)****National Cadet Corps (NCC)**

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 defences 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.

National Service Scheme (NSS):

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

Note:

As per the guidelines of the Ministry of Youth Affairs and Sports, Government of India (GoI), the minimum duration of NSS volunteering required to be eligible for Certificate A is 2 years, for Certificate B is 3 years, and for Certificate C is 4 years.

Hence, the college may introduce additional (optional) content for Semester III and Semester IV to help interested students qualify for these advanced certificates.

Semester III (optional)

Vocational Skill Development

To enhance the employment potential of volunteers and to equip them to set up small business enterprises, a list of 12 to 15 vocational skills will be drawn up based on local conditions and opportunities. Each volunteer will have the option to select two skill areas from this list.

Environmental conservation, enrichment, and sustainability: climate change; natural resource management (rainwater harvesting, energy conservation, afforestation, wasteland development, and soil conservation); and waste management.

Disaster management: introduction and classification of disasters; rehabilitation and post-disaster management; and the role of NSS volunteers in disaster management.

Entrepreneurship development: definition, meaning, and qualities of an entrepreneur; steps involved in starting an enterprise; and the role of financial and support service institutions.

Formulation of production-oriented projects: planning, implementation, management, and impact assessment of projects.

Documentation and data reporting: collection and analysis of data, documentation, and dissemination of project reports.

Semester IV (Optional)

Youth and Crime

Sociological and psychological factors influencing youth crime, cybercrime, peer mentoring in crime prevention, and awareness of juvenile justice.

Civil/Self-Defense

Civil defence services: aims and objectives of civil defence; need for and training in self-defence. Resource mobilization, including writing a project proposal for Self-Fund Units (SFUs) and their establishment.

Additional Life Skills

Positive thinking, self-confidence and self-esteem; setting life goals and working to achieve them; and managing stress, including time management.

Semester III

Types of courses and learning outcomes for the restructured undergraduate programs for the HAEIs

Year	Types of courses	Learning outcome	Exit option
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YEAR-2 NHEQF Level 5	Basic core courses and additional skill enhancement in chosen areas/ courses	The student will acquire the higher level knowledge in respective disciplines and adequate skill in some selected areas, to enable him for employment at middle level/ supervisory level or for entrepreneurship	The student must complete 10 weeks of internship (10 credits) after 2nd year if exit with UG- Diploma is opted.
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Code	Course title	Total credits
AG-3S01	Skill Enhancement	2(0+2)
AG-3M01	Entrepreneurship Development and Business Management	3 (2+1)
AG-3A01	Physical Education, First Aid and Yoga Practices	2(0+2)
AG-3C01	Principles of Genetics	3(2+1)
AG-3C02	Crop Production Technology-I (Kharif crops)	3(2+1)
AG-3C03	Production Technology of Fruit and Plantation Crops	2 (1+1)
AG-3C04	Fundamentals of Extension Education	2(1+1)
AG-3C05	Fundamentals of Nematology	2(1+1)
AG-3C06	Principles and Practices of Natural Farming	2(1+1)
	Total	21(10+11)

Course Title: AG-3M01 - Entrepreneurship Development and Business Management. Credits: 3 (2+1)

Objective:

To provide students with an insight into the concept and scope of entrepreneurship.

To expose the student to various aspects of the establishment and management of a small business unit.

To enable the student to develop a financially viable agribusiness proposal.

Theory:

Development of entrepreneurship: motivational factors, social factors, environmental factors; characteristics of entrepreneurs; entrepreneurial attributes/competencies; concept, need for, and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types and functions of entrepreneurs, importance of entrepreneurial development, and the process of entrepreneurship development. Forms of business organisations,

Environmental scanning and opportunity identification: need for scanning, spotting opportunities, scanning the environment, identifying products/services, starting a project, and factors influencing opportunity sensing.

Infrastructure and support systems: government policies and schemes for entrepreneurship development; role of financial institutions and other agencies in entrepreneurship development.

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

Production management: products, product levels, product mix, quality control, production control, and material management; raw material costing and inventory control.

Personnel management: manpower planning, labour turnover, wages and salaries.

Financial management/accounting: funds, fixed capital and working capital, costing and pricing, long-term planning and short-term planning, bookkeeping, 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:

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Readings:

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

Desai V., 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.

Gupta CB. 2001. Management Theory and Practice. Sultan Chand & Sons.

Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.

Khanka SS. 1999. Entrepreneurial Development. S. Chand & Co.

Mehra P., 2016, Business Communication for Managers. Pearson India, New Delhi.

Pandey M. and Tewari D., 2010, The Agribusiness Book. IBDC Publishers, Lucknow.

Singh D. 1995. Effective Managerial Leadership. Deep & Deep Publ.

Singhal R.K., 2013, Entrepreneurship Development & Management, Katson Books.

Tripathi PC & Reddy PN. 1991. Principles of Management. Tata McGraw Hill.

Vasant Desai, 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House

Course Title: AG-3A01 - Physical Education, First Aid and Yoga Practices

Credit: 2 (0+2)

Objectives

To make students aware of Physical Education, First Aid, and Yoga practices.

To disseminate knowledge and skills on how to perform physical training, administer first aid, and increase stamina and general well-being through yoga.

Practical

Physical Education: Training and Coaching – Meaning and Concept; Methods of Training; aerobic and anaerobic exercises; calisthenics, weight training, circuit training, interval training, Fartlek training; effects of exercise on the muscular, respiratory, circulatory, and digestive systems; balanced diet and nutrition; effects of diet on performance; physiological changes due to ageing and the role of regular exercise in the ageing process; personality, its dimensions and types; role of sports in personality development; motivation and achievement in sports; learning and theories of learning; adolescent problems and their management; posture; postural deformities; exercises for good posture.

Yoga:

History of Yoga, types of Yoga, introduction to Yoga. Asanas (definition and importance): Padmasan, Gaumukhasan, Bhadrasan, Vajrasan, Shashankasan, Pashchimottanasan, Ushtrasan, Tadasan, Padahastasan, Ardha Chandrasan, Bhujangasan, Utthanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalasan (left leg–right leg), Pawanmuktasan, Halasan, Sarpasan, Ardha Dhanurasan, Shavasana.

Surya Namaskar; Pranayama (definition and importance): Omkar, Suryabhedan, Chandrabhedan, Anulom Vilom, Sheetali, Sheetkari, Bhastrika, Bhramari.

Meditation (definition and importance); Yogic Kriyas (Kapalbhati), Tratak, Jal Neti, and Tribandh.

Mudras (definition and importance): Gyan Mudra, Dhyan Mudra, Vayu Mudra, Akash Mudra, Prithvi Mudra, Shunya Mudra, Surya Mudra, Varun Mudra, Pran Mudra, Apan Mudra, Vyan Mudra, Udan Mudra.

Role of yoga in sports.

Teaching of asanas – demonstration, practice, correction, and practice.

History of sports and ancient games; governance of sports in India; important national sporting events; awards in sports; history, latest rules, measurements of playfields, specifications of equipment, skills, techniques, styles, and

coaching of major games (cricket, football, table tennis, badminton, volleyball, basketball, kabaddi, and kho-kho) and athletics.

Need and importance of first aid; first aid equipment and upkeep; first aid techniques. First aid related to the respiratory system; heart, blood, and circulation; wounds and injuries; bones, joints, and muscle-related injuries; nervous system and unconsciousness; gastrointestinal tract; skin and burns; poisoning; bites and stings; sense organs; handling and transport of injured or traumatized persons; sports injuries and their treatment.

Course Title: AG-3C01 - Principles of Genetics

Credits: 3 (2+1)

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

Theory

Pre- and post-Mendelian concepts of heredity, Mendelian principles of heredity, architecture of chromosomes: chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory of inheritance, cell cycle and cell division – mitosis and meiosis. Probability and chi-square. Dominance relationships, epistatic interactions with examples. Multiple alleles, pleiotropism and pseudoalleles. Sex determination and sex linkage, sex-limited and sex-influenced traits. Blood group genetics. Linkage and its estimation, mechanism of crossing over, chromosome mapping. Structural and numerical variations in chromosomes and their implications. Use of haploids, dihaploids and double haploids in genetics. Mutation: classification, methods of inducing mutations and CIB technique, mutagenic agents and induction of mutation. Qualitative and quantitative traits, polygenes and continuous variation, multiple-factor hypothesis. Cytoplasmic inheritance. Genetic disorders. Nature, structure and replication of genetic material. Protein synthesis, transcription and translation mechanisms of genetic material. Gene concept: gene structure, function and regulation; Lac and Trp operons.

Practical

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

Suggested Readings:

Fundamentals of Genetics: B. D. Singh

Principles of Genetics: Gardner, Simmons and Snustad

Genetics: M. W. Strickberger

Principles of Genetics: Sinnott, Dunn and Dobzhansky

Course Title: AG-3C02 - Crop Production Technology-I (Kharif crops)

Credits : 3(2+1)

Objectives:i)To impart basic and fundamental knowledge on principles and practices of kharif crop production. To impart knowledge and skill on scientific crop production and management.

Theory:

Origin, geographical distribution, economic significance, soil and climatic needs, varieties, cultural practices, and yield of Kharif crops. Cereals – rice, maize, sorghum, pearl millet, and finger millet; pulses – pigeonpea, mungbean, and urdbean; oilseeds – groundnut and soybean; fibre crops – cotton and jute; forage crops – sorghum, cowpea, cluster bean, and Napier.

Practical:

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

Suggested readings:

- B. Gururajan, R. Balasubramanian, and V. Swaminathan. Recent Strategies on Crop Production. KA Publishers, New Delhi.
- Chidida Singh. 1997. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Rajendra Prasad. Textbook of Field Crops Production – Commercial Crops. Volume II. ICAR Publication.
- S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
- S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
- UAS, Bangalore. 2011. Package of Practices. UAS, Bangalore.
- Subhash Chandra Bose, M., and Balakrishnan, V. 2001. Forage Production. South Asian Publishers, New Delhi.
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Course Title: AG-3C04 - Fundamentals of Extension Education**Credit: 2 (1+1)****Objectives:**

1. To acquaint students with the concept, philosophy, objectives and principles of extension education, and the role of agricultural extension in transfer of technology and rural development.
2. To develop an understanding of communication and diffusion of innovations, and familiarize students with major extension systems, methods and strategies for planning, implementing and evaluating extension programmes.

Theory:

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 the pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Reorganised Extension System (T&V system); various extension/agricultural development programmes launched by ICAR/Government of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).

Social justice and poverty alleviation programmes – ITDA, IRDP/SGSY/NRLM. Women's development programmes – RMK, MSY, etc. New trends in agricultural extension: privatised extension, cyber extension/e-extension, market-led extension, farmer-led extension, expert systems, etc.

Rural Development: Concept, meaning, definition; various rural development programmes launched by the Government of India. Community development – meaning, definition, concept and principles; philosophy of community development.

Rural leadership: Concept and definition; types of leaders in the rural context; methods of identification of rural leaders.

Extension administration: Meaning and concept; principles and functions.

Monitoring and evaluation: Concept and definition; monitoring and evaluation of extension programmes.

Transfer of technology: Concept and models; capacity building of extension personnel.

Extension teaching methods: Meaning, classification; individual, group and mass contact methods; 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.

Agricultural journalism; diffusion and adoption of innovation – concept and meaning; process and stages of adoption; adopter categories.

Practical:

To get acquainted with the university extension system. Group discussion- exercise; Identification of rural leaders in village situation; preparation and use of AV aids, preparation of extension literature – (leaflet, booklet, folder, pamphlet news stories and success stories); Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA/PRI and other development departments at district level; visit to NGO/FO/FPO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television.

Suggested readings:

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

Course Title: AG-3C05 - Fundamentals of Nematology**Credits: 2(1+1)****Objectives:**

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

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

Theory:

Introduction – History of Phyto nematology; habitat and diversity; economic importance of nematodes. General characteristics of plant-parasitic nematodes. Nematodes – 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. Symptomatology; role of nematodes in disease development; interaction between plant-parasitic nematodes and disease-causing fungi, bacteria and viruses. Nematode pests of crops: rice, wheat, vegetables, pulses, oilseed and fibre crops, citrus and banana, tea, coffee and coconut. Different methods of nematode management: cultural methods, physical methods, biological methods, chemical methods, plant quarantine, plant resistance and INM.

Practical:

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

Suggested Readings:

Textbook on Introductory Plant Nematology – R. K. Walia and H. K. Bajaj
Plant Parasitic Nematodes (Vol. 1) – Zuckerman, Mai and Rohde
Plant Parasitic Nematodes of India: Problems and Progress – Gopal Swarup, D. R. Dasgupta and P. K. Koshy
Economic Nematology – edited by J. M. Webster

Course Title: AG-3C06 - Principles and Practices of Natural Farming**Credits :2 (1+1)****General Objectives:** To provide a comprehensive understanding and knowledge to students about natural farming**Specific Objectives:**

- i) To teach students the concepts, needs, and principles of native, ecology-based production under natural farming.
- ii) To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

Theory:

Indian heritage of ancient agriculture; history of natural farming; importance of natural farming in the context of climate change, soil health, water use, carbon sequestration, biodiversity conservation, food and nutritional security, and the Sustainable Development Goals (SDGs). Concept, definition, objectives, essential characteristics, and principles of natural farming; scope and importance of natural farming. Main pillars of natural farming; methods, types, and schools of natural farming. Characteristics and design of a natural farm. Concept of ecological balance, ecological engineering, and community responsibility in natural versus other farming systems. Introduction to the concepts of ecological, water, carbon, and nitrogen footprints. Concept and evaluation of ecosystem services.

Integration of crops, trees, and animals; cropping system approaches; biodiversity; indigenous seed production; farm waste recycling; water conservation and renewable energy use approaches on a natural farm. Rearing practices for animals under natural farming. Nutrient management in natural farming and their sources. Insect, pest, disease, and weed management under natural farming. Mechanization in natural farming. Processing, labelling, economic considerations and viability, certification and standards in natural farming; marketing and export potential of natural farming produce and products. Initiatives taken by government (central/state), NGOs, and other organizations for the promotion of natural farming and chemical-free agriculture. Case studies and success stories in natural farming and chemical-free traditional farming. Entrepreneurship opportunities in natural farming.

Practical:

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

Suggested Readings:

- Nalini S. 1999. *Krishi-Parashara (Agriculture by Parashara)*. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104 pp.
- Shamasastri R. 1915. *Kautilya's Arthashastra*.
- Ayachit S.M. 2002. *Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa)*. Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4:205.
- 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 Telangana), India. 94 pp.
- Ecological Farming – The Seven Principles of a Food System that Has People at its Heart. May 2015, Greenpeace.
- HLPE. 2019. *Agroecological 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>
- FAO. 2018. *The 10 Elements of Agroecology: Guiding the Transition to Sustainable Food and Agricultural Systems*. <https://www.fao.org/3/i9037en/i9037en.pdf>
- Behera U.K. 2013. *A Textbook of Farming System*. Agrotech Publishing House, Udaipur. (ISBN: 978-81-8321-309-7)
- Hill S.B. and Ott P. (eds.). 1982. *Basic Techniques in Ecological Farming*. Birkhäuser Verlag, Basel, Germany, 366 pp.
- Boeringa R. (ed.). 1980. *Alternative Methods of Agriculture*. Elsevier, Amsterdam, 199 pp.
- Ecological Farming – The Seven Principles of a Food System that Has People at its Heart. May 2015, Greenpeace.
- Fukuoka M. 1985. *The Natural Way of Farming: The Theory and Practice of Green Philosophy*. Japan Publications, Tokyo, 280 pp.
- INFRIC. 1988. *Guidelines for Nature Farming Techniques*. Atami, Japan. 38 pp.
- Khurana A. and Kumar V. 2020. *State of Organic and Natural Farming: Challenges and Possibilities*. Centre for Science and Environment, New Delhi.
- 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.
- Faires N. 2016. *The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides)*.
- Dabholkar S.A. and Prayog Pariwar. 2021. *Plenty for All: Natural Farming A to Z – Prayog Pariwar Methodology*.
- Paramu P. 2021. *Natural Farming Techniques: Farming without Tilling*.
- Lindenmayer D.B., Macbeth S.M., et al. 2022. *Natural Asset Farming: Creating Productive and Biodiverse Farms*. कमलागत प्राकृतिक कृततः आचार्य देवव्रत, pp. 1-166.

Malhotra R. and Babaji S.D. 2020. Sanskrit Non-Translatables – The Importance of Sanskritizing English. Amaryllis, New Delhi, India.

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, Documents 1 to 7. Indian Council of Agricultural Research, New Delhi.

Semester IV

S. No	Course Title	Total credits
AG-4S01	Skill Enhancement course	2(0+2)
AG-4M01	Agri informatics	3(2+1)
AG-4C01	Production Technology of Vegetables and Spices	2(1+1)
AG-4C02	Principles of Agricultural Economics and Farm Management	2(2+0)
AG-4C03	Crop Production Technology-II (Rabi Crops)	3(2+1)
AG-4C04	Farm Machinery and Power	2 (1+1)
AG-4C05	Water Management	2 (1+1)
AG-4C06	Problematic Soils and their management	2(1+1)
AG-4C07	Basics of Plant Breeding	3(2+1)
	Total	21(12+9)

Course Title: AG-4M01 - Agri Informatics

Credits: 3 (2+1)

Objective

To acquaint students with the basics of computer applications in agriculture, multimedia, database management, mobile app applications, and decision-making processes, etc.

To provide basic knowledge of computers with applications in Agriculture.

ii) To make the students familiar with Agricultural-Informatics, its components and applications in agriculture.

Theory

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 a database; uses of DBMS in agriculture. Internet and World Wide Web (WWW): concepts and components.

Computer programming: general concepts; introduction to Visual Basic, Java, Fortran, C/C++, etc.; concepts and standard input/output operations.

e-Agriculture: concepts, design and development; application of innovative ways to use information and communication technologies (ICT) in agriculture. Computer models in agriculture: statistical, weather analysis, and crop simulation models—concepts, structure, input–output files, limitations, advantages, and applications for understanding plant processes; sensitivity, verification, calibration, and validation. IT applications for the computation of water and nutrient requirements of crops. Computer-controlled devices (automated systems) for agri-input management. Smartphone and mobile apps in agriculture for farm advice (market prices, post-harvest management, etc.). Geospatial technology: concepts, techniques, components and uses for generating valuable agri-information. Decision support systems: concepts, components and applications in agriculture. Agricultural expert systems, soil information systems, etc., for supporting farm decisions. Preparation of contingent crop planning and crop calendars using IT tools. Digital India and schemes to promote digitalization of agriculture in India.

Practical

Study of computer components and accessories; practice of important DOS commands; introduction to different operating systems such as Windows and Unix/Linux; creating files and folders; file management. Use of MS Word and MS PowerPoint for creating, editing and presenting scientific documents. MS Excel: creating spreadsheets; use of statistical tools; writing expressions; creating graphs; analysis of scientific data; handling macros. MS Access: creating databases, preparing queries and reports. Demonstration of agri-information systems. Introduction to the

World Wide Web (WWW) and its components. Introduction to programming languages such as Visual Basic, Java, Fortran, C and C++. Hands-on practice on crop simulation models (CSM): DSSAT, Crop-Info, CropSyst, WOFOST. Preparation of input files for CSM and study of model outputs; computation of water and nutrient requirements of crops using CSM and IT tools. Use of smartphones and other devices in agro-advisory services and dissemination of market information. Introduction to geospatial technology. Hands-on practice on preparation of decision support systems. Preparation of contingent crop planning. India Digital Ecosystem of Agriculture (IDEA).

Suggested Readings

Fundamentals of Computer by V. Rajaraman.

Introduction to Information Technology by Pearson.

Introduction to Database Management Systems by C. J. Date.

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

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

Course Title: AG-4C01 - Production Technology of Vegetables and Spices

Credits: 2 (1+1)

Objectives:

To educate about the different forms of classification of vegetables

To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices.

To educate about the physiological disorders of vegetables and spices

Theory

Importance of vegetables & 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 (Tomato, Brinjal, Chili, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knol-Khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak, Perennial vegetables)

Practical

Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices. Fertilizers applications. Harvesting & preparation for market. Economics of vegetables and spices cultivation.

Suggested readings:

Vegetable Crops by J. Kabir, T.K. Bose, M.G. Som

Olericulture, Fundamentals of Vegetable Production (Vol.1) by K.P. Singh, Anant Bahadur

Vegetable crops (Production technology, Vol II) by M.S. Fagaria, B.R. Choudhury, R.S. Dhaka

Course Title: AG-4C02 - Principles of Agricultural Economics and Farm Management

Credits : 3(2+1)

Objectives:

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

Theory:

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macro economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition,

characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. 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.. Cost: Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement.. 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. International trade and balance of payments. GST and its implication on Indian economy.

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms. Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage. Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies.

Practical

Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns/opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crop and livestock enterprises. Preparation of farm plan and budget, farm records and accounts and profit & loss accounts. Collection and analysis of data on various resources in India.

Suggested readings:

S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd
Johl, S.S and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers

Course Title: AG-4C03 - Crop Production Technology-II (Rabi Crops)

Credits: 3(2+1)

Objectives: i) To impart basic and fundamental knowledge on principles and practices of rabi crop production.
ii) To impart knowledge and skill on scientific crop production and management. .

Theory:

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

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

Suggested readings:

B. Gururajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.

Chidda Singh. 1997. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co. Pvt. Ltd., Delhi.

Rajendra Prasad. Textbook of Field Crops Production – Commercial Crops. Volume II. ICAR Publication.

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

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

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

UAS, Bangalore. 2011. Package of Practices. UAS, Bangalore.

Rajendra Prasad. 2002. Textbook of Field Crops Production. ICAR, New Delhi.

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

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

Course Code: AG-4C04 - Farm Machinery and Power**Credits: 2(1+1)****Objectives:**

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

Theory:

Status of farm power in India; sources of farm power. Internal combustion (I.C.) engines: working principles of I.C. engines and comparison of two-stroke and four-stroke cycle engines. Study of different components of an I.C. engine, I.C. engine terminology, and solved problems.

Familiarization with different systems of I.C. engines: air cleaning, cooling, lubrication, fuel supply, and hydraulic control system of a tractor. Familiarization with the power transmission system: clutch, gear box, differential, and final drive of a tractor. Tractor types; cost analysis of tractor power and attached implements; criteria for selection of tractors and machine implements.

Familiarization with primary and secondary tillage implements; implements for hill agriculture; implements for intercultural operations. Familiarization with sowing and planting equipment, calibration of a seed drill, and solved examples. Familiarization with plant protection equipment, harvesting equipment, and threshing equipment.

Practical:

Study of different components of an I.C. engine. Study of the air-cleaning and cooling systems of the engine. Familiarization with the clutch, transmission, differential, and final drive of a tractor. Familiarization with the lubrication and fuel supply systems of the engine. Familiarization with the brake, steering, and hydraulic control systems of the engine. Learning basic tractor driving. Familiarization with the operation of a power tiller. Study of implements for hill agriculture. Familiarization with different types of primary and secondary tillage implements: mouldboard plough, disc plough, and disc harrow. Familiarization with seed-cum-fertilizer drills, their seed-metering mechanisms and calibration, planters, and transplanters. Familiarization with different types of sprayers and dusters. Familiarization with different inter-cultivation equipment. Familiarization with harvesting and threshing machinery. Calculation of power requirements for different implements.

Suggested readings:

Jagdiswar Sahay – Elements of Agricultural Engineering

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

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

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

Course Title: AG-4C05 - Water Management**Credits :2(1+1)****Objectives:**

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

Theory:

Irrigation: definition and objectives, Importance of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships; Available and unavailable soil moisture – distribution of soil moisture – water budgeting – rooting characteristics – moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, 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; Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); Agricultural drainage. Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops., drip, sprinkler. Layout of underground pipeline system.

Practical:

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

Suggested readings:

Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech Publishing, Aca Udaipur.
DilipkumarMujmdar. Irrigation Water Management: Principles and Practices. Prentice Hall of India Pvt.
S.V. Patil & Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish publishing House, Delhi.
Carr M. K. V. and Elias Fereres. Advances in Irrigation Agronomy. Cambridge University Press.
Michael, A.M. Irrigation Theory and practice. Vikas publishing house Pvt, Ltd.

Course Title: AG-4C06 - Problematic Soils and their management**Credits: 2 (1 + 1)****Objectives:**

1. To acquaint students with various problem soils, including degraded, acidic, saline, alkali, eroded, submerged, and polluted soils, and to impart knowledge about remote sensing, GIS, multipurpose trees, and land capability classification.
2. To provide hands-on training in the estimation of various soil and water quality parameters associated with problem soils.

Theory

Soil quality and health, Distribution of Waste land and problem soils in India with special reference to Assam and

North-Eastern Region. Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Management of Riverine soils, Waterlogged soils, Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined),

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

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

Practical :

Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO₃, HCO₃, Cl, SAR and RSC), Determination of nitrate (NO₃-) from irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples,

Suggested readings:

Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices. AGROBIOS (India).

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

Indian Society of Soil Science, 2002. Fundamentals of Soil Science. IARI, New Delhi.

Brady Nyle C and Ray R Well, 2014. Nature and properties of soils. Pearson Education Inc., New Delh i.

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

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

Course Title: AG-4C07 - Basics of Plant Breeding

Credits : 3(2+1)

Objectives:

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

Theory:

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

Practical:

Plant breeder's kit; study of germplasm of various crops; study of floral structures of self-pollinated and cross-pollinated crops; emasculation and hybridization techniques in self- and cross-pollinated crops; consequences of inbreeding on the genetic structure of resulting populations; study of male sterility systems; handling of segregating populations; methods of calculating mean, range, variance, standard deviation, and heritability; designs used in plant breeding experiments; analysis of Randomized Block Design (RBD); determining the mode of pollination in a given crop and estimating the extent of natural out-crossing; prediction of the performance of

double-cross hybrids.

Suggested readings:

- Allard, R.W. Principles of Plant Breeding (1st & 2nd ed.).
- Sharma, J.R. Plant Breeding: Principles and Practices.
- Singh, B.D. Plant Breeding.
- Chahal, G.S. and Gosal, S.S. Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches.
- Acquaaah, G. Principles of Plant Genetics and Breeding.

Semester V

Types of courses and learning outcomes for the restructured undergraduate programs for the HAEIs

Year	Types of courses	Learning outcome	Exit option
YEAR-3	Advanced core subjects and their practical applications	The student will have deeper understanding of the subjects and their major application areas	No exit after 3rd year

S. No	Course title	Total credits
AG-5M01	Agricultural Marketing and Trade	3 (2+1)
AG-5C01	Introduction to Agro-meteorology	2(1+1)
AG-5C02	Fundamentals of Crop Physiology	3(2+1)
AG-5C03	Pest management in Crops and Stored Grains	3 (2+1)
AG-5C04	Diseases of Field & Horticultural Crops & their Management	3(2+1)
AG-5C05	Crop Improvement - I	2 (1+1)
AG-5C06	Weed Management	2(1+1)
AG-5C07	Ornamental Crops, MAPs and Landscaping	2 (1+1)
AG-5C08	Introductory Agro forestry	2 (1+1)
AG-5N01	Study Toure	2(0+2) NG
	Total	22(13+9)

Course Title: AG-5M01 - Agricultural Marketing and Trade

Credits : (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:

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 agricultural commodities: nature and determinants of demand and supply of farm products; producer's surplus – meaning and types; marketable and marketed surplus; factors affecting the marketable surplus

of agricultural 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, transportation and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark). Market functionaries and marketing channels: types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.

Integration, efficiency, costs and price spread: meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting the cost of marketing; reasons for higher marketing costs of farm commodities; measures to reduce marketing costs.

Role of Government 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; overview of futures trading. Agricultural prices and policy: meaning and functions of price; administered prices; need for innovations in agricultural price policy. Trade: concept and need of international trade; theories of absolute and comparative advantage; present status and prospects of international trade in agricultural commodities; WTO; Agreement on Agriculture (AoA) and its implications for Indian agriculture; IPR. Role of Government in agricultural marketing; role of APMC and its relevance in the present context.

Practical:

Plotting and study of demand and supply curves and calculation of elasticities; study of the relationship between market arrivals and prices of selected commodities; computation of marketable and marketed surplus of important commodities; study of price behaviour over time for selected commodities; construction of index numbers; visit to a local market to study various marketing functions performed by different agencies; identification of marketing channels for a selected commodity; collection of data on marketing costs, margins and price spread and class presentation of the report; visit to market institutions – NAFED, SWC, CWC, cooperative marketing societies, etc. to study their organization and functioning; application of the principles of comparative advantage in international trade.

Suggested Readings:

Acharya, S.S. and Agarwal, N.L., 2006, Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Chinna, S.S., 2005, Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.

Dominic Salvatore, Micro Economic Theory

Kohls Richard, L. and Uhl Josheph, N., 2002, Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.

Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall.

Lekhi, R. K. and Jogindr Singh, 2006, Agricultural Economics. Kalyani Publishers, Delhi.

Memoria, C.B., Joshi, R.L. and Mulla, N.I., 2003, Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.

Pandey Mukesh and Tewari, Deepali, 2004, Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.

Sharma, R., 2005, Export Management, LaxmiNarain Agarwal, Agra.

Course Title: AG-5C01 - Introduction to Agro-meteorology

Credits : 2(1+1)

Objectives

1. To introduce students to the concepts of weather and climate and the underlying physical processes related to plants and the atmosphere.
2. To impart the theoretical and practical knowledge of instruments/equipment used for the measurement of different weather variables in an agrometeorological observatory.

Theory

To study the meteorological aspects of climate change in agriculture and allied activities, covering the meaning and scope of agricultural meteorology; the structure, extent, and composition of the Earth's atmosphere; atmospheric weather variables; atmospheric pressure and its variation with height; wind, types of wind, daily and seasonal variation in wind speed, cyclones, anticyclones, land and sea breezes; the nature and properties of solar radiation, solar constant, depletion of solar radiation, shortwave, longwave and thermal radiation, net radiation, and albedo; atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical temperature profile, and Earth's energy balance; atmospheric humidity, the concept of saturation, vapour pressure, processes of condensation, formation of dew, fog, mist, frost, and clouds; precipitation, processes of precipitation, types of precipitation such as rain, snow, sleet, and hail, and cloud formation and classification; artificial rainmaking; monsoon—mechanism and importance in Indian agriculture; weather hazards—drought, floods, frost, tropical cyclones, and extreme weather events such as heat waves and cold waves; agriculture–weather relationships; modification of crop microclimate; climatic normals for crop and livestock production; weather forecasting—types of weather forecasts and their uses; and climate change, climatic variability, global warming, causes of climate change, and its impact on regional and national agriculture.

Practical

Visit to an agrometeorological observatory, selection of observatory site, exposure of instruments and weather data recording; measurement of total, shortwave, and longwave radiation, and estimation using Planck's law of radiation; measurement of albedo and sunshine duration, computation of radiation intensity using BSS; measurement of maximum and minimum air temperature, data tabulation, and trend and variability analysis; measurement of soil temperature and computation of soil heat flux; determination of vapour pressure and relative humidity; determination of dew point temperature; measurement of atmospheric pressure and analysis of atmospheric conditions; measurement of wind speed and direction and preparation of wind rose; measurement, tabulation, and analysis of rainfall; measurement of open-pan evaporation and evapotranspiration; computation of PET and AET.

Suggested readings:

Introduction to Agrometeorology & Climate Change by Alok Kumar Patra

Fundamentals of Agrometeorology and Climate Change by G. S. Mahi & P. K. Kingra

Text Book of Agricultural Meteorology by MC Varshneya & PB Pillai

Introduction to Agrometeorology by H. S. Mavi

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

Course Title: AG-5C02 - Fundamentals of Crop Physiology

Credits: 3(2+1)

Objectives:

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

Theory:

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 in crop plants. Definition of water potential and its components. Water absorption by plants: concepts of active and passive absorption. Water loss by plants: types of water loss (transpiration, stomatal physiology and guttation). Water-use efficiency (WUE) and factors affecting it.

Classification of mineral elements: essential and beneficial elements. Passive and active transport of mineral elements: Nernst equation, ion transport, ion pumps and channels. Functions of essential elements and their deficiency and toxicity symptoms. Hydroponics and sand culture.

Brief outline of the photosynthetic apparatus, pigment systems, quantum requirement and quantum yield: structure of the chloroplast; examples of different photosynthetic pigments (chlorophylls, carotenoids, phycobilins, etc.); differences between chlorophyll a and chlorophyll b; structures of chlorophyll a and chlorophyll b; short discussion on quantum requirement and quantum yield; red drop and Emerson enhancement effect; pigment systems I and II.

Introduction to the light reactions 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 photophosphorylation and the production of assimilatory power.

Introduction to C₃, C₄ and CAM pathways: Calvin cycle, Hatch–Slack cycle, CAM cycle. Significance of these pathways (concept of photorespiration; absence of photorespiration in C₄ plants; productivity of C₄ plants; CAM as an adaptive mechanism). Factors affecting photosynthesis (light, temperature, CO₂, O₂, etc.).

Outline of the process of respiration: definition and importance; glycolysis, Krebs cycle and electron transport chain (ETC). Factors affecting respiration (O₂, temperature, CO₂, etc.).

Terminologies/definitions: growth, development and differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimensions, area, etc.). Introduction to CGR, RGR, NAR, etc. Short discussion on factors affecting growth and development.

Photoperiodism: classical work of Garner and Allard. Photoperiodic classification of plants: short-day plants, long-day plants, day-neutral plants, etc. Introduction to photoperiodic induction, site of photoinductive perception, and role of phytochrome. Introduction to vernalization (vernalization, devernization, etc.).

Senescence: meaning and classification (seasonal, sequential, etc.) and its 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 (PGRs), plant growth inhibitors. Recognized classes of PGRs (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:

Study of the structure and distribution of stomata. Demonstration of imbibition, osmosis, plasmolysis; estimation of water potential and relative water content. Tissue tests for mineral nutrients; identification of nutrient deficiency and toxicity symptoms in plants. Estimation of photosynthetic pigments and rates of photosynthesis, respiration and transpiration. Plant growth analysis. Study of senescence and abscission and hormonal regulation of senescence.

Demonstration of the effects of different PGRs on plants.

Suggested readings:

Plant Physiology by Robert M. Devlin and Francis H. Witham

Plant Physiology by Lincoln Taiz and Eduardo Zeiger

Plant physiology by Frank B. Salisbury and Cleon W. Ross

Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Mølle and Angus Murphy

Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F. Blaydes

Course Title: AG-5C03 - Pest management in crops and stored grains

Credits: 3(2+1)

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

Theory

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

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

Practical

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

Suggested Readings:

1. Askary, Tarique Hassan. Pest Management: Methods, Applications and Challenges., Nova Science Publishers, 2022. (Agriculture Issues and Policies; Pest Control; Science and Technology)
 2. Thalya, Prakash Rambhat, and Ravi Chandra.: Essentials of Pest Management: Key Information on Pest Identification and Its Management., 2022.
 3. Sen, Somnath, and Mohd. Sameer. A Textbook of Insect Pest and Disease Management., S. Kataria & Sons, 2021.
 4. Athwal, A. S. :Agricultural Pests of India and Southeast Asia., Kalyani Publishers.
 5. Srivastava, K. P., and G. S. Dhaliwal: A Textbook of Applied Entomology., Kalyani Publishers.
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Course Title: AG-5C04 - Diseases of Field & Horticultural Crops & their Management Credits:3 (2+1)

Objectives:

1. To study the symptoms produced in the host
2. To study the aetiology of the diseases
3. To understand the disease cycles of the pathogens during pathogenesis
4. To study the epidemiological factors responsible for disease development
5. To study management techniques for controlling major diseases of field and horticultural crops

Theory:

Symptoms, aetiology, 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); Finger millet (blast, leaf spot); 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, Pokkah Boeng); Mustard (Alternaria blight, white rust, downy mildew, Sclerotinia stem rot); Sunflower (Sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, black arm).

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); Strawberry (leaf spot); 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); Cucurbits (powdery and downy mildew, wilts); 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); Marigold (Botrytis blight, leaf spots).

Practical:

Study of the symptoms of different diseases of field and horticultural crops: blast and brown spot of rice; sheath blight and bacterial leaf blight of rice; downy mildew and powdery mildew of cucurbits; Rhizoctonia and Cercospora leaf spot of green gram/black gram; Alternaria blight and downy mildew of mustard; early blight and late blight of potato and tomato; Phomopsis blight of brinjal; powdery mildew and rust of pea; stem gall of coriander; anthracnose and fruit rot of chilli; Taphrina leaf spot of turmeric; red rot of sugarcane.

Acquaintance with fungicides, antibiotics, and biopesticides, and their use in the management of diseases of horticultural crops. Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visits for the diagnosis of field problems, and collection and preservation of diseased plant specimens for the herbarium. Students should submit 50 well-mounted, pressed specimens.

Suggested readings:

Plant Diseases (By: R.S. Singh)
Plant Disease Management: Principles and Practices (By: HridayChaube)
Integrated Plant Disease Management (By: R.C. Sharma)
Plant Pathology (By: G.N. Agrios, 2010)

Course Title: AG-5C05 -Crop Improvement - I

Credits :2(1+1)

Objectives:

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

Theory:

Centres of origin and distribution of species; wild relatives of different cereals, pulses, oilseeds, fibre, fodder, and cash crops; vegetable and other horticultural crops. Plant genetic resources: their utilization and conservation; study of the genetics of qualitative and quantitative characters. Important concepts in breeding self-pollinated, cross-pollinated, and vegetatively propagated crops. Major breeding objectives and procedures, including conventional and modern innovative approaches, for the development of hybrids and varieties for improved yield, adaptability, stability, abiotic and biotic stress tolerance, and quality (physical, chemical, nutritional). Hybrid seed production technology in maize, rice, sorghum, pearl millet, pigeonpea, etc. Ideotype concept; climate-resilient crop varieties for the future.

Practical:

Floral biology, emasculation, and hybridization techniques in different crop species, viz. rice, jute, maize, sorghum, pearl millet, ragi, pigeonpea, urdbean, mungbean, soybean, groundnut, sesame, castor, cotton, cowpea, tobacco, brinjal, okra, and cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods such as pedigree, bulk, and single-seed descent methods. Study of field techniques for seed production and hybrid seed production in kharif crops. Estimation of heterosis, inbreeding depression, and heritability. Layout of field experiments. Study of quality characters and donor parents for different characters. Visit to seed production plots and to AICRP breeding plots of different crops.

Suggested readings:

Breeding field crops-I by V.L. Chopra
Genetic improvement of field crops by C.B. Singh and D. Khare
Genetics and Breeding of Pulse crops by D.P. Singh
Vegetable breeding – Principles and Practices by Hari Har Ram
Breeding field crops by D.A. Sleper and J.M. Poehlman
Plant Breeding –theory and practice by S.K. Gupta
Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur
Practical manuals on Crop Improvement I (Kharif crops) by Rajendra Kumar Yadav

Course Title: AG-5C06 - Weed Management

Credit: 2 (1 + 1)

Objectives:

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

Theory:

Introduction to weeds; characteristics of weeds; their harmful and beneficial effects on ecosystems. Classification, reproduction, and dissemination of weeds; crop–weed competition, factors of competition, and losses in crop growth and yield; factors affecting weed growth and development. Concepts of weed management: physical, cultural,

chemical, and biological methods; principles and practices of integrated weed management; implements for weed control; robotic weed control; weed management in organic and natural farming.

Herbicide classification and properties of important herbicides; concept of adjuvants and surfactants; herbicide formulations and their uses. Mode of action of herbicides and the phenomenon of selectivity. Concept and utility of herbicide mixtures in agriculture; herbicide compatibility with other agro-chemicals and their application; herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management.

Practical:

Techniques of weed preservation; weed identification and estimation of losses caused by weeds; biology of important weeds. Study of weeds in different situations; study of shifts in weed flora in long-term trials; study of herbicide formulations and herbicide mixtures. Study of methods of herbicide application; herbicide spraying equipment, their parts, use, and maintenance; weed control implements. Calculation of herbicide doses and requirements; assessment of weed control efficiency and weed index.

Suggested readings:

Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.

Naidu, V.S.G.R., Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.

Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G., 2015. Weed management of Horticultural Crops. Agr (India), Jodhpur.

Ramamoorthy, K. and Subbian, P., Predominant Weed flora in hill –ecosystems. Agrobios (India), Jodhpur. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.

Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. All About Weed Control. Kalyani Publi Ludhiana.

Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Madras.

Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.

Course Title: AG-5C07 - Ornamental Crops, MAPs and Landscaping

Credits:3 (2+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 MAP

Theory:

Production technology of Ashwagandha, Costus, Isabgol and Geranium; production technology of Mint, Aloe and Ocimum; production technology of Lemongrass, Citronella, Vetiver and Palmarosa. Importance and scope of ornamental crops; importance and scope of medicinal and aromatic plants (MAPs) and landscaping; principles of landscaping; landscape uses of trees, shrubs and climbers. Production technology of important cut flowers such as Rose, Gerbera and Orchids; production technology of Gladiolus, Tuberose and Lilium; production technology of Chrysanthemum and Carnation. Package of practices for loose flowers such as Marigold and Jasmine under open conditions. Brief concepts of home landscaping, carpet bedding, topiary, bonsai, lawns, flower arrangement, herbaceous border, hedges, edges, etc. Processing and value addition in important ornamental crops; processing and value addition of MAPs produce.

Practical:

Identification of medicinal and aromatic plants (MAPs) and ornamental plants (trees, shrubs, climbers, seasonal flowers, and house plants). Propagation of MAPs; bed preparation and planting of MAPs. Nursery bed preparation and sowing of seasonal flower seeds; propagation of ornamental plants through terminal and herbaceous cuttings;

propagation of Anthurium and Orchids; propagation of Bougainvillea; planting of Gerbera suckers and Gladiolus corms. Establishment and maintenance of lawns; preparation of floral preservatives and their use in extending the vase life of cut flowers; training and pruning of ornamental plants and raising of hedges and edges; planning and layout of gardens.

Suggested readings:

Floriculture in India by G.S. Randhawa and Mukopadhyay

Introduction to spices, plantation crops, medicinal and aromatic plants by N.Kumar, Abdul Khadder, P. Rangaswamy, I. Irulappam

Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia

Commercial flowers (Vol 1 and 2) by T.K. Bose

Course Title: AG-5C08 - Introductory Agroforestry

Credits: 2 (1 + 1)

Objectives:

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

Theory:

Agroforestry: Definition and scope of agroforestry systems; types of agroforestry systems; potential of agroforestry in India; prevailing agroforestry systems in NE India. MPTS – definition; role of MPTS in agroforestry systems; criteria for the selection of MPTS for different agroforestry systems; MPTS of NE India. Ecological aspects of agroforestry systems: tree–crop interactions, including competition and nutrient recycling. Traditional agroforestry as a viable option for conserving agrobiodiversity in North-East India. Management of agroforestry systems; role of agroforestry in soil and water conservation. Windbreaks and shelterbelts – definition and objectives. Socio-economic aspects of agroforestry systems. Design and diagnostic study of agroforestry systems.

Silviculture: Definition and scope of silvicultural systems; propagation of tree species; regeneration by seed, coppice, root suckers; transplanting; planting by stumps, branch cuttings, and rhizomes. Nursery bed preparation and management; cultural practices for bare-root and container seedlings; 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 requirements. Ground operations, tending, harvesting, and utilization, etc.

Practical:

Study of tree growth measurement; study of environmental parameters affecting agroforestry systems. Plant propagation methods; pre-sowing seed treatment; nursery bed preparation exercises; students' practical experience in vegetation establishment and afforestation methods; practical training in pruning, coppicing, pollarding, etc.; natural and artificial regeneration. Design and diagnostic survey of agroforestry systems. Evaluation of agroforestry systems in different agroclimatic zones. Exposure visits to prevailing agroforestry systems of the state and related important institutions.

Suggested readings:

Nair, P.K.R : 1993. An Introduction to Agroforestry, Kluwer Academic Publisher

Semester VI

S. No	Course title	Total credits
AG-6C01	Fundamentals of Agri Biotechnology	3(2+1)
AG-6C02	Basic and Applied Agril. Statistics	3(2+1)
AG-6C03	Crop Improvement - II	2(1+1)
AG-6C04	Renewable energy in Agriculture and Allied Sector	2(1+1)
AG-6C05	Dryland agriculture/ Rainfed agriculture and watershed management	2(1+1)
AG-6C06	Agricultural Microbiology and Phyto -remediation	2(1+1)
AG-6C07	Agricultural Finance & Cooperation	2(1+1)
AG-6C08	Essentials of Plant Biochemistry	3 (2+1)
AG-6C09	Fundamentals of Seed Science & Technology	2(1+1)
	Total	23(13+10)

Course Title: AG-6C01 - Fundamentals of Agricultural Biotechnology

Credits: 3(2+1)

Objectives:

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

Theory:

Introduction to Plant Tissue Culture & 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; 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 techniques for the generation of quality planting material.

Introduction to Molecular Biology: DNA structure, organization and function; DNA replication, transcription and translation; RNA, its types and functions; nucleic acid hybridization; 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; transgenics and their importance in crop improvement with successful case studies.

Introduction to Various Molecular Markers: RFLP, RAPD, SSR, SNP, etc.; marker-assisted breeding in crop improvement.

Practical:

Introduction to the Plant Tissue Culture Laboratory and good laboratory practices; media preparation and sterilization; glassware sterilization; micropropagation; callus induction and culture; anther culture; apical meristem culture; preparation of synthetic seeds; isolation of plasmid DNA; quantification of DNA; agarose gel electrophoresis and visualization of plasmid DNA; restriction digestion of plasmid DNA and agarose gel electrophoresis; isolation of plant genomic DNA; PCR amplification of DNA; gel electrophoresis of amplified DNA.

Suggested readings:

Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier.

Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani

Christou P & Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons. Lewin B. 2008. Gene IX.

Peterson Publications/ Panima. W.H. Freeman & Co.

Primrose SB. 2001. Molecular Biotechnology. Panima.

Course Title: AG-6C02 - Basic and Applied Agril. Statistics

Credits: 3(2+1)

Objectives: To provide an idea of statistical concepts of both descriptive and inferential statistics, which will be useful for statistical analysis.

Theory

Introduction to Statistics and its Applications in Agriculture. Types of data. Scales of measurement 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 number of class intervals), width of class interval (C.I.), class limits (boundaries), and midpoints. Types of frequency distribution. Diagrammatic presentation of data. Bar diagrams – simple, multiple, sub-divided, and percentage bar diagrams. Pie diagram. Graphical presentation of data – histogram, frequency polygon, and ogives.

Measures of Central Tendency. Requisites for an ideal measure of central tendency. Different types of measures. Arithmetic mean – definition, properties, merits, demerits, and uses. Arithmetic mean (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.

Measures of Dispersion. Characteristics of an ideal measure of dispersion. Different types of measures of dispersion. Definition of range, interquartile range, quartile deviation, and mean deviation. Standard deviation – definition and properties. Standard deviation and variance for grouped and ungrouped data. Variance of combined series. Coefficients of dispersion. Coefficient of variation.

Measures of Skewness and Kurtosis. Definition of symmetrical distribution. Definition of skewness and measures of skewness. Definition of kurtosis and measures of kurtosis. Relationship between mean, median, and mode for symmetrical and skewed distributions.

Probability Theory and Normal Distribution. Introduction to probability. Basic terminology. Classical probability – definition and limitations. Empirical probability – definition and limitations. Axiomatic probability. Addition and multiplication theorems (without proof). Conditional probability. Independent events. Simple problems based on probability. Definition of random variable. Discrete and continuous random variables. Normal distribution – definition, probability 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.

Tests of Significance. Definition. Null and alternative hypotheses. Type I and Type II errors. 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. Terminology. 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:

Diagrammatic and Graphical Representation of Data. Calculation of A.M., Median and Mode (Ungrouped and Grouped data). Calculation of S.D. and C.V. (Ungrouped and Grouped data). Correlation and Regression analysis. Application of t-test (one-sample, two-sample independent and dependent). Analysis of variance one-way classification. CRD. Selection of a random sample using simple random sampling.

Suggested readings:

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

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

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

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

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

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

Course Title: AG-6C03 - Crop Improvement - II

Credits : 2(1+1)

1. To provide knowledge about Self-pollinated and cross-pollinated Rabi crops
2. To learn about the 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:

Centres of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds, fibres, fodders and cash crops, vegetable and other horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures, including conventional and modern innovative approaches for the development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology in Wheat, Oat, Chickpea, Rapeseed & Mustard, etc. Ideotype concept, climate-resilient crop varieties for the future.

Practical:

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

Suggested readings:

Breeding field crops-I by V.L. Chopra

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

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

Vegetable breeding – Principles and Practices by Hari Har Ram

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

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

Course Title: AG-6C04 - Renewable energy in Agriculture and Allied Sector

Credits : 2(1+1)

Objectives:

1. To gain knowledge of different types of materials used in renewable energy.
2. To understand the importance of renewable energy technologies and their applications.
3. To train students in the applications of solar thermal technology.

Theory:

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application. Availability of bio mass and their application in different places

Practical:

Familiarization with renewable energy devices. To study biogas plants, gasifiers, biodiesel production processes, briquetting machines, and biofuel production processes. Familiarization with different solar energy devices. To study solar photovoltaic systems and their applications: solar lighting, solar pumping, and solar fencing. To study solar cookers, solar drying systems, solar distillation, and solar ponds. Study of solar–wind hybrid systems. Field visit to a solar–wind farm.

Suggested readings:

CS Solanki: Solar Photovoltaic – Fundamentals, Technologies and Applications, PHI Learning Pvt. Ltd., 2011.
S. Sukhatme and J.Nayak: Solar Energy: Principles of Thermal Collection and Storage, Third Edition (Tata McGraw-Hill, 2008)
V.V.N. Kishore, Renewable Energy Engineering and Technology: principles and practice, Teri, India, 2008.

Course Title: AG-6C05 - Dryland agriculture/ Rainfed agriculture and watershed management

Credits 2

(1+1)Objectives:

1. To understand the characteristics and conditions of dryland and rainfed agriculture.
2. To gain knowledge about drought and its mitigation.
3. To acquire knowledge of water harvesting and watershed management.

Theory:

Dryland/Rainfed Agriculture: Introduction, types and characteristics; history of dryland/rainfed agriculture in India; problems and prospects of dryland/rainfed agriculture in India; soil and climatic conditions prevailing in dryland/rainfed areas; soil and water conservation techniques; drought: types, effects of water deficit on physiological and morphological characteristics of plants, crop adaptation and mitigation strategies for drought; water harvesting: importance and techniques; efficient utilization of water through soil and crop management practices; crops and cropping systems in dryland/rainfed areas; management of crops in dryland/rainfed areas; contingent crop planning for abnormal weather conditions; concept, history, objectives, principles and components of watershed management; factors affecting watershed management.

Practical:

Studies on climate classification; studies on rainfall patterns in rainfed areas of the country and patterns of onset and withdrawal of monsoons; studies on cropping patterns of different rainfed areas in the country; demarcation of rainfed areas on a map of India; interpretation of meteorological data and scheduling of supplemental irrigation on the basis

of evapotranspiration demand of crops; critical analysis of rainfall and possible drought periods in the country; effective rainfall and its calculation; studies on cultural practices for mitigating moisture stress, including mechanical and agronomic measures; soil moisture determination under different land situations; importance of seed priming to mitigate drought; assessment of meteorological drought; characterization and delineation of watersheds; field demonstrations on soil and moisture conservation measures; field demonstrations on construction of water harvesting structures; visit to rainfed research stations/watersheds.

Suggested readings:

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

Course Title: AG-6C06 - Agricultural Microbiology and Bio-remediation

Credits:2(1+1)

Objectives

1. To gain an introduction to microbiology, with a specific focus on its significance in agricultural science.
2. To become acquainted with bacterial structure and the functions of its various components.
3. To learn about the major fields of microbiology.
4. To understand the bioremediation of polluted soils using microbial agents and phytoremediation.
5. To understand the concept of biological control and the role of biopesticides in plant disease management.

Theory

Introduction to Microbiology: Definition, applied areas, and importance of microbiology.

History of Microbiology: Discovery of microorganisms; spontaneous generation theory; germ theory of disease; immunization; fermentation; and theories on the origin of life.

Bacteria: Cell structure, chemoautotrophy, photoautotrophy, and bacterial growth.

Bacterial Genetics: Genetic recombination – transformation, conjugation, and transduction.

Genetic Engineering: Plasmids, episomes, and genetically modified organisms (GMOs).

Air Microbiology: Phyllosphere microflora, phylloplane microflora, and microflora of floral parts.

Food Microbiology: Microbial spoilage; principles of food preservation; and food poisoning.

Water Microbiology: Types of water; water microorganisms; microbial analysis of water (e.g., coliform test); and purification of water.

Industrial Microbiology: Microbial products; biodegradation; biogas production; biodegradable plastics; and biological control, including microbial biopesticides for plant disease management.

Rhizosphere Microbiology: Concepts of rhizosphere microbiology; rhizodeposits – biochemical nature and release mechanisms in the rhizosphere; their functions; carbon flow in the rhizosphere; and the rhizosphere microbiome – major residents and their roles.

Plant–Microbe Interactions and Soil Health: Potential of plant growth-promoting rhizobacteria (PGPR) and endophytes for soil health and sustainability; bioremediation of polluted soils using microbial mediators; and phytoremediation of polluted soils.

Practical:

Study of the microscope. Acquaintance with laboratory materials and equipment. Microscopic observation of different groups of microorganisms (e.g., moulds/fungi). Direct staining of bacteria using crystal violet. Negative or indirect staining of bacteria using nigrosine. Gram staining of bacteria. Study of phyllo sphere and rhizosphere microflora. Measurement of microorganisms. Preparation of culture media. Isolation and purification of rhizospheric microbes.

Isolation and purification of nitrogen-fixing microorganisms. Isolation and purification of nutrient-solubilizing microorganisms. Isolation and purification of endophytes.

Suggested readings:

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

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Course Title: AG-6C07 - Agricultural Finance & Cooperation

Credits: 2(1+1)

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

Theory:

Agricultural Finance – meaning, scope and significance; credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need and classification. Credit analysis: 3 R's and 4 C's of credit. Sources of agricultural finance: institutional and non-institutional sources; commercial banks; social control and nationalisation of commercial banks; micro-financing, including Kisan Credit Card (KCC); Lead Bank Scheme; Regional Rural Banks (RRBs); scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent developments in agricultural credit. Preparation and analysis of financial statements – balance sheet and income statement. Basic guidelines for preparation of project reports, bank norms and SWOT analysis.

Agricultural Cooperation – meaning; brief history of cooperative development in India; objectives and 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 and NAFED. 3 R's, 4 C's and 7 P's of credit. Crop insurance: 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:

Optimum allocation of limited capital among different enterprises. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures. Estimation of credit requirements of farm business – a case study. Preparation and analysis of a balance sheet – a case study. Preparation and analysis of an income statement – a case study. Appraisal of a loan proposal – a case study. Techno-economic parameters for the preparation of projects. Preparation of bankable projects for various agricultural products and their value-added products. Seminar on selected topics. Different types of repayment plans.

Suggested readings:

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

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Course Title: AG-6C09 - Fundamentals of Seed Science & Technology

Credits: 2 (1 + 1)

Objectives:

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

Theory:

Introduction to seed technology: definition and importance. Seed quality: definition, characteristics of good quality seed, causes of deterioration of varietal purity, assessment of genetic purity, and different classes of seed. Foundation and certified seed production of important cereals, pulses, and oilseeds: field inspection (importance and procedures), post-harvest seed quality management, seed processing procedures (including seed drying), seed treatment (importance and methods of application), and seed packing. Seed storage: general principles, stages, and factors affecting seed longevity during storage; seed health management during storage. Seed certification and legislation: Seed Act and its enforcement, duties and powers of seed inspectors, offences and penalties, Seeds Control Order (1983), and basics of seed quality testing.

Practical:

Seed structure, seed sampling, physical purity, moisture determination, germination test, seed and seedling vigour tests, seed viability, genetic purity test (grow-out test), field inspection, and seed health testing using blotter and agar plate methods. Visits to seed production farms, seed testing laboratories, and seed processing plants.

Suggested Readings

Agarwal, R.L (1995). Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India
 Khare, D., 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
 Vanangamudi, K. (2014). Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India
 Bhojwani SS & Bhatnagar SP. 1999. The Embryology of Angiosperm. Vikas Publ
 McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall.
 Tunwar NS & Singh SN. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Semester VII

Types of courses and learning outcomes for the restructured undergraduate programs for the HAEIs

Year	Types of courses	Learning outcome	Exit option
YEAR-4 NHEQF Level 6	Specialization/ Elective courses and advanced skill enhancement through project and internship	The students will acquire advanced knowledge and skill in different areas so as to meet the higher order requirements of the society and industry as well as other prospective employers. It will also enable the graduates to become a job provider rather than being a job seeker through establishment of enterprises in concerned fields.	UG degree in concerned discipline

S. No	Course tilte	Total credits
1	5 Elective Courses each of 4(3+1) credits/ Research Project with related courses	20
	Total	20

ELECTIVE COURSES

Sl. No	Title	4(3+1)
AGE-01	Agri-Business Management	4(3+1)
AGE-02	Management of natural resources	4(3+1)
AGE-03	Agrochemicals	4(3+1)
AGE-04	Agricultural Journalism	4(3+1)
AGE-05	Landscaping	4(3+1)
AGE-06	Commercial Plant breeding	4(3+1)
AGE-07	Food safety and standards	4(3+1)
AGE-08	Bioformulation and Nano formulation	4(3+1)
AGE-09	Biopesticides and Biofertilizers	4(3+1)
AGE-10	System Simulation and Agro-advisory	4(3+1)
AGE-11	Hi-tech Horticulture	4(3+1)
AGE-12	Protected cultivation	4(3+1)
AGE-13	Climate Resilient Agriculture	4(3+1)
AGE-14	Biotechnology of Crop Improvement	4(3+1)
AGE-15	Geoinformatics and Remote Sensing, precision farming	4(3+1)
AGE-16	Micro-propagation Technologies	4(3+1)
AGE-17	Commercial Seed Production	4(3+1)
AGE-18	Principles and Practices of Organic Farming/ Conservation Agriculture	4(3+1)
AGE-19	Food Science and Nutrition	4(3+1)
AGE-20	Post Harvest Technology and Value Addition	4(3+1)

Elective course

Elective Course 01

Course Title: AGE-01 - Agri-Business Management

Credits: 4(3+1)

Objectives: To impart knowledge on understanding the concepts, processes, significance, and role of management and organisational behaviour.

Theory

Transformation of agriculture into agribusiness; various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy. Distinctive features of agribusiness management. Importance and need for agro-based industries. Classification and types of agro-based industries. Institutional arrangements and procedures to set up agro-based industries. Constraints in establishing agro-based industries.

Agri-value chain: Understanding primary and support activities and their linkages. Business environment: PEST and SWOT analysis. Management functions: roles and activities; organizational culture. Planning: meaning, definition, and types of plans. Purpose or mission, goals or objectives, strategies, policies, procedures, rules, programs, and budgets. Components of a business plan; steps in planning and implementation. Organization, staffing, directing, and motivation. Ordering, leading, supervision, communication, and control. Capital management and financial management of agribusiness. Financial statements and their importance.

Marketing management: segmentation, targeting, and positioning; marketing mix and marketing strategies; consumer behavior analysis; Product Life Cycle (PLC); sales and distribution management; pricing policy and various pricing methods.

Project management: definition, project cycle, identification, formulation, appraisal, implementation, monitoring, and evaluation. Project appraisal and evaluation techniques.

Practical

Study of agri-input markets: seeds, fertilizers, and pesticides. Study of output markets: grains, fruits, vegetables, and flowers. Study of product markets, retail trade, commodity trading, and value-added products.

Study of financing institutions: cooperatives, commercial banks, RRBs, Agribusiness Finance Limited, and NABARD. Preparation of projects and feasibility reports for agribusiness entrepreneurs. Appraisal and evaluation techniques for identifying viable projects: non-discounting techniques. Case studies of agro-based industries. Trend and growth rate of agricultural commodity prices. Net present worth technique for selection of viable projects. Internal rate of return.

Suggested readings:

Broadway, A.C. and Broadway Arif A 2002 A textbook of Agri-Business Management. Kalyani Publishers
Bairwa, S.L. 2016. Objective on fundamentals of Agri-business Management. Kalyani Publishers
Anjan Nishra, Debasish Biswas and Arunangshu Giri, 2019. Agribusiness Management, Himalaya Publishing House, 220p.
Shoji Lal Bairwa, Chandra Sen, L.K.Meena and Meera Kumari, 2018. Agribusiness Management Theory And Practices, Write And Print Publications
Virender Kamalvanshi, Agribusiness Management, Random.

Elective Course 02

Course Title: AGE-02-Management of natural resources

Credits: 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:

Introduction to Natural Resource Bases: Concept of resources; classification of natural resources; factors influencing resource availability, distribution, and use; interrelationships among different types of natural resources; concerns regarding productivity issues; and the ecological, social, and economic dimensions of resource management.

Land Resources: Land as a resource; dryland agriculture; land use classification; land degradation; human-induced landslides; soil erosion and desertification; landscape impact analysis; wetland ecology and management.

Water Resources: Use and overutilization of surface and groundwater; floods and droughts; conflicts over water; dams—their benefits and associated problems; water ecology and management.

Energy Resources: Growing energy needs; renewable and non-renewable energy sources; use and potential of alternative energy sources.

Resource Management Paradigms: Evolution and history of resource management paradigms; resource conflicts related to extraction, access, and control systems.

Approaches in Resource Management: Ecological, economic, and ethnological approaches; implications of these approaches; integrated resource management strategies.

Introduction to Soil and Water Conservation: Causes of soil erosion; definition and agents of soil erosion; water erosion—forms of water erosion, gully classification, and control measures; soil loss estimation using the Universal Soil Loss Equation; soil loss measurement techniques.

Principles of Erosion Control: Introduction to contouring and strip cropping; contour bunds, graded bunds, and bench terracing; wind erosion—mechanics of wind erosion and types of soil movement; principles and control measures for wind erosion; water harvesting techniques including lining of ponds, tanks, and canal systems.

Practical:

Identification of natural resources and their utility; practice of survey principles and training in pacing techniques for measurement; area calculation through chain survey; GPS demonstration for tracking and area measurement; estimation of soil loss and calculation of erosion index; leveling concepts and their practical utility in agriculture; preparation of contour maps; concept and design of vegetative waterways and grassed waterways; wind erosion estimation; study of different irrigation pumps and their constructional differences; farm pond construction and design aspects; visit to a nearby farm pond; visit to an erosion site; exposure to strip cropping and contour bunding.

Suggested readings:

Sustainable Natural Resource Management by Danill R. Lynch

Management of Natural Resource for Sustainable Development, by [Vijay Singh Rathor and B S Rathor](#), Daya Publishing House

Managing Natural Resources : Focus On Land And Water: Ed. Harikesh N. Mishra PHI, 2014 Learning, 496p.

Management of Resources for Sustainable Development: Sushma Goel, The Orient Blackswan 2016, 284p.

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

Natural Resource Management for Growth Development and Sustainability: Vasudeva Srishti Pal, 2023, Today & Tomorrows Printers And Publishers, 336p.

Elective Course 03**Course Title: AGE-03 -Agrochemicals****Credits: 4 (3+1)****Objectives:** To impart knowledge on different classes of agrochemicals**Theory:**

An introduction to agrochemicals, their types and roles in agriculture; their effects on the environment, soil, and human and animal health; merits and demerits of their use in agriculture; and management of agrochemicals for sustainable agriculture.

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

Fungicides – Classification. Inorganic fungicides – characteristics, preparation, and use of sulphur and copper. Mode of action of 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 uses.

Introduction and classification of insecticides: inorganic and organic insecticides – organochlorines,

organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, biorationals. Insecticide Act and rules. Insecticides banned, withdrawn, and restricted in use. Fate of insecticides in soil and plants. IGRs, biopesticides, reduced-risk insecticides, botanicals, and plant- and animal-based systemic insecticides – their characteristics and uses.

Fertilisers and their importance.

Nitrogenous fertilizers – Feedstocks and manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, and urea. Slow-release nitrogen fertilizers.

Phosphatic fertilizers – Feedstocks and manufacturing of single superphosphate. Preparation of bone meal and basic slag.

Potassic fertilizers – Natural sources of potash, manufacturing of potassium chloride, potassium sulphate, and potassium nitrate.

Mixed and complex fertilizers – Sources and compatibility, preparation of major, secondary, and micronutrient mixtures. Complex fertilizers – manufacturing of ammonium phosphates, nitrophosphates, and NPK complexes. Fertilizer Control Order. Fertilizer logistics and marketing.

Plant biopesticides for ecological agriculture. Bio-insect repellents.

Practical:

Sampling of fertilizers and pesticides. Pesticide application technology – study of various pesticide application equipment. Quick tests for identification of common fertilizers. Identification of anions and cations in fertilizers. Calculation of doses of insecticides to be used. Study and identification of various formulations of insecticides available in the market. Estimation of nitrogen in urea. Estimation of water-soluble P₂O₅ and citrate-soluble P₂O₅ in single superphosphate. Estimation of potassium in muriate of potash/sulphate of potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicides. Determination of thiram. Determination of ziram content.

Suggested readings:

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

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

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

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

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

Elective course 4

Course title: AGE-04 - Agricultural Journalism

Credits: 4(3+1)

Objectives: To impart knowledge and skill in agricultural journalism

Theory

Journalism – Meaning, nature, importance, and types of journalism. Agricultural Journalism – Meaning, definition, principles, objectives, types, and scope. Similarities and differences between agricultural journalism and other types of journalism. Role of the agricultural journalist; training of the agricultural journalist. Qualities of a journalist. Role of the journalist/journalism in agricultural development and in developing newspaper and magazine readership.

Newspapers and magazines as communication media: Characteristics, types, and functions of newspapers and magazines. Characteristics of newspaper and magazine readers. Form, content, style, and language of newspapers and magazines. Standard parts of newspapers and magazines.

The agricultural story: Types of agricultural stories, subject matter of the agricultural story, and structure of the agricultural story. Gathering farm information – Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events. Other sources: electronic media, field study.

Success stories – Definition, nature, components, and guidelines for writing a success story. Writing a news story – Difference between news and feature stories, principles of writing a news story, inverted pyramid structure.

Organising the material, treatment of the story, writing the news lead and the body.

Readability measures – Readability ease score, automated readability index, Gunning Fog Index. How to improve the readability of articles and stories.

Use of photographs in agricultural journalism – Basic principles of photography: composition, exposure, lens, light.

Use of artwork (graphs, charts, maps, etc.). Writing captions.

Editorial mechanism: Copy reading, headline and title writing. Proofreading – Definition, signs and symbols of proofreading, levels of proofreading, duties of a proofreader. Layout – Meaning, principles of layout and design.

Practical

Practice in writing an agricultural news story. Practice in writing an agricultural feature story. Covering agricultural events for information collection. Practice in interviewing for information collection. Abstracting stories from research and scientific materials and wire services. Selecting pictures and artwork for the agricultural story. Practice in editing and copy reading. Practice in headline and title writing. Practice in proofreading. Practice in layout of newspapers. Testing copy with a readability formula. Visit to a publishing office.

Suggested readings

Introduction to Journalism-Book by Carole Fleming, Emma Hemmingway, and Gillian Moore

Basic Journalism Book by Rangaswami Parthasarathy

News Reporting and Editing Book by K. M. Shrivastava

Professional Journalism Book by MV Kamath

The Journalist's Handbook Book by MV Kamath.

Farm Journalism and Media Management – Bhaskaran et al,

Agricultural Extension and farm Journalism – A K Singh,

Farm Journalism – Jana and Mitra.

Web Materials

Prepared You Tube videos

Elective course 5

Course Title: AGE-05 -Landscaping

Credits 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:

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 Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers importance, selection, propagation, planting, Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions, Bonsai principles and management, lawn: establishment and maintenance. CAD application.

Practical:

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals, care and maintenance of plants, potting and repotting, identification of tools and implements used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of

computer software, visit to important gardens /parks /institutes.

Suggested readings:

Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia

Principles Of Landscape Gardening: Y. Chandrasekhar and Hemla Naik B., 2020. ICAR,

Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh, 2020, Bio-Green Books.

Principles Of Landscape Architecture: Pragnyashree Mishra and Bhimasen Naik, 2022, New India Publishing Agency.

Landscape Gardening: Sudhir Pradhan, 2018, Scientific Publishers India.

Elective course 6

Course Title: AGE-06 - Commercial Plant Breeding

Credits: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, 2

Theory

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self- and cross-pollinated crops (A/B/R and two-line systems) for the development of hybrids and seed production. Genetic testing of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton, pigeon pea, Brassica, etc. Quality seed production of vegetable crops under open and protected environments. Alternative strategies for developing line cultivars: haploid inducers, tissue culture techniques, and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under the PPV & FR Act. Variety testing, release, and notification systems in India. Principles and techniques of seed production, types of seeds, and quality testing in self- and cross-pollinated crops.

Practical

Floral biology in self- and cross-pollinated species; selfing and crossing techniques. Seed production techniques in Self- and cross-pollinated crops using A/B/R and two-line systems. Learning techniques in hybrid seed production using male sterility in field crops. Understanding the constraints in hybrid seed production. Tools and techniques for optimizing hybrid seed production. Concept and practice of rouging in seed production plots.

Concept of lines, their multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structures in quality seed management. Screening techniques during seed processing, viz. grading and packaging. Visit to public and private seed production and processing plants.

Suggested readings:

Commercial Plant Breeding at a glance by Phundan Singh, PratibhaBisen, Reshu Tiwari. Daya Publishing House

Plant Breeding: Principles and Methods by B. D. Singh. Kalyani Publishers

Principles of Plant Breeding (1st & 2nd Edition)” by RW Allard.

Breeding Field Crops by JM Poehlman.

Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh, 2021, Astral Publishing, 160p.

Breeding and Crop Production: H. Padmalatha, Random

Biotechnology for Agricultural Breeding: Mangal, S K, GeneTech Books

Elective course 7

Course Title: AGE-07 - Food safety and standards

Credits: 4 (3+1)

Objectives:

1. Understand core principles of food safety.
2. Interpret and apply food standards and regulations.
3. Implement and evaluate food safety management systems.

Theory

Food Safety – Definition, Importance, Scope, and Factors Affecting Food Safety. Hazards and Risks.

Types of Hazards – Biological, Chemical, and Physical Hazards. Management of Hazards – Need and Importance.

Control of Parameters, Temperature Control, 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, Food Safety Measures.

Food Safety Management Tools – 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 Hygiene.

Food Laws and Standards – Indian Food Regulatory Regime, FSSAI. Global Scenario – CAC. Other Laws and

Standards Related to Food. Recent Concerns – New and Emerging Pathogens, Packaging, Product Labelling and

Nutritional Labelling, Genetically Modified Food/Transgenic Food, Organic Foods, Newer Approaches to Food Safety, Recent Outbreaks, Indian and International Standards for Food Products.

Practical:

Water Quality Analysis – Physico-chemical and Microbiological. Preparation of Different Types of Media.

Microbiological Examination of Different Food Samples. Assessment of Surface Sanitation by Swab/Rinse Method.

Assessment of Personal Hygiene. Biochemical Tests for Identification of Bacteria. Scheme for the Detection of Food-borne Pathogens. Preparation of Plans for Implementation of FSMS – HACCP, ISO:22000.

Suggested Readings:

- Textbook of Food Science and Technology – Avantina Sharma.
 - Handbook of Food Safety – D.S.L. Khatekar and N. Sarkate, 2023, Step Up Academy, 576 p.
 - Food and Beverage Management – Bernard Davis, Andrew Lockwood, Ioannis Pantelidis, Peter Alcott, 2011, Routledge.
 - Food Safety and Quality Control – Pulkit Mathur, 2018, Orient Blackswan, 332 p.
 - Safe Food Handling: HACCP Booklet for Food Handlers – Cletus Fernandes.
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Elective Course 8

Course Title: AGE-08 - Bioformulation and Nano formulation

Credit: 4 (3+1)

Objectives:

1. To develop students' knowledge and practical skills in bioformulations, nano formulations, and agrochemical formulations involving nanotechnology.
2. To help students understand the role, importance, production techniques, and applications of biofertilizers, biopesticides, essential oils, botanicals, predators, parasitosis, pheromones, and Para pheromones in sustainable insect pest management.
3. To familiarize students with modern biological and nanotechnological approaches for effective and eco-friendly agricultural pest and nutrient management.

Theory:

Introduction and history of biological control of pests and diseases; microbial biopesticides: global and Indian market scenario; biopesticides for organic agriculture; different phytopathogenic biocontrol agents and their modes of action; different entomopathogenic biocontrol agents and their modes of action; microbial inoculants as

biofertilizer candidates; production, quality assessment, and methods of application of biopesticides and biofertilizers; regulatory system of biopesticides in India; formulations of plant essential oils, botanicals, pheromones, and parapheromones and their application in insect pest management; use of predators and parasitoids for insect pest management; nanotechnology and its applications in pest and disease diagnosis and management; nano-biopesticides: concept and importance; different techniques for producing nano-biopesticides; nano-fertilizers: concept and importance; types of nano-fertilizers; different techniques for producing nano-fertilizers; green synthesis of nano-fertilizers; green slow-release fertilizer compositions based on urea-modified hydroxyapatite nanoparticles.

Practical:

Introduction and acquaintance with the biopesticide laboratory; preparation of culture media; isolation and purification of bioagents from soil and infected insects; microscopic study of different microbial bioagents; in vitro assay of microbial bioagents against plant pathogens; in vitro compatibility study among different microbial bioagents; mass multiplication of biopesticides; population enumeration of biocontrol agents in different biopesticides; preparation of plant extracts and their efficacy testing against insect pests; use of pheromones and parapheromones for monitoring and management of insect pests; bioassay of entomopathogenic biocontrol agents on insect pests; preparation of microbial inoculants of biofertilizer microbes; compatibility of biofertilizer microbes; preparation of solid and liquid consortia of biofertilizer microbes.

Suggested readings:

- Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society
Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology
Boland, G.J. and David, L. 1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC.
Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural products.
Gnanamanickam, S.S. 2002. Biological control of crop Disease. Kuykendall Marel Dekker, INC.
Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services Bangalore.
Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services Bangalore.
Allhoff, Fritz and Lin, Patrick (Eds) 2009. Nanotechnology and Society, ISBN: 978-1-4020- 6208-7 Springer Publications, UK
Prasad, Ram, Vivek Kumar, Manoj Kumar and Devendra Choudhary Eds, 2019. Nanobiotechnology in Bioformulations, Kindle Edition
Koul, Opendar Ed, 2019. Nano-biopesticides today and future perspectives, Academic Press
Shah, MA and Tokeer Ahmad Nano Science & Technology, Wiley India
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Elective course 9

Course Title: AGE- 09 - Biopesticides and Biofertilizers

Credits: 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

History and concept of biopesticides. Importance, scope and potential of biopesticides. Definitions, concepts and classification of biopesticides, viz. pathogens, botanical pesticides, and biorationals. Botanicals and their uses. Mass production technology of biopesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes. Methods of application of biopesticides. Methods of quality control and techniques of biopesticides. Impediments and limitations in the production and use of biopesticides.

Biofertilizers – Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers – Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; cyanobacterial biofertilizers – Anabaena, Nostoc, Hapalosiphon; and fungal biofertilizers – AM mycorrhiza and ectomycorrhiza. Nitrogen fixation – free-living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, and K solubilisation. Production technology: strain selection, sterilization, growth and fermentation, mass production of carrier-based and liquid biofertilizers. 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

Isolation and purification of important biopesticides: Trichoderma, Pseudomonas, Bacillus, Metarhizium, etc., and their production. Identification of important botanicals. Visit to a biopesticide laboratory in a nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities under field conditions. Quality control of biopesticides.

Isolation and purification of Azospirillum, Azotobacter, Rhizobium, P-solubilizers and cyanobacteria. Mass multiplication and inoculum production of biofertilizers. Isolation of AM fungi – wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Suggested readings:

Biopesticides

Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society
Boland, G.J. and David, L. 1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC.

Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology

Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited
Published by Springer.

Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural Products.

Gnana Manickam, S.S. 2002. Biological control of crop Disease. Kuykendall Marel Dekker, INC.

Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services Bangalore.

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

Biofertilizers

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

Biofertilizers for Sustainable Agriculture- Sampat Nehra, Aavishkar Publishers, Jaipur, India

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

Earthworm Vermiculture and Vermicomposting, R.K. Bhatnagar, R.K. Palta, Kalyani Publishers

Organic Farming: Standards, Accreditation, Certification and Inspection- Dushyent Gehlot, Agrobios (India)

Fungal Biopesticides and VAM applications-P.C. Trivedi, Pointer publishers, Jaipur, India

Elective course 10

Course Title: AGE-10 - System Simulation and Agro-advisory

Credits: 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 the preparation and dissemination of the agro-advisory bulletin

Theory

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

Practical

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

Suggested readings:

Introduction to Agrometeorology by H. S. Mavi

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

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.

Text Book of Agricultural Meteorology. ICAR by MC Varshneya & PB Pillai

Principles of Agricultural Meteorology by OP Bishnoi

Elective course 11

Course Title: AGE- 11 - Hi-tech Horticulture

Credits 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

Introduction & importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods, Protected cultivation: advantages, controlled conditions, method and techniques, Micro irrigation systems and its components; EC, pH based fertilizer scheduling, canopy management, high density orcharding, Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate Applicator (VRA), application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment identification and application, micropropagation, nursery portraits, micro-irrigation, EC, pH-based fertiliser scheduling, canopy management, visit to hi-tech orchard/nursery.

Suggested readings:

Hi-tech Horticulture by T.A. More

Greenhouse operation and management by Paul V. Nelson
Hi Tech Horticulture (Pb), S. Prasad, Dharam Singh and R'L, Bharadwaj, 2020, Agrobios
Instant Horticulture, S.N.Gupta, Jain Brothers, 2023, 488p.
Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide, Tom
Garden, Webb Eleanor

Elective course 12

Course Title: AGE-12 - Protected cultivation

Credits: 3 (2+1)

Objective:

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

Theory

Protected cultivation- importance and scope, status of protected cultivation in India and the world, types of protected structures based on site and climate. Cladding material involved in greenhouse/poly house. Greenhouse design, environmental control, artificial lights, and automation. Soil preparation and management, Substrate management. Types of benches and containers, Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops-rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lily, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc. Cultivation of economically important medicinal and aromatic plants. Off- season production of flowers and vegetables. Insect pest and disease management.

Practical

Raising seedlings and saplings under protected conditions, the use of pro-trays in quality planting material production, bed preparation, and crop planting for production. Intercultural operations, soil EC and pH measurement, and regulation of irrigation and fertilizers through drip, fogging, and misting systems.

Suggested readings:

Greenhouse operation and management by Paul V. Nelson
Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujana Singh Paikra, Manju Rani Sahu
Protected Cultivation of Horticulture Crops by Itigi Prabhakar, 2020, IBPSS.
Advances in Protected Cultivation by Brahma Singh and Balraj Singh, 2015, NIPA, 252p.
Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar, 2020
New Delhi Publishers, 263p.
Textbook Of Protected Cultivation and Precision Farming For Horticultural Crops by B. Ashok Kumar, Eggadi
Ramesh and Sindhu V, 2022, Jain Brothers.

Elective course 13

Course Title: GE – 13 - Climate Resilient Agriculture

Credits: 3(2+1)

Objectives:

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

Theory

Climate change and its impacts on agriculture and food security; crop productivity under different climate change scenarios, including extreme events such as drought, floods, pest and disease outbreaks, etc.

Basics of adaptation and mitigation in the agricultural sector; analysing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socioeconomic impacts

on the agricultural sector; risk assessment strategies; preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.

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

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

Practical

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

Suggested readings:

Climate Resilient Animal Agriculture by GSLHV Prasada Rao (New India Publishing Agency)

Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish, New India Publishing Agency

Climate-Smart Agriculture Sourcebook, FAO (2013).

Implications for Climate Smart Agriculture, Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari, Biotech Books, 357p.

Climate Resilient Agriculture, Adaptation and Mitigation Strategies, Manish Bhan, 2018, New India Publishing Agency, 294p.

Climate Change & Agriculture Over India by Prasad Rao, 2010, PHI Learning, 352p.

Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M.2022, Satish Serial Publishing House, 178p..

Elective course 14

Course Title: AGE-14 - Biotechnology of Crop Improvement

Credits: 4(3+1)

Objectives

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

Theory

Impact of Biotechnology on crop improvement and the perspective of society; Various biotechnological techniques available for crop improvement – Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection. Biosafety regulations and their application in Agricultural Biotechnology.

Somaclonal variation and its use in crop improvement; embryo culture; anther/pollen culture; somatic embryogenesis; artificial seeds; techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants.

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.

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.

Marker Assisted Breeding & 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:

Agrobacterium-mediated transformation in Tobacco – preparation of construct, transfer to binary vector, transform Agrobacterium, prepare explant, Inoculation and Co-cultivation, antibiotic based selection of putative transformants, validation using PCR; Genome editing- preparation of CRISPR/Cas construct, direct transfer to plant, analysis of the targets; Planning of a MABB programme – selection of parents, crossing strategies, marker analysis

Suggested readings:

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

Green, M. R., & Sambrook, J. (2012). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

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

Sander JD and Joung JK. (2014). CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.

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

Pranav Kumar and Usha Mina, 2015. Biotechnology: A Problem Approach, Pathfinder Publication, K.H.Singh, Ajay Kumar and Nehanjali Parmar, 2019. Agricultural Biotechnology At a Glance:, science technology.

Hari Har Ram, 2019,.Crop Breeding And Biotechnology: Kalyani Publications

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

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

Elective course 15

Course Title: AGE-15 - Geoinformatics and Remote Sensing, precision farming.

Credits: 4(3+1)

Objective: To equip students with foundational knowledge of remote sensing techniques and precision farming applications for improving crop production and soil health management.

Theory:

Introduction and history of remote sensing; sources and principles of remote sensing; propagation of radiation in the atmosphere; interaction with matter; applications of remote sensing techniques in land use mapping, soil surveys, crop stress detection, and yield forecasting; advantages and disadvantages of remote sensing., Remote sensing institutes in India, Basic Concepts about Geoinformatics.

What is artificial intelligence; History of artificial intelligence, Fundamentals of big data & machine learning (ML), Use of artificial intelligence in autonomous systems: agricultural robots and drone monitoring systems, driverless tractors, automated sprinklers and self-harvesting machines etc.; Use of AI in crop analysis: monitoring soil quality, promoting organic crops, monitoring weeds, precision agriculture, using drones for crop analysis; Role of AI for

sustainability and climate change, yield and demand forecasting, food tech/wider value chain including impact of blockchain, AI use for in the emerging markets; Technology deployment like sensors , AI and agricultural technologies and How to scale AI for agricultural technologies applications, Responsible AI in agriculture, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents.

Practical:

Familiarization with different remote sensing equipment and data products; interpretation of aerial photographs and satellite data for land resource mapping; Global Positioning System (GPS); basics of Geographic Information System (GIS); georeferencing of toposheets.

Live examples and case studies of AI applications in agriculture; search and control strategies: blind search, breadth-first search, depth-first search, hill-climbing method, best-first search, branch-and-bound search; programming in Prolog—syntax and meaning of Prolog programs, using data structures, controlling backtracking, input and output, built-in predicates, using Prolog grammar rules; higher-level assignments and exercises for implementation using Prolog.

Suggested readings:

Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor(s):.RabinarayanSatpathy, Tanupriya Choudhury, SuneetaSatpathy, Sachi Nandan .
Machine Learning Approaches to Bioinformatics by Zheng Rong Yang
Textbook of Remote Sensing and Geographical Information Systems By M. Anji Reddy
Precision Agriculture Technologies for Food Security and Sustainability By [A El-Kader](#), M Sherine, M El-Basioni, M Basma.
Principles and Theory of Geoinformatics, P.K. Garg, Khanna Publishers,2019, 296
Advances in Geoinformatics Remote Sensing, and GIS by Bhunia, Gouri Sankar & Uday Chatterjee & Gopal Krishna Panda, BIO GREEN
Artificial Intelligence: Machine Learning, Deep Learning, and Automation Processes, John Adamssen,2020, Efalon Acies
Remote Sensing and Image Interpretation, 6ed (WSE) Paperback – 1 January 2011, Willey Student Edition
Remote Sensing and Geographic Information: A.M.Chandra and S.K.Ghosh, Narosa

Elective course 16

Course Title: AGE-16 - Micro-propagation Technologies

Credits: 4 (3+1)

Objective:

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

Introduction, history, advantages and limitations. Types of cultures (seed, embryo, organ, callus, cell). Stages of micropropagation. Axillary bud proliferation (shoot tip and meristem culture, bud culture). Organogenesis (callus and direct organ formation). Somatic embryogenesis. Cell suspension cultures. Production of secondary metabolites. Somaclonal variation. Cryopreservation.

Practical

Identification and use of equipment in the tissue culture laboratory. Nutrient media composition. Sterilization techniques for media, containers, and small instruments. Sterilization techniques for explants. Preparation of stock and working solutions. Preparation of working media. Culturing of explants: seeds, shoot tips, and single-node segments. Callus induction. Induction of somatic embryos and regeneration of whole plants from different explants. Hardening procedures.

Suggested readings:

Basics of Horticulture by Jitendra Singh

Introduction to Horticulture by N. Kumar

Handbook of Horticulture by K.L. Chadda

Plant Tissue Culture : Basic and Applied by Timir Baran Jha and Biswajit Ghosh, 2016, Platinum Publishers, 439p.

Elective course 17

Course Title: AGE-17 - Commercial Seed Production

Credits : 4 (3+1)

Objectives:

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

Theory

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 apomixis, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops

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

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

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 labeling, 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

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

Planning of Seed Production, requirements for different classes of seeds in field crops - unit area and rate Operation and handling of mechanical drying equipments; effect of drying temperature and duration on seed germination and storability seed processing equipments; seed treating equipments

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, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application

and visits to seed production plots etc., Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurship visit to nearby areas, 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, control of seed borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro- propagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation

Suggested readings:

Agarwal RL. 1997. Seed Technology. 2nd Ed. Oxford & IBH.

McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall

Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill.

Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani.

Justice OL & Bass LN. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.

Tunwar NS & Singh SN. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

Chawla H.S. (2008) Introduction to Plant Biotechnology second edition, Oxford & IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049

Elective Course 18

Course Title: AGE-18 - Principles and Practices of Organic Farming and Conservation Agriculture

Credits: 2 (1+1)

Objectives:

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

Theory:

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

Practical:

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

Suggested readings:

A. C. Gaur. Handbook of Organic farming and biofertilizers.

A. K. Dahama. Organic farming for sustainable agriculture. Agrobios (India), Jodhpur.

Arun. K. Sharma. Handbook of Organic farming. Agrobios (India), Jodhpur.

S.P. Palaniappan and K. Annadurai. Organic farming – Theory and Practice. Scientific Publishers. Jod

U.Thapa and P. Tripathy. Organic farming in India- Problems and Prospects. Agrotech publishing ag Udaipur.

G. K. Veeresh. Organic farming. Foundation Books. New Delhi.
Purshit, S. S. Trends in Organic Farming in India. Agros Bios (INDIA), Jodhpur.
Thampan, P. K. Organic Agriculture. Peckaytree Crops Development Foundation, Cochin, Kerala.
Sathe, T. V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
Abhinandan Singh Pankaj Kumar Ojha & Rahul Kumar, 2018. Conservation Agriculture Technologies, Biotech Books
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.

Elective Course 19

Course Title: AGE-19 - Food Science and Nutrition

Credits: 4 (3+1)

Objectives:

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

Theory:

Introduction to the fundamentals of food and human nutrition; basic food groups; concept of a balanced diet; Recommended Dietary Allowances (RDA) for various age groups; biochemical composition, energy content, and nutritional value of major food grains, fruits, and vegetables; carbohydrates, proteins, and fats as nutrients and their interactions; physicochemical, functional, and nutritional characteristics of essential nutrients—their sources and functions; nutritional requirements, malnutrition, inborn errors of metabolism, and deficiency diseases; digestion, absorption, transport, and metabolism of nutrients in the human body; and protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidants, antinutritional factors, and the biochemistry of post-harvest storage and losses during processing.

Effects of cooking, processing, and preservation on nutrients in different food products; biochemical aspects of food spoilage; food fads; and food safety and quality standards.

Enzymes in the food industry, food additives, and the nutritional quality of plant, animal, dairy, marine, and fermented products.

Practical:

Proximate analysis of foods; calorific value of foods, Estimation of vitamins, phenols & flavonoids, carotenoids, antinutrients like Phytate/ Oxallate, Trypsin and Chymotrypsin inhibitor activities, limiting amino acids in food stuff

Suggested readings:

Damodaran S. and Parkin KL (ed.) 2017. Fennema's Food Chemistry. CRC Press
Gibney MJ, Lanham-New SA, Cassidy, A and Voster HH (ed.) 2009. Introduction to Human Nutrition. Wiley-Blackwell
Trueman, P. 2007. Nutritional Biochemistry. MJP Publishers
Rekhi, Tejmeet and Heena Yadav, 2014. Fundamentals of Food and Nutrition by, Elite Publishing House, 257p.
Dharmesh Kumar, Food Science and Nutrition by, RANDOM.

Elective Course 20

Course Title: AGE-20 - Post-Harvest Technology and Value Addition

Credits: 2 (1+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 the preparation techniques of value-added products.
3. To educate about the different dehydration techniques of horticultural crops

Theory

Importance of postharvest processing of fruits and vegetables; extent and possible causes of postharvest losses. Preharvest factors affecting postharvest quality: maturity, ripening, and changes occurring during ripening. Respiration and factors affecting respiration rate. Harvesting and field handling. Storage (ZECC, cold storage, CA, MA, and hypobaric). Value addition: concept. Principles and methods of preservation. Intermediate-moisture foods—jam, jelly, marmalade, preserve, candy: concepts and standards. Fermented and non-fermented beverages. Tomato products: concepts and standards. Drying/dehydration of fruits and vegetables—concept and methods, including osmotic drying. Canning: concepts and standards; packaging of products.

Practical

Applications of various packaging and container types for shelf-life extension. Effect of temperature on shelf life and quality of produce. Demonstration of chilling and freezing injury in vegetables and fruits. Extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar, candy, tomato products, and canned products. Quality evaluation of products—physicochemical and sensory. Visit to the processing unit/industry.

Suggested readings:

Post harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal

Post-Harvest Technology by Suja Nabi Qureshi, Kounser Javeed and Abhay Kumar Sinha, 2018, Bioscientific Publishers.

Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira, 2020, New India Publishing Agency, 320p.

Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann, 2014, Daya Publishing House.

Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K., Biotech, 181p.

Semester VIII

Code	Course title	Total credits
SEC	For student opting 4year BSc. (Hons.) degree Student READY (RAW / Experiential Learning / Hands on Training / Industrial Attachment / Project Work / Internship Duration: 90-120 days	20
	Total	20

Eighth Semester: Student READY programs: The eighth semester of the B.Sc. (Hons) Agriculture curriculum is dedicated entirely to Experiential Learning, Internship, and Skill/Industry Immersion, as per the ICAR Model Curriculum and the NEP 2020 emphasis on holistic, multidisciplinary, and employability-driven education. This structure ensures that students are fully industry-ready and capable of applying their theoretical knowledge in real-world contexts.

This semester is aligned with:

- NHEQF Level 6.5–7.0 outcomes emphasizing application, problem-solving, innovation, and leadership.
- ABC/NCrF frameworks for credit recognition and mobility.
- Viksit Bharat 2047 vision by creating a skilled and self-reliant agri-youth workforce.

Semester VIII: Details of Core Components

A. Rural Agricultural Work Experience (RAWE) (3 Weeks) (Village attachment and KVK/Research Station)

- Immersion in rural settings to understand agro-ecological conditions, cropping systems, rural livelihoods, and farmer challenges.
- Activities: Field surveys, PRA (Participatory Rural Appraisal), agri-extension practice, communication with SHGs, NGOs, and farmer groups.
- **Learning Outcomes (NHEQF Level 6.5):**
 - Demonstrate the ability to analyse rural realities and integrate traditional and scientific knowledge.
 - Develop farmer-centric extension strategies and communication skills.
 - Apply interdisciplinary agricultural knowledge for problem-solving in the field.

B. Agro-Industrial Attachment (AIA) (3 Weeks)

- Placement in agro-industrial units: input manufacturing, agri-finance, warehousing, agro-processing, marketing chains, or FPOs.
- **Learning Outcomes:**
 - Understand industrial processes, business models, and value chain operations.
 - Apply entrepreneurial and managerial skills in a live business context.
 - Build industry readiness and professional conduct.

C. Skill Development & Entrepreneurship Training (3 weeks)

- Short-term training in areas like organic farming, mushroom cultivation, apiary, farm tools repair, AI in agriculture, etc. (opt any two)
- **Learning Outcomes:**
 - Acquire job-oriented vocational and enterprise skills.
 - Evaluate and develop microenterprise models in agriculture.

D. Experiential Learning / Industry Internship (3 weeks)

- Advanced engagement in a student-chosen specialization (e.g., agri-tech, horticulture, seed industry, food processing, precision farming).
- **Can be undertaken at:**
 - Research institutions (e.g., ICAR institutes, KVKs)
 - Agri-startups / Agri-export companies
 - Government agencies / International organizations
- **Learning Outcomes (NHEQF Level 7.0):**
 - Design and implement practical solutions to agricultural problems.
 - Perform project planning, reporting, and performance analysis in a real work environment.

E. Project Work / Research Study / Case Study (2 weeks)

- Students conduct original field/lab-based research or a detailed business case/impact analysis under faculty mentorship.
- **Deliverables: Report, presentation, Interrection. (7- Working days)**
- **Learning Outcomes:**
 - Demonstrate research competence, critical thinking, and academic writing.
 - Apply scientific methodology and data analysis tools.

SKILL ENHANCEMENT COURSE (SEC)

A student admitted to the 1st year of the B.Sc. (Hons.) Agriculture degree programme shall take two Skill Enhancement Courses (SECs), each of 2 credits, in each semester of the first year. Likewise, a student continuing to the 2nd year of the B.Sc. (Hons.) The Agriculture degree programme shall take one Skill Enhancement Course, worth 2 credits, in each of the two semesters of the second year.

Students may select these courses from a basket of Skill Enhancement Courses as indicated below, or from courses offered by the college. These courses may be offered as modules of complementary courses to help the student acquire skills in a specific area of their interest.

The University/HAEIs/Colleges may offer such Skill Enhancement Courses in areas where they have strength/expertise and where there is potential for local employment and entrepreneurship development. The courses on the list are indicative, and the University/HAEIs may add more need-based courses depending on their strengths and expertise.

Indicative Skill Enhancement Courses:

Code	Title	Credits
AGSEC8-01	Biofertilizer and biopesticide production	2(0+2)
AGSEC8-02	Production Technology of Bioagents	2(0+2)
AGSEC8-03	Seed Production and Testing Technology	2(0+2)
AGSEC8-04	Mushroom Production Technology	2(0+2)
AGSEC8-05	Soil, Plant and Water Testing	2(0+2)
AGSEC8-06	Post harvest processing technology	2(0+2)
AGSEC8-07	Beneficial insect farming	2(0+2)
AGSEC8-08	Plantation Crop Production and Processing	2(0+2)
AGSEC8-09	Poultry Production Technology	2(0+2)
AGSEC8-10	Piggery Production Technology	2(0+2)
AGSEC8-11	Commercial Horticulture	2(0+2)
AGSEC8-12	Floriculture and Landscaping	2(0+2)
AGSEC8-13	Food Processing	2(0+2)

1. AGSEC8-01-Biofertilizer and Biopesticide Production

(2 credits: 0+2)

Course Objectives

- To familiarize students with beneficial microorganisms used in agriculture.
- To impart skills in small-scale production, quality control, and application of biofertilizers and biopesticides.

Practical Content

Introduction & Lab Safety

- Layout of a small biofertilizer/biopesticide unit.
- Good laboratory practices (GLP), sterilization techniques, and aseptic handling.

2. Microbial Culture Techniques

- Isolation and maintenance of Rhizobium, Azotobacter, Azospirillum, PSB, Trichoderma, Bacillus, etc.
- Sub-culturing and preservation methods.

3. Production of Biofertilizers

- Mass multiplication of N-fixing and P-solubilizing bacteria.
- Selection, preparation, and sterilization of carriers (peat, lignite, charcoal, talc).
- Mixing of culture with carriers and curing.

4. Production of Biopesticides

- Mass multiplication of Trichoderma, Pseudomonas, Bacillus thuringiensis (Bt), NPV, etc.

- Solid and liquid formulations (talc-based, wettable powder, liquid formulations).
- 5. Quality Control & Standards**
 - Counting CFU, spore load, viability testing.
 - Shelf-life testing and storage conditions.
 - 6. Packing, Labeling and Storage**
 - Packaging materials and techniques.
 - Label requirements: strain, dose, expiry, batch, precautions.
 - 7. Field Application Techniques**
 - Seed treatment, seedling root dip, soil application methods.
 - Compatibility with fertilizers and pesticides.
 - 8. Entrepreneurial Aspects**
 - Basic cost analysis of a small unit.
 - Regulatory requirements, licensing, and marketing strategies.
- Suggested Experiments/Practicals**
- Isolation and mass multiplication of at least one biofertilizer and one biopesticide agent.
 - Preparation of a carrier-based formulation and quality testing.
 - Preparation of a simple business plan for a micro-enterprise.

2. AGSEC8-02 - Production Technology of Bioagents (2 credits: 0+2)

Course Objectives

- To impart skills in mass production of biological control agents.
- To train students in maintenance, release, and monitoring of bioagents in the field.

Practical Content

- 1. Introduction to Bioagents**
 - Types: predators, parasitoids, entomopathogens.
 - Identification and basic biology (egg, larva, pupa, adult).
- 2. Laboratory Facilities & Rearing Units**
 - Design and management of insectaries.
 - Environmental control: temperature, humidity, photoperiod.
- 3. Mass Rearing of Host Insects**
 - Rearing of *Corcyra*, *Sitotroga*, or other host insects.
 - Diet preparation and maintenance.
- 4. Mass Production of Parasitoids and Predators**
 - *Trichogramma*, *Bracon*, *Chrysoperla*, ladybird beetles, etc.
 - Parasitization techniques and handling of egg/larval cards.
- 5. Production of Microbial Agents**
 - Mass production of NPV, Bt, *Beauveria*, *Metarhizium*, etc.
 - Preparation of spore suspensions and formulations.
- 6. Quality Control of Bioagents**
 - Parasitization percentage, emergence rate, sex ratio.
 - Pathogenicity/bioassay for microbial agents.
- 7. Field Release Techniques**
 - Preparation of release cards and field release protocols.
 - Monitoring effectiveness and record-keeping.
- 8. Entrepreneurship and Certification**
 - Setting up a small insectary unit.
 - Registration procedures, branding, and marketing.

Suggested Practicals

- Rearing of *Corcyra* and production of *Trichogramma* cards.
 - Demonstration of field release of at least one bioagent.
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3. AGSEC8-03 - Seed Production and Testing Technology

(2 credits: 0+2)

Course Objectives

- To develop skills in quality seed production and seed quality testing.
- To familiarize students with seed certification and labeling.

Practical Content

1. Identification of Seed Classes

- Breeder, foundation, certified seed – samples and labels.

2. Field and Seed Standards

- Field layout, isolation distance, rouging procedures (demonstration/visit).

3. Seed Processing

- Cleaning, grading, drying, and treatment.
- Use and operation of basic seed processing equipment.

4. Seed Testing in Laboratory

- Seed sampling methods.
- Physical purity analysis.
- Germination testing (paper towel, sand, between paper methods).

5. Seed Health Testing (Basic)

- Blotter test, visual examination.

6. Seed Viability and Vigor Tests

- Tetrazolium test (TZ), accelerated aging (demonstration).

7. Seed Storage and Packaging

- Types of containers and storage structures.
- Storage conditions and seed deterioration.

8. Seed Legislation and Labeling

- Elements on a seed tag.
- Brief on Seed Act, certification procedures.

Suggested Practicals

- Complete seed testing for 2–3 crops (purity, germination, moisture, viability).
 - Preparation of a seed label with required information.
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4. AGSEC8-04 - Mushroom Production Technology

(2 credits: 0+2)

Course Objectives

- To impart hands-on skills in mushroom cultivation and spawn production.
- To promote small-scale mushroom entrepreneurship.

Practical Content

1. Mushroom Unit Layout and Hygiene

- Structures, equipment, and sanitation.

2. Substrate Preparation

- Selection of substrate (paddy straw, wheat straw, etc.).
- Chopping, soaking, pasteurization/sterilization.

3. Spawn and Spawn Production (Basic)

- Types of spawn, spawn substrate preparation, sterilization.
- Inoculation and incubation (demonstration or hands-on, depending on facilities).

4. Bag Filling and Spawning

- Spawning methods for oyster, button, or milky mushroom.
- Spawning rate and layering.

5. Crop Management

- Incubation conditions, temperature, humidity control, aeration.
- Pest and disease management.

6. Harvesting and Post-harvest Handling

- Harvesting at correct stage.

- Sorting, grading, packaging, storage.

7. Preparation of Value-added Products

- Mushroom pickles, powders, chips, etc. (demonstration/practical).

8. Economic Analysis

- Cost of production and profit estimation for small units.

Suggested Practicals

- Complete cultivation cycle of at least one mushroom species.
- Preparation of a simple mushroom-based value-added product.

5. Soil, Plant and Water Testing

(2 credits: 0+2)

Course Objectives

- To train students in collection and analysis of soil, plant, and water samples.
- To enable basic interpretation of results for fertilizer and water-use recommendations.

Practical Content

1. Sample Collection Techniques

- Soil sampling from fields, orchards, and pots.
- Plant sampling (leaf, petiole, whole plant parts).
- Water sampling from wells, canals, borewells.

2. Sample Preparation

- Drying, grinding, sieving, and storage of samples.

3. Basic Soil Analysis

- Determination of soil pH and EC.
- Organic carbon (Walkley-Black or demonstration method).
- Available N, P, K (demonstration or simplified protocols).

4. Plant Tissue Analysis (Basic)

- Preparation of plant samples for nutrient analysis.
- Estimation of N, P, K (demonstration).

5. Water Quality Analysis

- pH, EC, TDS.
- Hardness, alkalinity, salinity hazards (SAR/RSC – at least concept + demo).

6. Interpretation of Results

- Rating soil nutrients (low/medium/high).
- Suitability of water for irrigation.

7. Preparation of Soil Health Cards

- Converting lab results to farmer-friendly recommendations.

8. Visit to Soil/Water Testing Laboratory

- Observation of advanced instruments (AAS, flame photometer, spectrophotometer).

Suggested Practicals

- Complete analysis of soil and water from at least 2–3 locations.
- Preparation of soil health cards with brief recommendations.

6. AGSEC8-06 - Post-Harvest Processing Technology

(2 credits: 0+2)

Course Objectives

- To develop skills in handling, grading, processing, and storage of agricultural produce.
- To introduce value addition and primary processing equipment.

Practical Content

1. Post-harvest Handling and Grading

- Sorting and grading of fruits, vegetables, and grains.
- Use of simple grading equipment.

2. Cleaning and Drying

- Grain cleaning and drying techniques.
 - Use of moisture meters.
 - 3. Storage Techniques**
 - Traditional vs improved storage structures.
 - Bag storage, bins, hermetic storage.
 - 4. Primary Processing**
 - Dehusking, milling (rice, pulses – demo/visit).
 - Oil extraction (mini oil expeller – demo).
 - 5. Processing of Fruits and Vegetables**
 - Preparation of jams, jellies, pickles, squashes, RTS beverages.
 - Minimal processing and packaging.
 - 6. Quality and Safety Aspects**
 - Basic hygiene and sanitation.
 - Brief introduction to FSSAI norms.
 - 7. Packaging and Labeling**
 - Packaging materials and methods.
 - Label information and branding.
 - 8. Economic Feasibility**
 - Calculation of cost of processing and profit margins.
 - Suggested Practicals**
 - Preparation and packaging of at least 2–3 value-added products.
 - Visit to a local processing unit/warehouse.
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7. AGSEC8-07 - Beneficial Insect Farming

(2 credits: 0+2)

Course Objectives

- To impart skills in mass rearing and management of beneficial insects (honey bees, silkworms, etc.).
- To promote income generation from bee products, silk, and other beneficial insects.

Practical Content

- 1. Identification of Beneficial Insects**
 - Honey bees, silkworms, lac insects, predators, parasitoids.
 - 2. Apiary Management**
 - Types of bee boxes, parts of a hive.
 - Handling of bees, colony inspection, queen identification.
 - 3. Seasonal Management of Bee Colonies**
 - Feeding, swarm management, pest and disease control.
 - 4. Honey Extraction and Processing**
 - Use of honey extractor.
 - Straining, filtration, bottling, labeling.
 - 5. Other Bee Products**
 - Collection of wax, propolis, pollen (demo).
 - 6. Silkworm Rearing (if relevant)**
 - Rearing house preparation, tray arrangement.
 - Feeding schedule, cocoon harvesting.
 - 7. Lac or Other Beneficial Insects**
 - Host trees, inoculation, scraping, and processing (as per local relevance).
 - 8. Economics and Marketing**
 - Cost-benefit analysis of apiary or sericulture unit.
- Suggested Practicals**
- Hands-on apiary work (opening hives, handling frames).
 - Extraction and bottling of honey.
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8. AGSEC8-08 - Plantation Crop Production and Processing

(2 credits: 0+2)

Course Objectives

- To train students in cultivation and basic processing of major plantation crops.
- To provide exposure to field operations and primary processing.

Practical Content

1. Identification and Botany of Major Plantation Crops

- Coconut, oil palm, tea, coffee, rubber, arecanut, cocoa, etc. (depending on region).

2. Nursery and Planting Techniques

- Raising planting material.
- Layout and planting methods in the field.

3. Intercultural Operations

- Manuring, irrigation, mulching, weeding.
- Canopy management and pruning.

4. Plant Protection and Special Practices

- Common pests/diseases and control measures.
- Tapping (rubber), skiffing (tea), etc. (demo/visit).

5. Harvesting Techniques

- Harvesting methods and indices of maturity.

6. Primary Processing

- Tea leaf processing (withering to drying) – demo/visit.
- Coffee processing (pulping, drying, hulling).
- Coconut and arecanut processing.

7. Grading, Packaging, and Storage

- Standards and grading for tea, coffee, coconut, etc.

8. Field/Industrial Visit

- Visit to a plantation estate and processing unit.

Suggested Practicals

- Field visit reports and preparation of package of practices for one plantation crop.
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9. AGSEC8-09 - Poultry Production Technology

(2 credits: 0+2)

Course Objectives

- To impart skills in scientific poultry management for egg and meat production.
- To enable small-scale poultry entrepreneurship.

Practical Content

1. Poultry Housing and Equipment

- Deep litter and cage systems.
- Feeders, drinkers, brooders, nest boxes.

2. Breeds and Strains

- Identification of layers, broilers, and backyard poultry breeds.

3. Brooding Management

- Brooder preparation and chick arrival management.
- Temperature, litter, and ventilation management.

4. Feeding and Nutrition

- Types of feeds (starter, grower, finisher, layer mash).
- Feed formulation (demonstration) and feeding methods.

5. Health and Biosecurity

- Vaccination schedule and deworming.
- Common diseases, symptoms, and basic first-aid.

6. Production Management

- Culling, debeaking (demo), litter management.
- Record-keeping of production and mortality.

7. Egg Handling and Marketing

- Egg collection, grading, cleaning, and storage.

8. Economics of Poultry Farming

- Cost of production and profit calculation for small units.

Suggested Practicals

- Routine management of a small flock over a few weeks.
 - Preparation of a simple project report for a backyard/broiler unit.
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10. AGSEC8-10 - Piggery Production Technology

(2 credits: 0+2)

Course Objectives

- To provide hands-on training in pig rearing and management.
- To enable students to plan and manage small piggery units.

Practical Content

1. Breeds and Selection

- Identification of important pig breeds.
- Selection of breeding boars and sows.

2. Housing and Equipment

- Design of pens and waste disposal.

3. Feeding and Nutrition

- Formulation of rations using local feed resources.
- Feeding schedules for different categories (piglets, growers, adults).

4. Breeding and Reproduction

- Heat detection and mating management.
- Care of pregnant sows and farrowing management.

5. Piglet Management

- Colostrum feeding, teeth clipping, tail docking, castration (demonstration), iron injection.

6. Health and Hygiene

- Vaccination and deworming schedule.
- Common diseases, sanitation, and biosecurity.

7. Fattening and Marketing

- Growth monitoring and record-keeping.
- Market preparation and sale.

8. Economic Analysis

- Cost-benefit analysis for a small piggery unit.

Suggested Practicals

- Routine management of pigs (feeding, cleaning, health check).
 - Preparation of a small piggery project report.
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11. Commercial Horticulture (2 credits: 0+2)

Course Objectives

- To develop practical skills in commercial fruit and vegetable production.
- To expose students to protected cultivation and value addition.

Practical Content

1. Planning of a Commercial Orchard/Vegetable Farm

- Layout, spacing, and irrigation planning.

2. Nursery Techniques

- Raising seedlings, grafting, budding, layering.

3. Planting and Intercultural Operations

- Planting techniques, staking, training, pruning.
- Fertigation and drip irrigation (demo).

4. Protected Cultivation

- Basics of polyhouse/shade net cultivation.

- Construction, crop choice, and management.
 - 5. Crop Protection and IPM**
 - Common pests/diseases and their management.
 - 6. Harvesting and Post-harvest Management**
 - Maturity indices, harvesting methods.
 - Grading, packing, and cold storage (visit/demo).
 - 7. Marketing and Supply Chain**
 - Market survey, contract farming concepts, FPOs.
 - 8. Enterprise Planning**
 - Preparation of a business plan for a commercial horticulture venture.
 - Suggested Practicals**
 - Layout and planting of a small plot/orchard.
 - Preparation of a commercial production plan for one high-value crop.
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12. AGSEC8-12 - Floriculture and Landscaping

(2 credits: 0+2)

Course Objectives

- To train students in commercial flower production and basic landscape design.
- To promote entrepreneurial skills in floriculture-based enterprises.

Practical Content

1. Commercial Flower Crops

- Identification of major loose and cut flowers.

2. Nursery and Planting Techniques

- Propagation of flowers by seeds, cuttings, division, layering.

3. Protected Cultivation of Flowers

- Polyhouse/greenhouse basics for cut flowers.

4. Cultural Operations

- Pinching, disbudding, staking, fertigation.

5. Landscape Design Basics

- Principles of design, garden styles.
- Preparation of simple garden layouts (drawing & field work).

6. Lawn Establishment and Maintenance

- Selection of grasses, mowing, irrigation, fertilization.

7. Flower Arrangement and Value Addition

- Bouquets, garlands, dry flowers, floral crafts.

8. Marketing and Event-based Floriculture

- Supply to florists, event decorators.
- Costing and pricing of arrangements.

Suggested Practicals

- Layout and establishment of a small garden/bed.
 - Preparation of at least 2–3 flower arrangements and costing.
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13. AGSEC8-13 - Food Processing

(2 credits: 0+2)

Course Objectives

- To provide hands-on exposure to basic food processing and preservation.
- To encourage development of small-scale food processing enterprises.

Practical Content

1. Hygiene and Safety in Food Processing

- Personal hygiene, plant sanitation, basic HACCP concepts.

2. Cereal and Pulse Processing

- DE husking, milling, roasting, puffing.

3. Fruit and Vegetable Processing

- Preparation of squashes, RTS beverages, pickles, sauces, chutneys.
- 4. Milk and Dairy Products (Basic)**
 - Preparation of paneer, ghee, flavored milk, curd.
- 5. Bakery Products**
 - Bread, biscuits, cakes (demo/selected items as hands-on).
- 6. Preservation Techniques**
 - Use of sugar, salt, acids, drying, refrigeration, pasteurization.
- 7. Packaging and Labelling**
 - Packaging materials and techniques for different products.
 - Label design: ingredients, nutrition facts (basic), expiry.
- 8. Costing and Entrepreneurship**
 - Simple costing, pricing, and branding for small-scale units.
- Suggested Practical**
 - Preparation of at least 3–4 processed products from different raw materials.
 - Drafting of labels and simple brand concepts.

Online Learning Component – agMOOCs/NPTEL/Value-Added Course – 10 Credits

- Self-paced completion of two UGC/ICAR/MoE-endorsed certified courses via SWAYAM, agMOOCs, or NPTEL.
- Examples: "Digital Agriculture," "Entrepreneurship in Agribusiness," "Plant Health Management," etc.